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EDITED BY

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HAWAIIAN DEPARTMENT POLO TEAM

Left to right:-Major Carlos Brewer, 8th, F. A., Major Joseph M. Swing, 11th. F. A., Captain Frederick D. Sharpe, F. A., A. D. C., Major John Milliken (Cavalry), General Staff, Lieutenant-Colonel Beverly F. Browne, 11th, F. A. (Team Captain). This team is touring the Pacific Coast and will participate in the Pacific Coast Circuit games of the American Polo Association, which and in the final tournament in April at Del Monte. California. (Photograph by courtesy of Lieutenant-Colonel Stephan O. Fugna G.S.)

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MODERN WAR AND MACHINES*

BY GENERAL DEBENEY
DIRECTOR OF THE ÉCOLE SUPERIEURE DE GUÉRRE

THE terrible ordeal of the World War convinced all nations that the burden of armaments must be lessened in times of peace. As far as navies are concerned the problem is comparatively simple. In the navy, in fact, the matériel holds the most important place, and whatever the different types of ship may be, they can be rated by comparison with a common standard in which tonnage, speed, offensive and defensive armament are considered. In a word, it is possible to have some kind of a catalogue or directory in which the allotment of ships of various descriptions is made for all the powers. It is reasonable that international agreements, like those of Washington, should be arrived at, first, to stabilize and then to reduce naval armaments.

On the contrary, the wisest heads have not yet been able to devise a scheme for regulating in any practical way the size of the various armies of the world, so numerous and varied are the factors of the problem to be considered. Thus the defensive value of a frontier depends on its geographic situation, the effectives of peace depend on the length of the period of service, while the effectives of war depend on the size of the population, the budgets for war do not represent all the expenses of war and the matériel suitable for war use is not confined to what is stored in arsenals, during times of peace. In this confusion it is no longer possible to assign a definite value to an army by reference to a common standard and the pictures we used to see of soldiers drawn in different sizes to represent the comparative strength of armies, now represent nothing, especially when these soldiers are drawn in the heroic attitude of the bayonet charge.

After a war of four years it is impossible to wait for this delicate question to solve itself. Also, as soon as peace was signed, the nations started to reduce their terrible burdens, each in its own way, in order to rest their weary shoulders and get a chance to breathe. England and the United States profited by their geographical situation

* Translated from an article appearing in the *Révue de la Semaine* for February 10, 1922, by Captain Paul C. Harper, Field Artillery.

to do away with the draft which the pressure of events had forced them to institute. Italy, a continental nation, while continuing obligatory service, reduced the period to eight months. But practical difficulties have prevented her putting this scheme entirely into effect and new laws are now being discussed. Belgium still has conscription but is trying to reduce the period. France also has retained obligatory service, but the length of the period has been reduced, and now only two instead of three classes are kept with the colors. Moreover, we shall not stop there, as plans are being made to cut off another half class, thus reducing the service to eighteen months.

To change from a service of three years to one of eighteen months, which cuts in half our peace-time effectives, is a drastic move toward disarmament, and it is astonishing that it is not generally recognized as such. The effort is especially commendable in that it requires a complete reorganization of our military institutions. It can be easily seen that an organization which depends on a peace strength of 600,000 men, for example, can no longer function if the effectives are reduced to 300,000. Everything must be made over. Immediately after the victory this disposition became manifest, and from that moment study and preparations have been undertaken looking to an early general reorganization of the army.

The question which was, and still is, uppermost in all minds is: along what basic lines should this organization proceed and in what direction should the post-war army be oriented? The unanimous reply is that the organization of today should conform to the experiences of the recent war.

Some of the allies came upon the field of experience gradually and others tardily, but the French Army had the unwelcome privilege of following the evolution of the war in the fulness of its violence from the 2nd of August, 1914, to the 18th of November, 1918. The intensity of their impressions did not relax for a minute and those who fought in our ranks were able to secure a synthetic view of modern war as complete as is possible to obtain at the actual time.

In speaking of a synthetic view, the point is that it is not so much a question of determining the stage of evolution at which we finally won the war, but to follow the various steps and to watch the tendencies which an implacable reality forced on us without any volition on our part. It would be futile to examine purely and simply the results of the war, but it is profitable to base the orientation of the future on the developments that took place during the war.

I shall attempt to take this viewpoint by employing a classification of ideas which appears to me to include the entire subject, and I shall examine what the war has revealed to us regarding the

actual importance of matériel, the rôle played by personnel and the relations between matériel and personnel, that is to say, in what manner should the modern army be organized. Thus I hope to be able to assist in the crystallization of the opinions which the great war with its trying experiences has already more or less developed.

I

In spite of appearances, most people allow themselves to be influenced more by their observations than by their imaginations. They work easily on what they see, but with difficulty on what they suppose. Also in time of peace, an exaggerated importance is attached to armament. It is therefore upon the tangible element that all the other elements of military power depend. For example, the organization has for its object only to make use of the armament, and manœuvres serve only to combine the effects of this armament.

In peace time the exact value of an armament cannot be determined. The armament only lends itself to the experience of the drill ground which does not teach much, because the destructive effect, as well as the moral effect, cannot be tested. To complete the experience requires an effort of the imagination which is always uncertain and of which few are capable. Then, if war breaks out, the armament gives its full effects, destructive and bloody, and regains the place of first importance.

It had already gained this place in the nineteenth century, a period of industrial progress, by bringing out with each new conflict some new matériel which had a decisive influence on the result of the operations. The campaign in Italy in 1859 revealed the value of the French 4 cannon. At Sadowa the Prussian Dreyse rifle appeared. Finally, in 1870, the Krupp gun crushed our infantry still armed with the chassepot. That was the progress made in eleven years. It continued, nevertheless, and in the Transvaal *smokeless powder* was first used. Then in the Balkans and in Manchuria we find machine guns and, to a limited extent, heavy artillery appearing on the battlefield.

Then came the great war, and this time it was not a new rifle or a newly perfected field gun that appeared, but a formidable and uninterrupted outpouring of diabolical engines, the nomenclature of which would fill an encyclopædia, the encyclopædia of death. In the last analysis it is the projectile which kills, but all the sciences and all the industries were allied to make the projectile, whether bullet or shell, more and more deadly. The range was increased to distances unheard of before, or the projectile was suspended in the air, a hovering menace, or, on the other hand, it glided noiselessly under the water. The rate of fire was accelerated until it was not so many shots per minute, but so many per second. The capacity of the

projectile was increased until it became an infernal machine. Explosives were introduced which were more and more powerful and even gas, asphyxiating, poison and tear-producing. Finally the sciences which seemed to be the most peaceful were employed to locate targets hidden in the best defiladed parts of the terrain. By these sciences the fire was directed and regulated in a way that made it more precise and deadly than ever.

The armament also was no longer composed of simple instruments such as a rifle and a field gun worked by a rifleman or a cannoneer. It was now composed of machines with all their complicated mechanism and with a complete machine shop to assure their service. These machines were of two kinds: those which were adapted and those which were invented. This adaptation naturally was applied to the time-honored weapons of the soldier which up to this day had been considered the only dependable arms. Suddenly the rifle, the old rifle, a revered descendant of the arquebuse and musket, was transformed into the light and heavy machine gun. Instead of ten rounds as a maximum, it now fired an average of four hundred rounds a minute and went as high as five and six hundred rounds with an accuracy unknown to the rifle. We entered the war with 5000 machine guns and at the time of the Armistice we had 105,000. The rifle, an individual arm, has largely given way to a collective machine manned by a small group.

It is true that the cannon had made progress since the days when the Bureau brothers supported Joan of Arc's charges at Patay with their bombards. Nevertheless, the epoc is not so far back (1870) when muzzle loaders were still used, which had to be laid after each shot. However, the field gun at the beginning of the war possessed the essential qualities of the modern weapon, breechloading, rapidity of fire and independent sight. There only remained to perfect the carriage and to make a variety of calibres reaching from the little 37-millimetre infantry gun to the mastodons requiring a locomotive to haul them. Important improvements had already been made, to which others were added, especially in the manufacture of projectiles, but everything considered they were only improvements.

The real transformation of the gun was in the manner in which it was served, or more exactly, in which it was fired. The gun no longer existed as an instrument of fire. It was replaced by the battery. Whether the battery consisted of six, four, three or two pieces made no difference; it was the battery alone which was capable of executing fire. But what a wealth of apparatus, unknown to Gribeauval or Drouot, was at its disposal! Telephones, wireless, signal panels, firing tables, alidade, clinometer, goniometer, theodolite, barometer, hygrometer and so forth, were spread out in the

battery while overhead floated balloons and airplanes, and more distant in the observatories telescopes of strange shapes swept the horizon and the queer apparatus for sound-ranging caught the distant detonations. All this arsenal is necessary for the battery in order to determine with mathematical accuracy the emplacements which are farthest away and most carefully concealed, in order to control the point of fall of projectiles, in order to transmit observations and orders and to measure the changes caused by the velocity of the wind or the temperature of the moment. The gun, the old gun, is incorporated in a work-shop surrounded by many machines and is transformed into the main element of a most complex machine.

Then there is the telegraph which we were so proud to have connecting our headquarters. It quickly grew into an infinity of telephone wires which ran as far as the most advanced posts. Telegraphy was even volatilized to make wireless and heliograph communication. The use of the telephone was enormously extended. An idea of this can be gained from the fact that in 1917 on one kilometre of front there were a thousand kilometres of telephone wire. These transformations effected in our pre-war matériel were not the only ones but they will suffice to show the most important and characteristic, and we can pass to the domain of inventions and innovations.

First there is the automobile. Of course its employment was foreseen before 1914, but only to a negligible extent; a few touring cars for the staffs and a few light trucks for small supplies. But at the end of a few months the truck was supplementing the railroad in the transport of munitions and heavy matériel and even in some cases supplanted the railroad entirely, as in the case of the endless chain of trucks which ran on the Sacred Road and saved Verdun. The truck became an instrument of strategic manœuvre transporting entire divisions which were thrown into the battle at a critical moment, as in 1918 before Amiens and Chateau Thierry. The figures are particularly eloquent. From a total of 6000 motor vehicles at the beginning of the war the number mounted to 90,000 at the end. Moreover, the motor vehicle was made to enter directly into the fighting by the use of tractors. They dragged heavy guns onto the field of battle itself and, better still, clothed as with a turtle shell they became tanks and crushed without trouble the barbed-wire entanglements. They promenaded their machine guns in the middle or even ahead of the assault waves and made victory possible for the British on the Somme as well as for us on the 18th of July, 1918.

In whatever form it may be, truck, tractor, armored car, or tank, the motor vehicle is only an application of the gas engine. Another application which was developed with startling rapidity was the

airplane. The motor found in its power the ability to leave the ground and, supported on wings, floated over the battlefield as an airplane. First used only for reconnaissance, it was perfected to the point where it could make accurate observations for the artillery. This progress was of incalculable importance to our batteries, who now had eyes suspended in the air and could hide themselves so as to have no worries as to their security while they executed their fire through the airplane with which they had wireless communication. Finally, the airplane was armed with machine guns and became an offensive weapon, consecrated by the wonderful prowess of our aces. Gaining more and more power, the airplane began to carry great quantities of explosives to great distances behind the front, and Mainz, Stuttgart, Carlsruhe, London and Paris found themselves under constant menace of bombardment.

At the service of all these machines, a new science appeared, whose entry into the line in such a far-reaching manner constituted an innovation of the greatest importance. Until the last war chemistry had contented itself with providing the powder with which to propel the projectile and to explode it. Of course this rôle was a very important one, and far from abandoning it, the chemists continued during the war to improve the quality of the explosives as well as their power in spite of the difficulties in securing raw materials caused by the submarine war. But the real innovation was the introduction of poison gas. Never before has an adversary been encountered on the battlefield as crafty and redoubtable as this. As a rule it is invisible and often cannot be detected by the nose while it is poisoning large sections of the atmosphere. One may hope to pass through a barrage between the exploding shells, but there are no intervals in a gas pocket. At times it even infects the ground and, as with Yperite, remains effective for several days. The combatant does not know whether it will be tear-gas, blistering or poison, so that he should protect not only his respiratory organs, but his eyes, his hands, and even his clothing. The poor poilu with his mask, his gas suit and his mittens is certainly evidence enough that the inventions of science are as murderous as they are unesthetic.

Through the transformation of the old armament and the addition of inventions a new armament has appeared on the field of battle. It consists of an impressive collection of machines, at the same time delicate and powerful, around which the combatants are grouped in small gangs, utilizing the most varied resources of all the different sciences. This is a striking phenomena, the development of which has been kept pace with from day to day by a corresponding evolution of tactics on the battlefield. It was reasonable to expect that after the war there would be a stabilization of armament and a halt in military science, at least for a time. After each war it is

always thus. But it was written that this war, begun with surprises, should end also with surprises and that to the phenomenon of an entirely new armament, developed in only four years, should be added a second phenomenon even stranger and more unavoidable than the first.

It is now three years since the close of the war and already it is evident that the changes in armament caused by the war are not yet finished. On the contrary, the period of 1918, which we supposed would be the end of development, was only the beginning and the evolution of armament continues in peace time with an astonishing persistence. It is natural that the inventors should continue trying to turn out a machine gun that can fire twice as fast as our good machine guns used in the war and that they should seek to obtain fantastic ranges such as that realized by the too famous Berthas. That is their trade. The impressive thing, however, is what is going on in the industrial world at large and which everyone meets and sees every day. The automobile fought the war tied to the road, but it will soon be liberated from this servitude. The progress made in the development of tractors is such that we shall soon see them employed in circulation across country hauling guns, munitions, supplies and personnel. Farm tractors have become very generally used. Tractor automobiles have succeeded in ascending Mount Revard in the snow. A British review has announced the trials of water-tight cars built to cross rivers.

Aviation has been taken up universally by the commercial world, a step whose importance cannot be exaggerated. Not only has the metal dirigible come back into use, but the airplane has been developed up to a point where it can carry twenty-five men, or an equivalent weight, for distances of several hundred kilometres. In a few hours it would be possible to turn these commercial planes into bombers that could carry tons of explosives and drop them on Berlin, London or Paris. But the increased capacity for speed and carrying power is only an improvement in aviation. The real innovation will come when airplanes are made independent of their landing fields. The day when the airplane can alight easily on any ground it will really have conquered the air, and then aviation will take its place beside our land forces and sea forces as our army of the air. It is impossible to say how far off this time is, but the commercial development of aviation will result inevitably in an air army.

As for gas, it should not be considered a weapon of modern warfare. It has been ruled out once more and no one is better pleased than the former combatants. It is to be hoped that this ostracism will be more effective than that of the Hague because the chemical industries capable of manufacturing gas are more flourishing than

ever in time of peace. In any small laboratory a new formula can be worked out every day from which tons of poison gas can be made in the dye factories that seem the most harmless.

After all, the most formidable of the forces of nature has as yet contributed very little to war. Electricity is used only for communication in the army. We need not be surprised to find it taking a more direct and active part in the warfare of the future. Already it has been used in places to electrocute attackers crossing barbed-wire entanglements and to explode mines at great distances. It is possible that some inventor may find a way to gather Hertzian waves into a sheaf and send them out at his will.

The entire country is an immense arsenal. Even the peace-time products constitute the armament of war and the greater the peaceful activity is and the faster the progress of industry, the greater is the death-dealing power. The works of life perfect the works of death and the peaceful blacksmith is unconsciously preparing for war. This is the second and more serious phenomenon; the war of machines does not stop when hostilities cease. Peace stopped the war but continues the machines.

II

It is interesting to consider what will become of the man in the presence of all these machines which are being substituted more and more for the individual arm, these machines of war which are being multiplied and perfected every day during peace times. What will be the influence on personnel of this emphasis on matériel?

The answer that presents itself at once is that machines will replace men. A few soldiers skilled in the handling of machine guns, tanks, huge airplanes, will easily produce the same power as companies, battalions or squadrons armed with the rifle or sabre. Effectives seem to have lost their value. The victory will no longer rest with the heaviest battalions but with the most perfect matériel. This is the logical opinion of the situation and it immediately suggests the conclusion that it is better to replace quantity with quality and to entrust a carefully perfected armament to a limited number of well-trained crews, thus giving up a large army raised by conscription to return to a small professional army.

During the war the increasing use of a perfected armament had the result of permitting 500,000 men to be sent back from the front in the midst of the fighting. The number is impressive and suggests itself to the mind as representing the coefficient of the reduction in the number of combatants caused by the war of machines. It is possible to go farther and to add to the total the 300,000 men sent to work in the fields and the 400,000 assigned to duty on the railroads and to work in the mines. In this way the total goes well

over a million. The figures are approximate, of course, and are quoted to indicate the comparative numbers and to give an idea of certain important classes of workers which the war has withdrawn from the army in order that the army may fight and live.

In 1914 a battalion of infantry was composed of a thousand men in round numbers. In the course of the campaign its equipment of automatic arms was largely increased and its effectives were reduced to about seven hundred men. Far from diminishing its fighting value, the increased use of machines added to its power and permitted an economy of three hundred men, almost a third of its effectives. The new machines made possible an even greater economy of personnel. The light tank was manned by only two men, the pursuit plane carried only a pilot and a gunner. Might it not be said that the fighting values of these machines suggests the advantage of replacing the seven hundred men of an infantry battalion with three hundred and fifty tanks or planes? From whatever angle the problem is approached the result seems to be the same: the machine is replacing the man, so we should increase the number of machines and send less men to war. It must be admitted that this formula is attractive and it must be given full consideration in a country that left 1,500,000 men dead on the battlefield. Any solution that tends to economize blood is desirable. But for the very reason that it seems to offer favorable prevention, this formula must be subjected to careful scrutiny.

First, it is interesting to follow those 500,000 men who were withdrawn from the front during the fighting. Did they return to their homes and resume their peace-time occupations? Not at all. They were sent to designated factories to make deadly machines and engines of all kinds. Whether they worked at Toul, Lyon, Paris or Toulouse these men no longer fought at the front but they were still in the war.

In the battalion of infantry what became of the three hundred men who were replaced by automatic weapons? They did not return home either. The service of each of these automatic weapons requires a crew of seven or eight men for its up-keep and the supply of munitions and, as a battalion has thirty-nine of these weapons, the three hundred men who were withdrawn from the firing line were to be found in the immediate rear employed in the service of supply and repair.

The tank operated by only two men in combat requires forty-six men for its up-keep and replacement. The airplane which carries in the air only a pilot and gunner requires the services of sixty men to repair it, supply it, care for the landing field and overhaul it.

In fact, modern machines may be compared with the knights of the Middle Ages. The terrible lance, supported by the weight of

armor and mount, crushed, pierced, overwhelmed with an irresistible power. The lance was the unit of strength and it was said, for example, the Sire de Coucy has twenty-five lances with him. But each knight required the assistance of several squires to put on his armor and help him into his saddle. His heavy equipment had to be cared for by several varlets. Foot soldiers were needed to finish off his fallen adversary. All this personnel, indispensable for the warfare of the period, was included in the collective term, "the lance," and the twenty-five lances under the Sire de Coucy's banner represented not merely twenty-five knights but several hundred men.

It is the same today. A tank or an airplane represents fifty men, not simply two. The larger number is required to care for the precious engine when it returns from combat, to shelter it, repair it, lubricate it. Some of them bring the gasoline and oil from a great distance. Others more distant overhaul and rebuild it after hard wear and others in the extreme rear are engaged in the manufacture of parts which are so frequently needed or in building a new machine to replace it, for all these machines are delicate and short-lived.

This law which calls for the dispersion in depth of the crew of a machine is the law of modern war. The entire army has been laid out in a new disposition. This law controls the entire question of effectives, and a misconception of it has led to the fallacy of the machine replacing the man.

(*To be concluded*.)

RESULTS OF ARTILLERY ACTION IN THE MEUSE-ARGONNE OFFENSIVE

BY MAJOR-GENERAL EDWARD F. McGLACHLIN, U.S. ARMY

IN peace time we fire at targets, stationary or moving, having much the appearance of the real objects that they simulate. We observe the points of burst or fall of our projectiles, measure the ranges, count the hits and compile numerous other data. These data are analyzed statistically and Probability or the Law of Error is applied. Thus theoretical deductions are made that run closely parallel with practical effects under war conditions.

Still, in service practice and in shooting at a school, there is an actual lack of the real. The conductor of fire is freed from all the hazards of fighting, from the difficulties, frictions and interferences imposed by the enemy and by friendly troops, from any but artificial interruptions of his lines of communication and supply. His responsibilities are easy, his living conditions good; he may accommodate himself to the climate or to the weather. On the other hand, he has not at his disposition so many men or so much ammunition as he has in war.

Nevertheless, peace firing properly conducted and its results correctly interpreted give a very close measure of what may be expected in war. But there seems to be no way to visualize either during a problem or the following critique what would have really been happening at the far end of the sheaf of fire. We may, however, get a minimized idea of this by reading the evidence adduced from the other side during a real battle. Such testimony is available only from prisoners and captured papers during a war, although it may be supplemented afterward from books and articles written by the former enemy and by examination of captured ground. In any case the picture will be incomplete because only a small number of the witnesses will appear.

In the hope that some conception of the practical effects of artillery fire may be reached, particularly by those who have not had the good fortune to share in the vital hours of battle, the following unaltered notes recorded at Headquarters Army Artillery, First Army, A.E.F., during the Meuse-Argonne, are, for the first time, it is believed, printed.

September 26th.—Prisoner from the 2nd Landwehr F. A. Regiment states that he and two other men tried to retreat on account of our artillery fire, but it was impossible. Prisoners were cut off by our barrage and said it was so heavy and well placed that they

could not return. The 4th Company of the 112th K Y K had seventy-five per cent. losses from gas shelling.

September 27th.—Prisoners of the 1st Foot Guard Regiment were unable to retreat because of our heavy artillery fire. These prisoners were in advanced base.

September 30th.—Out of sixty men in one company, trench strength, only eighteen or nineteen were left, the remainder having been killed or wounded in the BOIS de FORET by the American artillery. Prisoners from the 2nd Landwehr Division state that the railroad line APERMONT-CHEVIERES and quartermaster depot at MARCQ were destroyed by our fire.

October 2nd.—The 458th Regiment suffered heavy losses from artillery fire in ROMAGNE. A noncommissioned officer of the 20th Regiment, 5th Guard Division, states that our artillery had "smashed everything" in GRAND PRÉ-ST. JUVIN road.

October 3rd.—The 2nd Company, 61st Austrian Regiment, had fourteen casualties by gas shells in the region north of HAUMONT road. Companies of the 5th Regiment which were in CONSENVOYE and valley of REGIVAUX FERME had to change their positions owing to being shelled. The Colonel of the 5th Austrian Regiment who was first in RAVIN de la MICHEUX had his P.C. damaged by shell fire, went to RAVIN de JINVAUX, then to BOIS de CONSENVOYE. He had to move each time on account of shelling. He finally went to the region of MOLLEVILLE FERME.

October 4th.—One company as a result of the recent offensive was reduced to sixteen men, seven of these were killed by a shell falling in a dugout.

October 5th.—As the 110th Grenadier Regiment was going into line, eleven men in one company were killed by artillery fire.

October 9th.—The 11th Company, 270 Reserve Regiment, lost twenty-five men by artillery fire; forty-five per cent. of their present trench effectiveness.

October 10th.—Prisoners stated that as a result of a direct hit a week previous, forty horses, and four grooms of the 7th F. A. Regiment, quartered in AINCREVILLE, were killed outright. Another prisoner states the American artillery is easily distinguishable from the British in that the latter concentrates on definite objectives, while the former always adopts a form of harassing fire which effectively sweeps backward and forward over large areas indiscriminately.

October 11th.—Two escaped prisoners report our shell fire on DUN-sur-MEUSE compelled the Boche to abandon that town as a detraining station and to transfer it to STENAY. Prisoners of the 110th Regiment, 28th Division, taken north of CUNEL, who were

in positions in the BOIS de la PULTIERE and on both sides of the CUNEL-CLERY le GRAND road, state that there were no shelters for their machine guns and that they were forced to change their emplacements continuously on account of the intensity of our artillery fire. In this region the enemy suffered quite heavy losses and most of the twelve machine guns of the 3rd Machine Gun Company were put out of action. Other prisoners commented on the accuracy of our artillery fire on the rear areas, particularly on the narrow gauge railroad running from SAULMARY to VILLERS-devant-DUN, which seriously impaired the bringing up of ammunition for the German artillery. In the region of DOULCON the 110th Regiment suffered severe casualties from the effects of gas shells. The Colonel of the 11th Regiment declared that he was unable to make a counter-offensive about the time that the American barrage opened. The result was a disaster; the regiment was "completely shattered." The artillery unit of Captain Cramer which was to prepare a counter-offensive, was either captured or broken to pieces; a large number of the officers were wounded or killed.

October 13th.—An escaped Russian prisoner of war stated that he saw tanks north of BRIEULLES two weeks previous to this time. He believes that they were injured by heavy artillery fire and moved further north. One battalion which was in reserve in the BOIS de PULTIERE was heavily shelled with gas which created considerable havoc. In fact, the battalion was moved forward into line where it might be of service rather than that it should remain in the woods and suffer heavy gas casualties.

October 14th.—Many of the barracks on the slopes of COTE de MORIMONT were destroyed. Part of the baggage train of the regiment was also cut by artillery fire while on the COTE D'ORNE and destroyed. A number of men in the 31st Bavarian Regiment were severely gased. The 30th Bavarian Regiment had seventy-three casualties from shell fire. An exact report appears on a captured document of the amount of heavy artillery and field artillery put out of use. It states that in one month thirteen per cent. of all pieces in line have been destroyed by enemy's artillery fire.

October 15th.—From October 6th to 11th the 1st Battalion of the 110th Regiment, 28th German Division, lost sixty-five to seventy-five per cent. of their combat effectiveness from artillery fire. Before VERPEL, one shell killed two and wounded twenty in the 3rd Company, 30th Bavarian Regiment. In the 7th Company, 32nd Bavarian Regiment, twenty-five were wounded and one killed, by shell fire; in the 9th Company, six were killed, nine severely wounded and ten slightly wounded.

October 16th.—Prisoner from the 15th Bavarian Regiment, 15th Division, states that his company had to withdraw from the RAVIN aux PIERRES on account of our heavy artillery fire in the afternoon of October 16th. The 107th Division had already lost heavily from shell fire. The 41st Division entered the line October 6th and 8th. Since then it had suffered heavily under our artillery fire even during the periods when its battalions were in support.

October 21st.—Two deserters, escaped from the 6th Disciplinary Company. On account of bombardments, chiefly gas, a new road was constructed southeast of QUATRE CHAMPS in order to avoid passing through QUATRE CHAMPS.

October 22nd.—From prisoners from 1st and 3d Battalions of the 352d Infantry Regiments, captured near Hill 229. HALLES, one-third of town damaged by shell fire; MONTIGNE, almost all houses have been destroyed by shell fire; VILLERS-devant-DUN, destroyed by artillery fire; the 3d Battalion, 352d Infantry Regiment, left VILLERS-devant-DUN owing to several direct hits by our artillery. The 458th Division has suffered such heavy losses that on October 15th it had only five companies, with effectives in each company very low. Prisoners stated that losses were largely due to artillery fire. The 15th Division had suffered heavy losses from artillery fire on 8th of October.

October 23rd.—The companies of the 33rd Division were very strong prior to October 8th, but all have had losses since, largely from artillery fire.

October 24th.—The 33rd Landwehr Regiment had many losses from shell fire on October 23rd on its way from REVILLE to BOIS ETRAYES.

October 25th.—Late in the afternoon the enemy is reported to have started an attack in the region of BANTHEVILLE which did not reach our lines, having been stopped by the American barrage.

October 26th.—Prisoners from the 32nd Division state that the 2nd Battalion, 102nd Regiment, had two heavy machine guns destroyed by shell fire. The 2nd Battalion, 103rd Regiment, had two heavy machine guns buried in a dugout which had received heavy shelling. A Light Minenwerfer of the 102nd Regiment at KOEHLERDORF was demolished by shell fire on the 19th. The railway station at SPINCOURT was closed on September 12th on account of shell fire and the traffic was transferred to LANDRES.

October 27th.—Prisoners from the 31st Landwehr Regiment and the 84th Landwehr Regiment stated that dugouts south of FLABAS and RAVIN DE MIROIR, BOIS DE MOIREY, and also artillery positions east of FLABAS had been heavily shelled and partly demolished.

October 28th.—Artillery did a great deal of damage, destroying dugouts and machine-gun nests, and appeared to be in perfect unison with the advancing infantry. The 3rd Machine Gun Company, 196th Regiment, had ten machine guns put out of action, six men killed and many wounded during the preparation of the American attack on the 28th. Diary of a lieutenant of the 448th Infantry Regiments: On September 12th we were forced to remain in cattle cars at LABRY as the railroad line was being shelled. On October 18th, beginning at noon, a barrage, which I could not have imagined more intense, was laid down on our position in the vicinity of BOIS DES RAPPES. Lieutenant Hoffman fell ten paces to my left. Many casualties resulted.

October 29th.—The BRIQUENAY, GRAND PRE narrow gauge line had been cut by our artillery fire near LE MORT HOMME at 293.1–290.0.

October 31st.—Two deserters from the 48th Regiment stated that the troops in the region north of GRAND MONTAGNE were often compelled to change position owing to continuous shelling.

November 1st.—Prisoner taken November 1st in region of LANDREVILLE stated that our fire effected a loss of eighty horses and sixty men in one battery a few days before the attack. He also stated that our fire was very accurate, counter-battery and harassing fire being very effective, and that the shelling of rear areas produced many casualties. He further stated that our artillery preparation of November 1st was very demoralizing and isolating in its effect. A young officer of the 54th Army Reserve states that our preparation left only about thirty men out of a battery of one hundred and ten men, three killed and the rest wounded. One gun was destroyed by our fire and the other three destroyed by them before they left.

November 2nd.—A prisoner from the 104th Field Artillery of the 52nd Division, taken yesterday in the vicinity of IMECOURT, stated that our artillery preparation prevented them from getting from their shelters to the guns and that they were captured without having fired a shot. In general, the prisoners interviewed today (November 2nd) by G-2 of the 5th Army Corps, all seems to express wonder at the amount of ammunition used and how thoroughly the entire area was covered. From prisoners' statement and from the general behavior of the enemy, it would appear that our heavy artillery barrage acompanying our attack was successful in lowering the morale of the enemy. The casualties in the light artillery have necessitated the use of heavy artillery officers and men in this branch.

November 3rd.—The prisoners speak highly of our fire. Telephonic communication is often not even attempted because of the

surety of destruction. After the attack began there was no opportunity for the artillery to escape because our fire was so intense that movement was impossible and our infantry and tanks followed it so closely that capture immediately followed the bombardments. Before the attack battery positions were often effectively shelled by us. Captured artillerymen of the 15th Bavarian Division state that in recent days the American artillery, shelling far to the rear areas, had interfered with the supply of munitions to such an extent that the batteries were almost without ammunition.

Losses in Artillery Units.—Prisoners of many field artillery units captured since October 31st, report that the American artillery has caused heavy losses in their units, and they are unanimous in praising our artillery's accuracy. Prisoners of the 104th Field Artillery Regiment state that on October 17th alone their regiment lost one hundred and fifty men from shell fire, on battery emplacements, and they are not informed as to additional losses in the regimental trains, to the rear. Early November 1st their battery emplacements were shelled so effectively that all communication with the rear and with the infantry was quickly cut off, and the batteries were practically put out of action. In the 7th Bavarian Field Artillery Regiment, the 7th Battery alone lost fifteen men between October 26th and November 1st, reducing the effectives with the battery to thirty to thirty-five men. On October 31st the 9th Battery of the 10th Field Artillery Regiment lost nine men. Similar figures are reported from a large number of batteries.

TRANSLATION OF A GERMAN LETTER

(Written by a man from Fusilier Regiment 40 (28th Division), on October 29, 1918, while in line opposite the American 1st Army.)

"I am with Fusilier Regiment 40, Company 7. To serve now, at the end, with an active unit, does not suit me at all. I do not feel at home in this outfit, they are only young fellows between the ages of twenty-two and twenty-four, and all unknown to me. It's a week that we have been in line again and things are getting hot here. No infantry action as yet, but the artillery fire is frightful. It is simply maddening. If peace does not come soon, I am going to desert. We receive no news here. Of course we soldiers are looked upon as dupes. Nights at 11:00 we get our dinner (mittagessen), cold, besides bread and coffee for the next day, and then you cough all day long in a shell hole until a shell gets you. It is an abominable thing."

November 5th—52nd Division.—Prisoners of a Flash and Sound Ranging Detachment, a new combined unit attached to the 104th Field Artillery Regiment, who were captured November 1st, near REMONVILLE, state that since October 20th they lost twenty-six men out of a total strength of forty-three, and that they

had been unable to function owing to our artillery fire. They report some improved technical apparatus and methods.

November 6th—Machine Gun Sharpshooter Detachments.—An officer of the 52nd Machine Gun Sharpshooter Detachment reports, as have prisoners of many other such units, that his detachment has had such heavy losses from our artillery fire that few machine guns are now in service. From October 4th to November 1st two of the three companies were reduced from twenty-four to eight heavy machine guns in service, in spite of receiving some from infantry units, meanwhile, on October 15th, the 3rd Company lost five of its ten machine guns. He states that positions had to be changed frequently, as our artillery drove them out of their nests. Prisoners of various sanitaets, or First Aid companies, all report many casualties in the enemy ranks, from our gas shelling. In the 169th Regiment, 52nd Division, there were one hundred gas casualties in the 1st Battalion, October 30 and 31, when it was at LANDRES-et-ST. GEORGES and in the 2nd Battalion of the 170th Regiment at CHATEAU de LANDREVILLE, the same day, there were fifty casualties. Two field hospitals at VERRIERRES had some three hundred gas cases November 1st, and twenty of these men died that day.

November 8th.—Extract from 88th Division (German) Order. In the last days considerable losses have been occasioned by enemy artillery fire. These are only to be prevented when the troops dig themselves in well. Moving about in prominent places is without object, as the American artillery places all landmarks and woods under fire.

SOME REMARKS ON MOUNTAIN ARTILLERY*

BY A. MORTUREUX, CAPTAIN OF ARTILLERY, FRENCH ARMY

FROM REVUE D'ARTILLERIE, PARIS, SEPTEMBER 15, 1922

CHAPTER V[1] (Continuation)

DESCRIPTION OF MOUNTAIN ARTILLERY GUNS OF THE LATEST TYPES

3RD ENGLISH MOUNTAIN HOWITZER OF 3.7 INCHES (94 MM.)

THE English artillery is at present armed with a 2.75-inch (69.8 mm.) gun of the Vickers-Maxim mechanism[2] and with a 3.7-inch (94 mm.) howitzer, 1918 model, constructed by Vickers, which we shall describe in some detail.

(*A*) *General Characteristics* (*Fig, r*)

The tube is composed of two elements, each one being a load for a mule; these elements are assembled by a joint, sustained by a joint nut. When the piece, thus made up, is mounted in the emplacement, it is fastened rigidly on a sleigh, which recoils on a cradle.

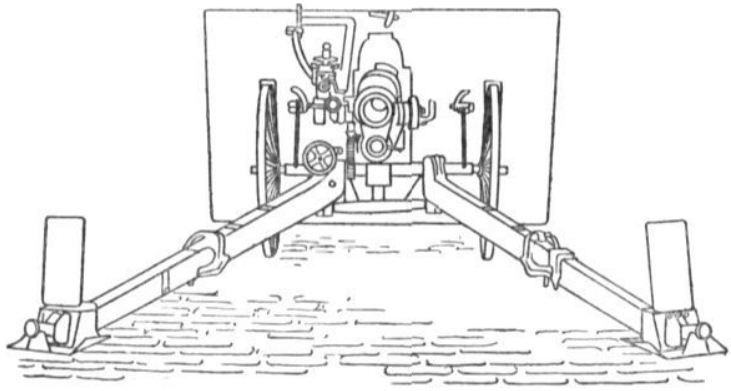


FIG. R.

The brake and the recuperator are separate from each other; each one contains a piston, the rod of which has its front end attached to the front of the cradle.

The brake has variable orifices, with automatic control, set in

* Translation furnished by courtesy of Military Intelligence Division, General Staff, U. S. Army.

[1] See *Revue d'Artillerie*, Vol. 89, April, 1922, p. 349.

[2] England is said to be studying a new 3-inch mountain gun (76.2 mm.); see note 2, p. 483, FIELD ARTILLERY JOURNAL, November-December, 1922.

action and regulated by the inclination of the carriage. The arrangement of the orifices is perceptibly analogous to that of the Skoda 75-mm. gun, 1915 model (diaphragm with valve mobile in respect to the piston). The brake also includes a buffer for return to battery with a special regulator.

The recuperator, which includes two cylinders, functions in a way similar to that of the Schneider system recuperators. A special device prevents the liquid, in case of large angles of fire, from exposing the orifice of communication from the upper cylinder to the lower cylinder.

Interesting detail: The liquid seems to be oil[3] and not glycerine. The gas is simply air.

The carriage has folding trails and seems entirely similar to the Deport mechanism of the 75-mm. Italian gun. Each trail is in two parts; one part may be used to prolong the other, or they may be folded back sideways one upon the other. The two trails together constitute a well-balanced load for a single mule and one easy to place on the pack-saddle.

The aiming mechanisms are reduced to a minimum as regards size and weight. Their very simple arrangement permits wide limits (40º) in traversing and elevation.

With its shields the gun requires eight mules to transport it on a pack-saddle. It is easily changed into a carriage by uniting the two trails, adding a shaft and wedging the cradle upon a fork in the form of an x, the feet of which are supported, respectively, upon each of the trails.

As a whole, it is an interesting gun which seems well-adapted to use in a mountainous country.

In our opinion, a 75-mm. gun, arranged in a similar way and with the same fields of fire, but with the tube in a single piece, could be carried on only five mules (shields not included).

(*B*) *Arrangement in Detail*

Tube (Fig. s).—The removable front section of the tube (tube volée) has two notches (or scarfs) and a ring to connect it with the sleigh, a junction nut moved by a worm and held towards the front by a stop ring. A device with tenons assures the immobility of the

[3] The English Drill Regulations of 1921 regarding the 3.7-inch howitzer, designates by the name of mineral oil, or simply oil, the liquid in the recuperator, without defining it otherwise. It would be interesting to know up to what point this liquid becomes an emulsion and what is the influence of this emulsion on the functioning of the mechanism.

nut in relation to the tube when the latter is separate from the breech section of the tube.

The breech section of the tube has in front teeth which fit into the teeth of the corresponding profile, cut out in the removable front section of the tube.

The jacket has a guide tenon which assures the good assemblage of the two parts of the tube and side-rails that come into contact with the slide ways of the cradle. It is threaded in the rear to receive the breech sleeve.

This is provided in its lower part with an eye in which the locking nut connecting with the sleigh can turn a quarter of a turn under the action of a

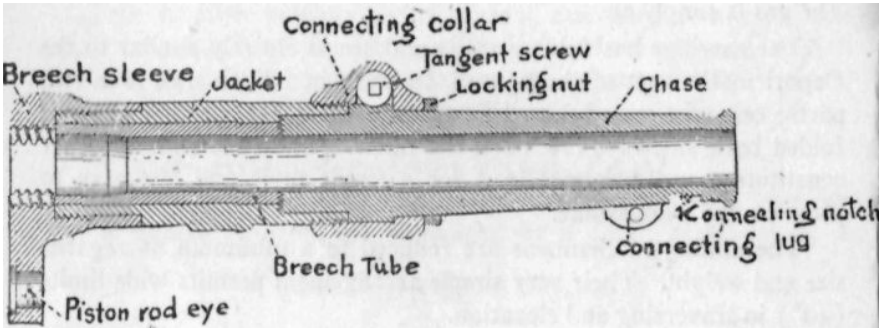


FIG. S.

handle. The nut has four smooth sectors and four threaded sectors.

On the left side of the sleeve the toothed elevation sector is placed.

Breech Mechanism (Figs. t and u).—The breech is one with a screw closure. It is arranged for fire with cartridge case. The breech block has at the rear:

(a) A recess in which the sear and the striker are placed. The sear has a hook in front and toe in the centre below. The percussion mechanism consists of a cylinder containing the striker. At the rear there is a recess in which the cam of the firing lever comes to rest;

(b) An axle about which the operating lever pivots. This bears a toothed pinion capping the axle and engaging with an interior thread of the breech screw.

The operating lever may be held stationary in the position of closure of the breech by a large flat spring, controlled by a spring placed in the handle of the lever;

(c) The axle of the firing lever prolonged by a cam placed in the handle of the lever.

A spring bolt is mounted on the axle of the lever.

Opening and Closing.—After unbolting the operating lever by hand, a single pull towards the rear unbolts the breech block after the breech screw is rotated a quarter of a turn in its carrier. The rotation is given by the pinion of the operating lever.

The breech is closed by the reversed procedure.

Armed and Fired.—To arm the gun the lever is pushed forward. Its cam pushes back the cylinder of the striker until the sear stops it with its hook.

The gun is fired by means of the firing lever which is pulled back or by means of a device on the carriage. Moving the lever back forces forward

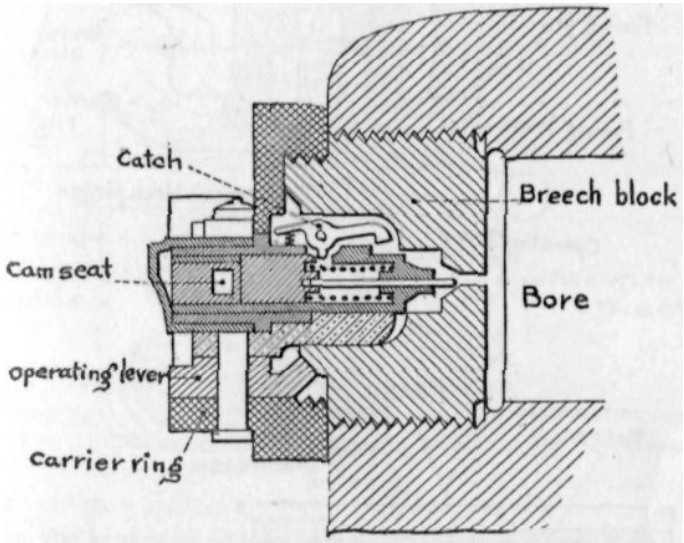


FIG. T.

the cylinder of the striker. The shock on the toe of the sear raises the hook of the sear, which frees the cylinder of the striker and this, under the action of its spring, moves forward while the toe of the sear finds a passage in a groove placed in the upper part of the cylinder.

Safety.—The breech has two safety devices, preventing fire unless the breech is closed:

1. It is only when the breech is closed that the cam of the firing lever finds a seat in the breech, permitting it to act.

2. As long as the breech is not closed, the toe of the sear is not opposite the groove in the cylinder of the striker. This toe then limits the forward movement of the striker.

Sleigh.—The sleigh recoils in the cradle. It bears the brake and the recuperator.

The brake (Fig. v) consists of a cylinder filled with oil, inside of which there moves a piston which is integral with a rod attached to the front of the cradle. On this rod, in front of the piston, there is jointed a valve (diaphragm) which follows during the recoil grooves arranged in the inside of the cylinder. The piston and the valve have orifices.

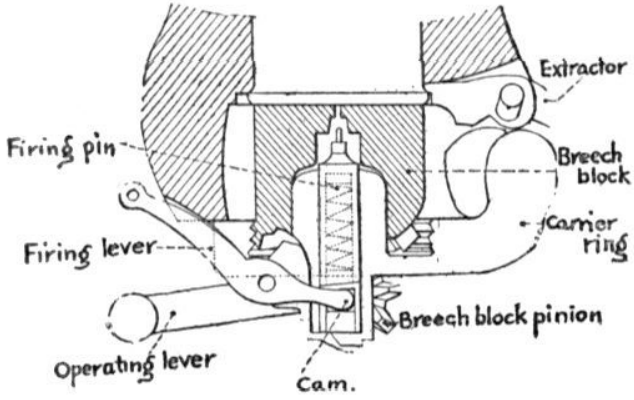


FIG. U.

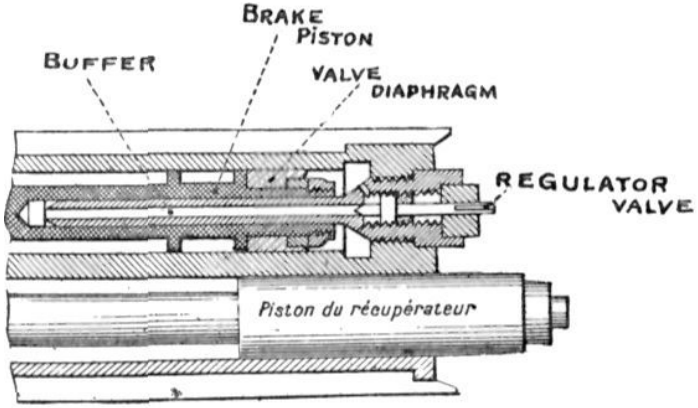


FIG. V.

The recoil is reduced automatically by a control arranged as follows:

A steel operating rod is located in a seat on the right of the cradle. Its rear end is branched on the right side of the pintle (or top carriage?), its threaded front end is jointed on a small vertical operating lever which revolves about an axis located towards the bottom and on the front part of the cradle.

This small lever has a bevelled segment which engages in a rigid segment of the piston rod.

At the time of the elevation, the operating rod pulls or pushes the lever and makes the segments and the piston rod revolve, which diminishes (or increases) the orifices of the piston-valve recoil mechanism, since the latter, held by its tenons, cannot revolve.

The recoil varies between 88 cm. (horizontal) and 47 cm. (40º).

In case of a recoil which is too long, we can act upon the front of the piston rod by means of a special key; one complete turn in the direction of the hands of a watch reduces the recoil one centimetre.

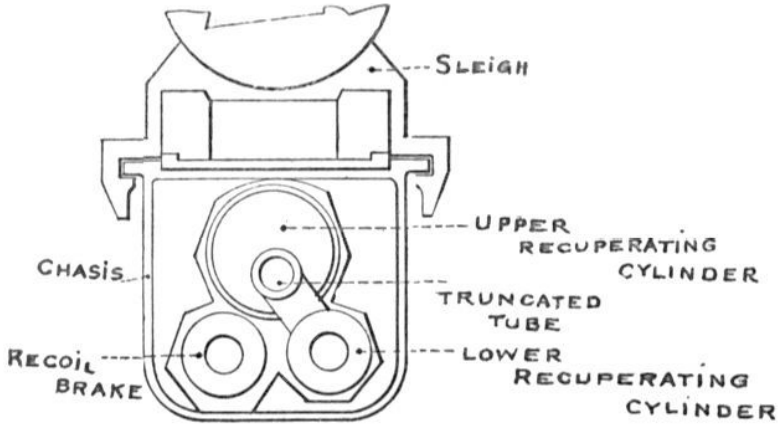


FIG. W.

For the return to battery the brake is provided with a buffer, a sort of long rod (carot) which penetrates into the interior of the piston rod. The rod of the buffer has an internal cavity which communicates by an orifice with the brake cylinder. The opening of this orifice (poppet valve) may be regulated by means of the buffer regulating valve, shown in Fig. v.

The recuperator (Figs. w and x) is composed of two cylinders placed one above the other and communicating with each other by an opening placed in the front part. In this opening there is mounted a retarding valve.

The upper cylinder is filled with liquid (oil) and compressed air. It contains a truncated tube (passage pipe) for the passage of the liquid. This tube caps the retarding valve. Its length is such that it is constantly filled with liquid and that the liquid covers the communication hole (retarding valve) even at the maximum inclination of the gun (40º). The joint of the piston is, therefore, always immersed (Fig. x).

The lower cylinder, of small diameter, is entirely filled with liquid and contains a piston, the rod of which is fastened to the front of the cradle.

Carriage and Top Carriage (*or Pintle*) (Figs. y and z).—The carriage is composed essentially of two wheels, an axle, an equalizer (or traverse), front trail supports and the trails.

The axle and the equalizer bulge out in the middle and are pierced by a hole giving passage to the axle of the pintle.

The front trail supports are jointed on the spherical rigid joints of the axle. In the same way the equalizer is suitably jointed in relation to the

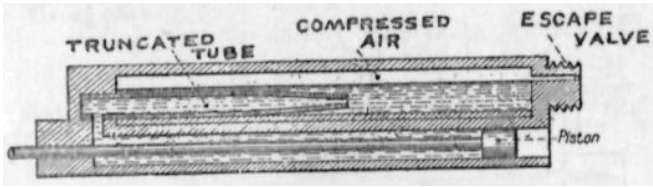


FIG. X.

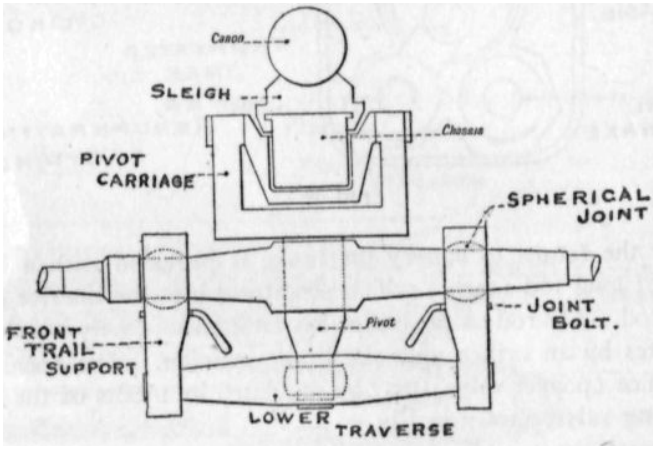


FIG. Y.

front trail support. In this way the front supports may be moved apart from each other and tilted in relation to the axle, as shown in Fig. z.

Each of the two trails may be brought into the extension of the corresponding front trail support and fastened rigidly in that position.

The rear end of each trail is provided with an adjustable trail-spade and a socket meant to receive an operating lever.

The top carriage revolves in the axle and in the equalizer. Its

upper part is terminated by a fork bearing the trunnion bedplates of the cradle.

The left branch of the top carriage fork is prolonged in the rear by an arm, a sort of bracket, bearing the handwheels and control pinions for elevation and traversing.

Aiming Mechanisms.—The elevation handwheel causes a toothed are which forms part of the gun itself to turn by means of a pinion. This are is guided by a slideway placed in front of the pinion.

The traversing mechanism is composed of a simple traversing nut (screw and threaded socket), fastened on one side by hinging to a ring borne by a socket which is an integral part of the carriage (left side), on the other side by hinging to a socket which is an integral part of the left bracket of the top carriage. When the traversing handwheel is operated, the traversing nut moves out or in, pushing back or pulling out the left bracket of the top carriage in relation to a fixed point located towards the left end of the axle.

The table given below shows the principal numerical data in regard to the matériel.

Numerical data in regard to the English 3.7-inch howitzer.

Calibre	94 mm.
Length of the removable front tube	749 mm.
Length of the breech section of tube	546 mm.
Length of the assembled tube	1.18 metres
Length (of the bore) in calibres	11.8 metres
Riflings — number	28
Riflings — pitch	progressive
Field of fire — vertical	–5º to +40º
Field of fire — horizontal	40º
Muzzle velocity	296 metres per second
Length of recoil	444–889 mm.
Maximum range	5.4 kilometres
Track (voie)	1.36 metres
Weight	
Of assembled tube	208 kilograms
Of the piece in battery (without shields)	728 kilograms
Of the shell	9 kilograms

Arrangement of the Battery.—A firing battery includes four guns and 54 mules, 32 of which carry the elements of the guns; 8 the ammunition; 3 the tools of the Pioneers and 3 the signalling apparatus; the 8 other mules are left free.

4TH. AMERICAN 75-MM. HOWITZERS ON PACK-SADDLE[4]

The regulation mountain gun in the United States at present is the 2.95-inch (75 mm.) Vickers-Maxim gun, but tests are now being made of a 75-mm. howitzer, constructed in accordance with the findings of the Westervelt Commission. This Commission had demanded the following characteristics for the mountain gun of the future:

Calibre of about 3 inches (76.2 mm.); use of the shells of the Divisional Artillery, maximum angle of fire of at least 45º;

Maximum range of at least 5000 yards (4570 metres);

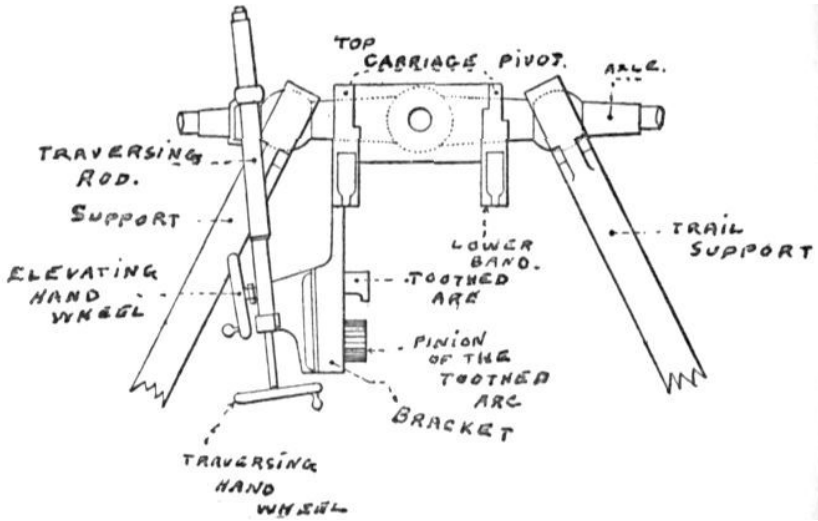


FIG. Z.

Weight of each load not more than 102 kilograms (pack-saddle not included);

75-mm. howitzer on pack-saddle, 1920 model.

Gun.—Two types have been constructed, with the same ballistic qualities. In one the breech has a wedge closure, with a horizontal movement and it is fired by a firing lanyard. In the other the breech has a screw closure and is armed automatically.

Brake.—The recoiling mass consists of the tube, piston and its rod. The brake is of the most recent Saint-Chamond type[5] with a variable recoil. We will describe it briefly below (Fig. a_1).

[4] See FIELD ARTILLERY JOURNAL, March-April, 1921, and *Army Ordnance*, July–August, 1921, and March-April, 1922.

[5] The U. S. Ordnance Department negotiated with the Saint-Chamond Co. during the war and obtained a license to apply the Saint-Chamond brake to artillery guns constructed since that time in the Ordnance workshops.

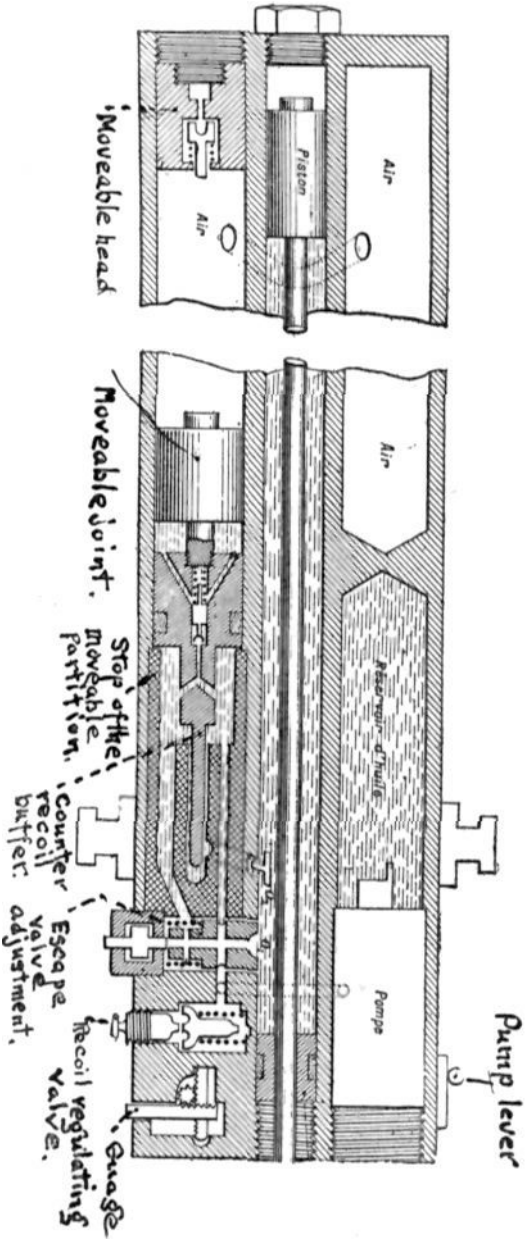

Moveable head
Air
Piston
Air
Air
Moveable joint.
Stop of the moveable partition.
Counter recoil buffer.
Escape valve adjustment.
Reservoir of fluid
Pump
Pump lever
Recoil regulating valve.
Gauge

FIG. A1.

It has three cylinders: The central cylinder filled with oil contains the piston[6]; the cylinder on the right contains a compartment filled with air under pressure, a reservoir of oil for the pump and the pump, the latter communicating with the cylinder on the left. The cylinder on the left includes from the front to the rear:

(a) A movable head for recharging it with air;
(b) A compartment for the air, communicating with the corresponding compartment of the cylinder on the right;
(c) A movable partition, including a movable joint and the mounting of a loaded valve with a moderating rod;
(d) The lug of the movable valve;
(e) The control device of the orifices;
(f) The adjuster of the drain;
(g) The gauge.

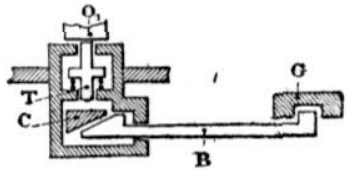


FIG. B_1.

Operation of the Brake.—At the recoil, the oil, pushed back by the piston, passes into the recuperator, lifting the valve o_1 (loaded valve). The left of this valve is limited in function by the angle of elevation. The passage of the oil is thus regulated and remains constant during a single recoil.[7]

The oil, in running out, pushes back the movable partition, which compresses the air.

At the return to battery, the oil passes back into the cylinder of the brake by means of the adjuster. Towards the end of the recoil, the rod on the movable partition moves to engage in the buffer cylinder, and restricts progressively the flow of the oil. Hence there results a slow return to battery without shock, the motor itself being braked.

In order to modify the length of the recoil according to the angle of elevation, an angular regulating device may be mounted on the head of the piston contained in a boss on the left side of the brake.

[6] The piston joint and the rear fittings of the piston rod are made with a view to replacing them easily and rapidly when in battery.

[7] The recoil of the gun on the slideway and the return to battery is obtained by sliding (side rails on smooth planes).

This device, very simple, has a bevelled cam c (Fig. b_1), placed opposite the rod T of the recoil valve o_1. In the crank case there is lodged an arm B, one end of which bears a sliding cam in a sector-guide G, which is integral with the bracket of the carriage, and the other end of which ends in the form of a wedge. The sector-guide has a groove with a profile calculated so that the arm advances or recoils according to the angle of elevation. The more this angle increases, the more the wedge advances into the crank case and limits the play of the valve O_1.

The recoil varies from about 46 to 71 centimetres. Under these conditions and in consequence of the trunnions being carried back, the breech cannot hit against the ground.

Aiming Mechanisms.—The traversing mechanism is of the type which slides upon an axle. The elevating mechanism consists of a toothed sector, engaging with a pinion on the right, the rotation of which is controlled by two handwheels placed on either side of the carriage. In order to diminish the strain upon the handwheels, two spiral springs, forming equalizers, are fastened to the ends of the elevation shaft.

Carriage.—The trail is jointed, so that it can be bent back upon itself.

Transport on Pack-saddles.—The gun may be dismounted to be put upon pack-saddles, or remounted to be put in its emplacement in less than a minute. It is divided into four loads: Gun, cradle (together with brake and recuperator), trail, wheels.

Howitzer on Pack-saddle, 1922 Model

Since the tests made with the 1920 model howitzer showed the necessity for certain modifications, the Ordnance constructed a new model, called the 1922 model, which does not seem to have been tested yet.

The characteristics of this are the following:

Gun.—Same ballistic data as for the 1920 model; breech with wedge closure; fired by means of a device mounted on the carriage; trunnions in the rear; spring equalizers.

Brake.—Of the Putesux type modified. A sleigh bears on the lower part the recuperator cylinder, on the upper part the brake cylinder. At the moment of mounting in the emplacement, the tube is fastened to the sleigh and the entire mass participates in the recoil.

In relation to the 1920 model there is an increase in the weight of the recoiling mass of nearly 40 per cent., which makes it possible to reduce by 1600 pounds (more than 700 kgms.) the strain to which the rod of the piston is subjected. The length of the recoil is constant and is equal to 28 inches (711 mm.).

The table on the following page sums up the characteristics of the 1920 model gun.

Numerical data in regard to the American 75-mm. howitzer, 1920 model.

Calibre		75 mm.
Length of the bore (in calibres)		14.7
Field of fire	Vertical	–5 to +45º
	Horizontal	5º (?)
Muzzle velocity		274 metres per second
Maximum range		6000 metres
Track (voie)		0.8 metre
Weight		
Of tube (with breech)		94 kilograms
Of recuperator and sleigh		107 kilograms
Of the piece in battery		385 kilograms
Of the shell		6.8 kilograms

5TH. SAINT-CHAMOND MOUNTAIN GUNS

The 70 SA and 75 p 1104 Saint-Chamond guns have the same construction and practically the same characteristics. They are light, very easy to handle and are carried in four loads.

These guns have been described in the study of Captain Amenc, of which we have already spoken. We shall restrict ourselves to reprinting the opinions expressed by the Belgian Major Furst regarding the 70 SA in his work entitled "l'Artillerie coloniale" (Colonial Artillery), which was published in 1918:

"This gun is perfectly suited for colonial warfare, provided that some modifications and some improvements which experience has shown to be necessary are made. Constructed for Mexico in 1914–1915, the Belgian troops operating in German East Africa in 1916 have been the only ones to make use of it up to the present, and although they had only three batteries of four pieces, they obtained from this gun a superiority which certainly had something to do with the rapidity of their conquest."

The Saint-Chamond guns had Ehrhardt guns opposed to them as adversaries in the German colonies.

We will recall the fact that the Saint-Chamond Company is at present constructing a mountain gun with a large field of fire.

6TH. BOFORS MOUNTAIN GUN

To be complete, we should add here some information regarding a new mountain gun that the Swedish Bofors Company is said to be on the point of putting on the market.

We shall wait until this gun has been tested officially to give a detailed description of it, as a supplement to this article.

(*Conclusion.*)

FIELD ARTILLERY IN REAR GUARD ACTION

The Historical Incident of Dilger's Battery

BY JENNINGS C. WISE, LIEUTENANT-COLONEL, F.A., O.R.C.

IN a previous paper, the writer in making a plea for applied history has shown how, in the case of DuPont's Battery at New Market, the initiative, the instant trained appreciation of terrain, the ready willingness to assume responsibility, coupled with a spirit of self-sacrifice on the part of a battery commander, may cause a single battery to exert a decisive influence upon the fate of an entire army.

In any such case, of course, it is not so much the effect of the independent action, however heroic it may be, as it is the manner in which it was accomplished that is valuable to the student, for it is only by knowing how a thing was actually done that the example which it constitutes may be followed.

At New Market the contending forces were small—four or five thousand on a side at most. So, too, the stake at issue was correspondingly small. The most that the Confederates could have done even had their pursuit not been checked by DuPont's Battery on the Shenandoah, would have been to capture several broken Federal regiments and batteries at the crossing of the river. By so doing they would have gained a victory no more decisive than that which was theirs without such tangible fruits, for what mattered the loss of several thousand men in the Valley of Virginia in May, 1864, to Grant who, with inexhaustible reserves, was losing that number or more daily in Meade's greulling campaign against the Army of Northern Virginia.

The situation at Chancellorsville in the spring of 1863 was quite different, however. There, not only military but political considerations as well were involved in the outcome of the contest between Lee and Hooker. Whatever the ultimate result may have been, it is not improbable that had Hooker's Army been destroyed after the overthrow of Burnside at Fredericksburg the preceding winter, the anti-administration party of the North would have had its way, and the battle of Gettysburg, which broke forever the offensive power of the Southern Confederacy, would never have had to be fought. But, however this may be, surely the stake at issue at Chancellorsville was a large one.

On the night of May 18th, Hooker's Army lay with its back to the Rappahannock River, extending a distance of six miles from the

river and Mine Roads on the east, through Chancellorsville to Talley's farm on the west, with the 11th or Howard's Corps on the extreme right. Having discovered that Hooker's right flank rested in the air, Lee planned to turn it, roll up the Federal Army with the river at its back, and destroy it. Maintaining Anderson's and McLaw's Divisions in position opposite Hooker's left and centre and causing them to make a show of activity, with amazing audacity he transferred Jackson's Corps clear across Hooker's front from the east, or the Confederate right, in one of those wide sweeping movements for which his bold lieutenant was famous, and hurled it squarely from the west upon Howard.

Jackson's column consisted of three divisions of infantry (Rodes, Colston, A. P. Hill) or seventy regiments,* four regiments of cavalry under Stuart himself, and parts of five battalions of artillery, or twenty-four batteries with about eighty guns. This force was designed with nicety to be of such a size that when the head of the turning column had reached the point from which the assault was to be delivered, the remainder could be deployed sufficiently rapidly to prevent the presence of Jackson on Hooker's flank from being discovered and countered against. As Jackson's column crossed Hooker's front, however, it was observed by Sickles' Corps, next to Howard, and assailed by Sickles from the flank, its general trend toward the southwest leading Sickles to believe that Lee's Army had begun a withdrawal, an idea which became so firmly rooted in Sickles' mind that he reported to Hooker that Lee was in full retreat. The delusion, which was thus created, was one which Hooker could not cast aside.

It was about 4 P.M. when the leading division (Rodes') ceased to advance and began to deploy on either side of the turnpike at Luckett's farm, two miles west of Dowdall Tavern, where Howard's headquarters were established. In about an hour, eight of the twelve Confederate brigades had formed in two lines on a two-mile front, Rodes' four in front, Colston's four a hundred yards behind. Only a part of A. P. Hill's division was deployed as a third line, the remainder being held in column along the turnpike. At about 5:15 P.M. Jackson personally gave Rodes the signal for the general advance.

The Confederate bugles rang out all along the eager line like the cry of wild fowl in the teeth of a gale. On past the leading wave dashed Breathed with a section of his horse battery, and, unlimbering on the pike, from each of his two guns fired a round of solid shot which, bounding down the roadway, fell in the front yard of the Talley House, a mile distant. Simultaneously, the Confederate

* At this period of the war an infantry regiment mustered about 300 men.—EDITOR.

skirmishers struck the Federal pickets of Devens' Division on Howard's extreme right, who fell back, giving the alarm.

Rodes' line closely followed by Colston's, now rushed forward like a tornado, sweeping all before it and capturing two guns of Dieckman's Battery that had been posted in the picket line on the pike before they had fired more than a few rounds. Von Gilsa's Brigade, facing to the west in the woods to the north, was almost immediately overlapped, while the remainder of Devens' Division, which was facing south along the pike, instantly enfiladed by musketry fire, found it impossible to change front. At the Talley House, where Devens was still resting, the remnants of his division sought to make a stand. There the fight became a massacre. The Confederate musketry fire and canister from Breathed's guns literally swept the brave Federals from their feet, bearing them back toward the Wilderness Church where Schurz was making desperate efforts to reform his division in a secondary line of defense. Rushing through Schurz's line, intermingling with two of his veteran regiments in the act of changing front, Devens' men broke Schurz's formations and transmitting their panic to his troops carried them down the pike to the Dowdall Tavern, where the fleeing mob was met by Howard. Seizing the colors of one of the broken regiments, the Corps Commander himself sought in vain to check the route. Thus, in half an hour Jackson had swept Devens' entire division of 4000 men from his path, and all but destroyed it, and before 6 P.M. was in possession of the Talley plateau, having advanced over a mile along the turnpike. Such was the situation when Jackson, due to Colquitt's failure to press on to the Dowdall clearing as ordered, received his first serious check at that point.

It has frequently been stated that the avalanche which fell upon Hooker's right flank was entirely unsuspected, and even Henderson, one of the most accurate of military historians, fell into this error.* The facts are that Jackson's movement to the right of the Federal Army was detected and reported during the early morning by various observers in Howard's Corps, Schurz himself, convinced of the impending attack, begging Howard in vain to allow him to reform Devens' and his own division facing west between Hunting Run east of the junction of the turnpike and the Orange Plank Road. Later, when the Officer of the Day of Devens' Division reported (10 A.M.) the movement of enemy troops to the west, he was made light of and rebuked by Howard, who warned him against circulating such reports.

Confirmed in his view by the occurrences of the morning, Schurz, who meanwhile had personally observed a column of Confederates

* See p. 539, Henderson's Life of Jackson.

marching in a southwesterly direction across his front, sent Captain Hubert Dilger, in whom he had great confidence, to make a personal reconnaissance of the flank.

Dilger, who commanded an Ohio battery attached to Schurz's Division, was a trained officer of wide experience from Baden, Germany. Resigning a commission in the German Artillery, he had come to America and volunteered his services to the United States, his veteran battery being deemed to be the best in the 11th Corps, in which he was known under the *sobriquet* of "Leather-breeches" by reason of a peculiarity of dress. Early in the afternoon, accompanied by a single orderly, the young soldier of fortune set out on his mission. Passing westward along the turnpike, he was met and urged by General Von Gilsa not to proceed further lest he be captured. This officer, who had faced his brigade squarely to the west on his own initiative, confident that the enemy was massing on the flank, had made numerous reports to that effect to Devens, who ignoring them took to his couch for a quiet siesta. But Dilger, all the more determined to see for himself, kept on his way, for his mission was actually to verify and not to accept reports at their face value. Proceeding about a mile, he came upon Rodes' men deploying north of the Luckett Farm. Cut off from the road by a body of cavalry and pursued northward for some distance, he finally succeeded in eluding his pursuers in the woods, and coming upon the United States Ford Road, followed it direct to Hooker's headquarters, which he knew to be at Chancellorsville. He had seen enough to know that there was insufficient time before the blow would be delivered in which to relay a report of his observations through channels to the high command.

It was about 4 P.M. when Dilger personally informed a member of the commanding general's staff of what he had seen only to be insulted for bothering his superiors with "such a yarn."

Dilger was too well trained, and had too much experience with incompetent staff officers, to allow his personal feelings to avoid the duty that remained to him. Galloping in hot haste to the headquarters of the 11th Corps to report the facts to Howard, he was there reprimanded for his trouble and assured in no uncertain terms that Lee was in full retreat with Sickles on his heels!

What was he now to do? He knew that little time remained in which to do anything. Returning with all haste to his battery, which was in bivouac near the Wilderness Church, he placed his guns in the best possible position on an eminence near the church, beside a section of Weidrick's Battery, even refusing to allow his teams to be watered. Hardly had his disposition been made when the distant popping of Rodes' skirmishers announced the advance of the enemy.

When Rodes fell upon Von Gilsa's Brigade on the extreme right, Dilger and Weidrick's guns, facing northwest, did what they could to support Von Gilsa by firing over the heads of the friendly infantry in the woods upon the enemy as they came into view at Hawkins' Farm, half a mile distant, soon being joined by Wheeler's Reserve Battery, and when Von Gilsa's men fell back Dilger moved his battery to the western edge of the Dowdall clearing near the turnpike along which Devens' men were rushing to the rear. Leaving the roadway open for their retreat, he threw his six pieces into action against the enemy as they cleared the woods a thousand yards away. In this position he was soon joined by Hill's Battery, armed with 3-inch rifles, which swung into position on his left and opened on the enemy in the Talley fields south of the pike. But as the enemy stole forward, Hill's Battery, entirely without canister, had to withdraw.

Meantime some of Weidrick's guns, which had been unable to fire up the pike, had been captured, and all of the reserve artillery which had so far come into action, including Wheeler's Battery, had retired, leaving Dilger entirely unsupported on the turnpike. There, for more than thirty minutes, single handed, he maintained his position, changing from shell to double charges of canister as the enemy filtered closer and closer through the scrub thickets in his front. Confronted at last by Breathed's four guns and suffering from point-blank musketry fire, reluctantly he gave the order for his battery to retire, but Dilger himself was not to accompany it. Seeing an opportunity to check the advance of the hostile artillery down the pike, he remained with one of his pieces which had been unhorsed, personally directing its fire. In this exposed position his horse, which was wounded, fell violently upon him, injuring his leg, the accident almost resulting in his capture. Rising to his feet just as a number of the enemy were upon him demanding his surrender, the last man with the gun, then and then only did he seek safety in flight. Running painfully down the pike followed by his pursuers, he was unexpectedly rescued by a little boy named Ackley, who, missing Dilger from the battery as it retired, had ridden back under a terrific fire in search of his devoted friend. Dismounting, the lad with great difficulty assisted the injured man into the saddle, and springing up behind him, together they escaped.

Surely, there is in all the history of war no more romantic incident than that of Dilger and the boy, though upon it we can not here dilate. Perhaps, some day it will appeal to a pen that will do it justice, if that is possible. It is such incidents that make war glorious in story and in song when the formal records of battle are forgotten.

Riding rearward, Dilger and his youthful companion overtook the battery in rear of an incomplete line of rifle pits which Barlow's Brigade had thrown up across the Orange Plank Road at the eastern side of the Dowdall clearing during the morning at the instance of Schurz and before the brigade was called upon to engage in Sickles' imaginary pursuit of Lee's army. These hasty entrenchments Bushbeck's brigade was now endeavoring to occupy. Ordering his lieutenant to retire four of the pieces of the battery to a better position in rear, Dilger himself posted the fifth in the gap in the line of shallow pits through which the road passed, and caused it to open fire to the front in order to cover the retirement of Schurz's Division which was falling back upon Bushbeck's line. In this position, supported only by two companies of infantry, Dilger with his own hands kept his single piece in action until the line formed by Bushbeck was finally turned on both flanks.

Dilger's work had just begun, however, for while his energetic action up to this time had been of tremendous value in momentarily checking the onrushing enemy and especially in denying the Confederate Artillery the free use of the turnpike, now by completely dominating the Plank Road leading from Dowdall's clearing to the position which Hooker's staff was organizing at Fairview, he was to make it possible for Bushbeck's Brigade and the men of Devens' and Schurz's broken divisions, who had rallied on it, to retire.

At this time, his was the sole and only gun of the Federal Artillery firing upon the advancing enemy. Doggedly, threatened at every step from both flanks, he fell back, covering the retirement with rapid discharges of canister while Howard and Schurz mingled with his gunners. It was not until Bushbeck's four regiments, Berry's Division, and a large force of reserve artillery, were established in position on Fairview Heights that he finally abandoned the unequal contest. Nor did he then retire from action, for on reaching the Fairview position he resumed command of his battery, which had been posted in the formidable line of artillery, and remained in action with it throughout the desperate fight of the night.

As an example of almost superhuman courage and energy, Dilger's exploits at Chancellorsville are interesting. His gallantry like that of little Ackley is above praise. But the numerous lessons which the incident carries with it are more than praiseworthy. They are of the utmost value to the student of artillery tactics.

First, there was a perfect reconnaissance on his part; second, the instant appreciation of the significance of his observations, and third, the soundest judgment on his part as to the value of military intelligence, which in the emergency carried him direct to the various headquarters where the information in his possession instantly acquired the greatest value, whether properly estimated or not. He

saw at a glance that not merely a brigade, or division, or corps, or even the entire right wing of the army were in jeopardy, but that the whole army was in imminent peril; that nothing which could now be done by Von Gilsa or Devens would save the situation, and that Hooker alone could prevent a disaster by an immediate realignment in force behind the right wing of the army. The High Command refusing to act, he still endeavored to accomplish the necessary shift of front by warning the commander of the endangered wing, and having done all that was in his power as a subordinate to warn his superiors of the danger of which he was aware, forthwith he prepared himself to delay the execution of the obvious plan of the enemy momentarily, at least, while it was disclosing itself to his incredulous superiors.

The manner in which he posted his guns illustrates the best manner in which to cover a vital approach. He might have inflicted as many casualties with his fire from other positions but his primary aim was to delay the movement of the enemy, not merely to inflict casualties upon him. So long as the free use of the turnpike was denied the enemy, there was bound to be an interruption of his movements and a consequent dislocation of his plans, for it was by this road alone that the artillery could move forward in support of the attacking infantry. It must be remembered that light artillery moved with the infantry in 1863. Furthermore, the maximum effect of canister was not to be had by oblique fire through the woods upon the roadway from a position on its flanks, canister being effective only in the open. Again, under the circumstances of so restricted a field of fire he exercised the best judgment in retaining one gun only instead of trying to handle a full battery on the narrow pike, since one gun was more readily handled and firing constantly gave the maximum fire effect obtainable in so limited a field of fire with far less risk of loss.

But all these things were matters that would not have occurred to a man who was merely courageous and energetic. In order to arrive at the correct decisions which Dilger made instantaneously with the shifting circumstances of the emergency, it was absolutely necessary that above all else he should have been a trained and experienced soldier.

If we examine Dilger's actions, it will be seen that modern developments have not precluded the possibility of their repetition. Indeed, with the increased power and fire efficiency of the modern field gun, greater tactical opportunities in rear-guard action for individual prowess than were made by Dilger and Dupont will continue to present themselves. It must not be forgotten that with almost the same armament as the artillery has at present, a single battery of mountain guns, under an intelligent Japanese officer, insured a

victory at Motienling when the issue was at least doubtful, and no doubt many decisive actions on the part of battery commanders during the more open phases of the European War will sooner or later come to light.

We now come to the final lesson to be drawn from the incident which has been described.

It is possible, of course, that faulty organization and the lack of a Chief of Artillery in whom administrative as well as tactical responsibility for the units of his arm were centred, caused Dilger to be overlooked. It seems strange indeed, however, that his remarkable exploits at Chancellorsville, even in the absence of proper organization, should have been almost unknown outside of his own, or the 11th Corps, and there may be a better explanation than the one suggested.

Sometimes a military subordinate by the very magnitude of his services on a particular occasion consigns himself to oblivion. This is a matter of psychology, disillusioning to be sure, but none the less a fact, for there are occasions when military superiors, who are after all human beings with all the vanities with which God endowed man, can not afford by reason of their selfish interests and the necessity of self-preservation to recognize the professional abilities and services of a subordinate.

The overwhelming disaster which befell Hooker's Army at Chancellorsville was most disappointing to the North. A great uproar against the boastful Hooker instantly arose. Nor was Sickles, who was in large measure responsible for the fatuous blunders of Hooker and his staff, and who, throughout the battle of Chancellorsville was in a maize of error, overlooked. Clearly, for reasons of self-preservation it was incumbent upon them to find a scapegoat upon whom to shift the blame, and for that purpose Howard and the 11th Corps were singled out.

The vision of Dilger rushing from army to corps headquarters, vainly urging the necessary action to be taken by Hooker and Howard, must have been little less than a nightmare at army and corps headquarters for a long time after the disaster of May 2nd. In the campaign of mutual recrimination between Hooker and Howard which ensued, those involved were naturally far more concerned with covering up their stupidity and concealing their culpability than with rewarding one who was a potential witness against them. To have rewarded Dilger would not only have been a confession of their own mistakes but would have put the stamp of credibility upon him. Imagine either Hooker or Howard commending Dilger in orders for having made a personal reconnaissance, under the orders of General Schurz, of the enemy's position at the risk of his life, and having with rare judgment informed the Army

Commander and the Commander of the 11th Corps one hour before the enemy's attack of the presence of the enemy in rear of the right flank of the army! How would either Devens or Howard escape court-martial if it developed that Von Gilsa and Schurz had reported to them over and over the whereabouts of Jackson? How would Hooker be able to shift all the blame on Howard if it appeared that the proper officers of his staff had been informed of the impending attack in ample time to counter against it? Under the circumstances, we may be sure that Hooker's and Howard's staffs, in whose hands the fate of Dilger rested, spared no effort to silence the voice of "Leather-breeches," the soldier of fortune.

Thus, it is possible that Dilger was but another victim of "headquarters policies"—an influence which in all armies tends to destroy initiative and produce moral cowardice.

The lesson to be drawn from Dilger's fate is that certain influences must not only not be disregarded, but they must be reckoned with and guarded against by proper organization lest they impair the efficiency of an army.

A FIELD ARTILLERY GROUP IN THE GENERAL ADVANCE*

BY COLONEL W. H. F. WEBER, C.M.G., D.S.O.

[EDITOR'S NOTE.—*In the May-June, 1920, and subsequent issues of the* JOURNAL, *we published an interesting article entitled "Being a Tactical Study of the Field Artillery Group in Retreat," by Colonel W. H. F. Weber, C.M.G., D.S.O., R.F.A., as a reprint from the Journal of the Royal Artillery. The October, 1922, number of the above-mentioned magazine contains another very interesting article by the same author, entitled "A Field Artillery Group in the General Advance," a reprint of which we are glad to be able to give our readers.*]

PREFACE

BETWEEN November, 1919, and March, 1920, there was published in the *R. A. Journal* under the author's name, in 5 Parts, an article recording with comments the doings of a Field Artillery Group, whose nucleus was the 2nd Brigade, R.F.A., during the great German offensive of 1918. It was entitled "A Tactical Study of the Field Artillery Group in Retreat." It was republished complete, with little additional comment, in 1921, by the *American Field Artillery Journal*.

The preface to the above-mentioned article explained the author's reasons for writing it, which apply to this paper equally as well as to its predecessor. In these days of changes of armament, the Press, military and civilian alike, frightens us with prognostications as to the next war; horrors are thrust in our face by the protagonists of the aeroplane, the tank, and chemical warfare in turn; the submarine terror seems quite innocuous in comparison. The author has no intention to underrate the possibilities of development in these branches of warfare, but would rather leave them to more ambitious prophets. His object is, by presenting in some detail a record of facts, to provide a framework on which to consider the practical effects on field artillery in battle of these developments.

In the May-June, 1922, numbers of the *R. A. Journal*, appeared an exceedingly interesting article by Lieutenant-Colonel C. N. F. Broad, D.S.O., R.F.A., entitled "The Development of Artillery Tactics, 1914–18"†, which presents the tactical (and indeed strategical)

* Reprint from the *Journal of the Royal Artillery*, October, 1922.

† See FIELD ARTILLERY JOURNAL for September-October, and November-December, 1922.

influence of artillery in its true light. One only wishes that the arguments and tendencies set forth therein could have been as clearly brought home to regimental leaders at that time. Orders and instructions would surely have been obeyed with more intelligence. But of course the quiet of today is so different to the conflict of thought, and the hurry and rush, which obtains on the theatre of operations.

Lieutenant-Colonel Broad outlines developments still impending at the end of 1918, as follows:

(a) Improvements in actual battle coöperation by the Royal Air Force.
(b) The introduction of large masses of tanks.
(c) The improvements in all forms of communications.
(d) The increase in mobility owing to cross-country traction.

Lieutenant-Colonel Broad was probably thinking chiefly of heavy artillery, but the last of these developments, at present being applied to the R.F.A. by the substitution of the mechanical tractor for our well-beloved draught horses, is likely to create a new mental attitude in the personnel. Will it materially alter field artillery tactics?

Once more the author wishes to apologize for any criticism which may be thought to apply to other formations or individuals. He declares again that the only intentional criticism is directed against "The Group Commander." The 6th Divisional Artillery was, in truth, a happy family, for its Chief was one of those who make happy families—which was none the less so because he taught, in a very kindly manner, that obedience is a soldier's first duty; he practiced what he preached. For our infantry we entertained the most profound respect and affection.

Birkin House, Dorchester. W. F. W.
Aug. 26, 1922.

PRELIMINARY

The Brigade Commander (2nd Brigade, R.F.A., 21st, 42nd, 53rd and 87th (howitzer) Batteries) arrived back in the Ypres Area from Shoeburyness in the first week of September, to find 6th Divisional Artillery withdrawn from the line preparatory to moving into the Somme district, and himself acting C.R.A. The elaborate arrangements to meet the expected attack by Prince Rupprecht of Bavaria had, fortunately, never been tested. On the contrary the enemy was retiring and Mount Kemmel fell into our hands once more.

NOTE.—The Author has since heard first-hand from German sources, how very unpleasant we had made his Hazebrouck salient for the enemy during the months of May, June, July and August.

The Fourth Army had attacked on August 8th and achieved a brilliant success. The French were fighting steadily on its right. The Third Army had joined in the attack (on the Ancre) on August 21st, and the First Army had broken the Queant-Drocourt Line E. of Arras on August 26th. On the Somme we had almost regained the ground lost during the German offensive; the First Army was an important step in front of its 1917 line.

The author would summarize as follows the psychological attitude of troops reaching the Somme battlefield at this time. The Somme held bitter memories for 6th Division, but the Fourth Army seemed "on the win." British troops had had a breathing space in which to recover from the severe blow dealt them in the Spring. It was probably possible after all to drive the enemy out of France and the war might really be ended before so very long. The Americans were seriously engaged and were present in France in great force, in spite of submarines. Things were looking better in other theatres of operations. Recent successes on the Western Front seemed to offer more than previous "victories." The third battle of Ypres (or Passchendaele) followed by the German offensive, had entirely altered the constitution of units, but some experience had been gained with the new personnel. We had not forgotten our offensive lessons of 1916–1917 and we had learned something during the year of defense; but always of the trench warfare and limited objective type of fighting. There might be open warfare before us, but of that we had no experience; such personnel left as had been trained in open warfare had forgotten it. Put into other words, we expected ample time to prepare for action, expected our food and ammunition to reach us according to plan, looked for reasonable comfort, and should fight by the map with the help of a barrage scheme which freed regimental officers of need for decisive independent action. One cannot have things both ways; we had grown used to "control cake."

On September 6th, the Brigade Commander summarized lessons gathered from the troops already in battle as follows:

(i) Not many casualties, but hard work, and short sleep.

(ii) Forward reconnaissance as well as observation, and liaison, to arrange for.

(iii) Necessity of 2/3 artillery being always ready to lay down a protective or creeping barrage; not more than 1/3 to be on the move.

(iv) Possibility of advanced sections with battalion headquarters.

(v) Shooting oneself in from observation, rather than by use of map.

(vi) Infantry jumping-off places conform to artillery barrage possibilities; direct attack on obstacles in preference to turning movements.

It was just possible to hold[1] four battery exercises and one brigade exercise, with full staffs, and one sub-section present per battery, rest represented by their Numbers One, to inculcate the forgotten principles of open warfare, before the 2nd Brigade moved to battle on September 13th.

* * * *

We heard, from those we relieved, of pursuit and infantry guns; very little of the kind was to come our way, at any rate at first. Theirs had been the long drive; we were to make an approach shot; our neighbors were to hole out across the Canal de St. Quentin at Bellenglise.

PART I (See Map No. 1)
"The Approach to a Fortress"

CHAPTER I. SEPTEMBER 13/17

One must consider the Hindenburg Line as the wall of a fortress, plans for the defense of which had long been prepared. From the point of view of the artillery supporting the attack, then, we were in for none too easy a task.

The outline of events during this period is given in pp. 122–125 of Major-General Sir A. A. Montgomery's "Story of the Fourth Army" and in slightly more detail on p. 59 of Major-General T. O. Marden's "Short History of 6th Division." The general trend of these events will only be briefly mentioned in this paper.

On the 13th September, 2nd Brigade, R.F.A., marched out of Corbie, spending the night 13/14 west of the Somme; we had opportunity there to witness determined, though to themselves disastrous, efforts of enemy airmen to destroy the rough bridge at St. Christ-Briost. It was on this night that 6th Division relieved 32nd Division (IX Corps) on the Holnon Wood front.

On the night of 14th September the Brigade was in action in a supporting position south of Villeveque (Position No. 1), ready to fire a long-range defensive barrage. Twenty-fourth Brigade, R.F.A., the other 6th Divisional Artillery unit, was in front and already

[1] We also held our long-promised, but time after time deferred, sports; the luck was against us, for the weather was wet, but refreshments only dry.

engaged in some rather confused infantry operations along the eastern edge of St. Quentin and Holnon Woods; the village of Holnon long remained a disputed point.

The 15th September was spent in reconnoitring the area X 4, R 34 and 35 (Position No. 2), for emplacement in the coming battle of the left group (to consist of 3 brigades), and in reconnaissance for passages through the woods; the enemy artillery made this duty unpleasant, especially within the confines of the wood. The defensive barrage prepared for the night was along the line X 22 b 5/O—X 17 a—X 11 c—X 4 d 3/5.

Instructions No. 1, issued by the Brigade Commander on 16th gave:

(i) Approximate time and date of attack (dawn September 18th).

(ii) First and second objectives and a further objective for patrols.

(iii) Composition of left group—2nd Brigade, R.F.A. (1),[2] 14th Army Horse Artillery Brigade (consisting of four 18-pr. batteries), 161st Brigade, R.F.A.

(iv) Allotment of tasks to sub-groups, complicated by the necessity of advancing part of the group whilst the barrage was in progress.

(v) Map coördinates of tracks being prepared by R.E. through the woods.

(vi) Orders to prepare O.P.'s at X 6 a 4/0 and R 35 d 5/8.

(vii) Allotment of liaison duties, as far as was possible at the moment.

(viii) Orders for dumping ammunition (18-prs. 300 r.p.g. 60% H.E. and 40% shrapnel with 50 r.p.g. smoke; 4.5″ Howitzers 250 r.p.g. fuze 106; echelons full).

(ix) Intentions reference wagon-lines (2) and location of battle headquarters (3), with orders as to synchronization. (4)

(x) And asked for "reconnaissance reports" from all three sub-groups on the areas into which they would have to advance during the battle, exact location of their intended battle headquarters, and information reference clearing the crests.

Special circumstances of the moment included the following:

(a) An operation[3] had to be carried out on 17th to capture

[2] Figures in brackets refer to comments at end of each chapter.

[3] Progress in this preliminary operation was not wholly satisfactory, which caused much trouble on the 18th.

the Line of Departure,[4] which involved action by the French about Savy on our right. (5)

(b) Second Brigade, R.F.A., could not occupy its battle position till night 17/18 because of its defensive responsibilities. Fourteenth A.H.A. Brigade (still some distance away) was not to be allowed to use the roads forward on night of 17/18 because of other traffic—must therefore choose between spending 17th at some half-way halt, or occupying their battle position at once, with risk of giving it away. One hundred and sixty-first Brigade, R.F.A., was already engaged on or near its battle position.

(c) Ammunition supply was presenting difficulties and there was no smoke available.

Instruction No. 2, issued late on 16th, explained briefly 16th Infantry Brigade plan of attack, *viz:*—Capture of first objective by 2/York & Lancaster Regiment (161st Brigade, R.F.A., to find liaison); Capture of second objective by 1/Buffs on right (2nd Brigade, R.F.A.) and 1/K.S.L.I. on left (14th A.H.A. Brigade).

Relying on known intentions, as would later be laid down in the barrage map, the group plan was:

2nd Brigade.

(i) Centre portion of barrage up to protective line second objective.
(ii) Take over 161st Barrage (on protective line first objective) while latter were on the move.
(iii) Advance immediately after reaching the protective line second objective.

14th A.H.A. Brigade.

(i) Left portion of barrage all through.
(ii) Be prepared to advance sections to support further objective of patrols.

161st Brigade, R.F.A.

(i) Right portion of barrage up to first objective.
(ii) Advance.
(iii) Take over 2nd Brigade barrage (on protective line second objective) while latter were on the move.

A formal group operation order was issued with an objective map during the morning of 17th. The barrage map did not come till much later in the day. The O.O.:

(a) Ordered the manning of the permanent O.P.'s, and that each sub-group should find a travelling F.O.O. in addition and a forward intelligence officer. (6)
(b) Announced definite arrangements with R.E. and No. 1 Section D.A.C.

[4] Sometimes called "Jumping-off Place" or, again, "Starting Line."

(c) Announced contemplated participation of Y/6 Trench Mortar Battery.

(d) Allotted valley in X 8 (a) and (c) for "forward wagon-lines"; said that "rear wagon-lines" would not move east of valley lying S.S.E. of Villeveque pending developments; subject to these principles, sub-group commanders could use their discretion as regards moves of wagon-lines. (2)

(e) Headquarters left group X 4 d 1/7, then with 16th I.B.; 2nd Brigade, R.F.A., R 34 c 3/5; 14th A.H.A. Brigade near level crossing in X 3 a; 161st Brigade R.F.A. X 3 a 2/3.

(f) All parties to be in position by midnight 17/18.

Fourteen copies of this O.O. had to be issued.

At a conference 2 P.M. 17th, the communication arrangements were explained.[5]

At the last moment it was necessary to issue special instructions to Y/6 T.M.B. (armed with mobile 6-inch Stokes Mortars). These instructions contemplated advance behind 2/York & Lancaster Regiment to the first objective and engagement of obstacles such as Fresnoy-le-Petit Cemetery between first and second objectives. (7)

Arrangements were now complete for the battle except:

(i) Barrage map with rates of fire not yet arrived.[6]

(ii) Synchronization hour not definitely settled.

(iii) Zero hour not yet announced.

It had been difficult throughout the time, on account of distance, to obtain personal touch with Headquarters 16th Infantry Brigade, whom the left group was to support.

Comments on Chapter I.

(1) As usual when a large group is found, it was necessary to extemporize a staff for 2nd Brigade, R.F.A., sub-group. Such an arrangement cannot well be avoided, but tends to lessen efficiency. The group commander took the brigade signal officer and a spare subaltern as orderly officer. Second Brigade was commanded by its senior major with the brigade orderly officer as adjutant and signal officer. (The adjutant was unfortunately sick at the time.) In this case it was expected that the B.G.C. 16th Infantry Brigade would be much on the move, but everything had to give way to

[5] Lateral communication with the group on our left was to be obtained through 14th A.H.A. Brigade (proved successful). Lateral communication with our right group was not possible except by orderly, an unsatisfactory condition for which we could not be held responsible.

[6] Tasks for the howitzers and rates of fire for whole group only arrived at 19-45 hrs. The meteor was received over the telephone at 00.05 hrs. on 18th from D.A.

the principle that the group commander must be with the infantry commander.

(2) It is always a question as to who should be responsible for moves during a battle of wagon-lines, the Divisional Artillery, the Group, the Brigade, or the Battery?

(3) Both on this occasion and on many others, especially in October, delay in settling the location of infantry brigade headquarters seriously hampered efficient preparation for artillery support, the basis of which is good communications.

(4) By this time it had become the drill in the 6th Division to synchronize twice daily, whatever extra arrangements might be made for special occasions. The original idea was to prevent overhearing by the enemy, but from a general point of view the custom proved very satisfactory.

(5) The French area included two localities known as Round Hill and Manchester Hill (further south), which dominated the glacis east of Holnon Wood and whose possession by the enemy rendered our attack on the Quadrilateral (west of Fayet and north of Selencey) most difficult. These two localities had already become famous during the German March offensive. The French now found them a serious obstacle and only completed their capture on September 26th; it was this which caused the trouble about the Quadrilateral, which in its turn impeded the efforts of the 16th Infantry Brigade against Fresnoy-le-Petit.

(6) Information reaches Infantry Brigade Headquarters slowly in battle, and comes from infantry sources only. The permanent O.P.'s must remain manned, but cannot see all localities. From this date on, as a result of his experiences in March and April, 1918, the Brigade Commander invariably detailed (a) travelling F.O.O.'s, whose duty was to procure artillery support to meet special circumstances, by any means available, also (b) forward intelligence officers, who reported events direct to group headquarters. Their task was difficult and uncertain and success depended almost entirely on the individuality of the officers thus employed. Some reports were quite invaluable. It was lucky we had almost always enough spare subalterns to allow of such extra work not contemplated by the training manuals.

(7) Y/6 T.M.B. section did not arrive in time to take part in the battle. This was no doubt a failure of organization and the Brigade Commander pressed very hard for (and would have been given) permanent affiliation to the 2nd Brigade, R.F.A., of at least a section of mobile trench mortars. During the period September 19/23 he put up the section commander at brigade headquarters, endeavored to train the section, carrying out practice shoots, and providing drivers from 2nd Brigade to take charge of the animals

lent (by order) to Y/6 T.M.B. It was rather surprising that, in spite of the lessons taught us by the Germans in their spring offensive in the use of mobile T.M.'s, we made a poor show with them when our turn came. One supposes it was the transport question; but all requests for suggestions began "No extra transport can be provided," which presented an impasse. On this occasion they would without doubt have proved helpful.

CHAPTER II. SEPTEMBER 18/19

At 04.00 hours on 18th, B.G.C. 16th Infantry Brigade decided to move into St. Quentin Wood. (1) The group commander accompanied him with one officer and two orderlies and ran out a line to group headquarters X 4 d 1/3. It was raining in torrents and the wood was under a fairly heavy fire.

The barrage opened well at 05.20 hours, and, when the pause on the first objective arrived, all seemed well. One hundred and sixty-first Brigade, R.F.A., moved up, battery by battery, at five-minute intervals, without interference, into the area R 36a (Position No. 3), whence it took part in a portion of the next barrage.

The dark and the mist had, however, caused loss of direction and confusion amongst infantry units. It was soon known things had not gone very well for 71st Infantry Brigade on our right. When the second barrage had been completed, information was almost entirely lacking, and it became a question what to do about the advance of 2nd Brigade, R.F.A. This sub-group was of course the nucleus of the left group; the other brigades might be called away at any moment; one had to think of defense against a possible counter-attack. The group commander decided to keep 53rd Battery at R 35 a 2/2 (7) and advance the remainder of 2nd Brigade to area R 35 d and X 5 b (Position No. 3); the advance was carried out by batteries (by sections of 87th Howitzer Battery) between 11 and 11.30 hours.

B.G.C. 16th Infantry Brigade now moved his headquarters to the Quarry X 5 b 9/9, where his three battalion commanders were. (1) Casualties in and round about the quarry had obviously been heavy and continued to occur all day;[7] there was also some gas.

The information obtained from twelve specially detailed officers (three F.O.O.'s, three F.I.O.'s, three "travelling" F.O.O.'s, and three liaison officers) was poor (2), but in time things got clearer. Between 11.55 and 12.25 hours it was possible to issue a provisional protective barrage line, with a considerable amount of information, to all three sub-groups; this barrage line ran S 3 central—M 34 a 5/0—M 28 central—M 22 central; it was thought we held Fresnoy—and probably we did at that time; the

[7] Thirty men were killed at the quarries before noon.

situation at Holnon village was not known. The above line was amended at 13.37 hours to read western point of Fayet—M 28 d 9/5—M 28 b 5/8—M 22 d 1/0—M 22 central (*i.e.*, along Argonne trench). A provisional group operation order issued later confirmed this and ordered 14th A.H.A. Brigade to remain where it was, 161st Brigade, R.F.A., to withdraw two batteries to their old position in X 4, 2nd Brigade, R.F.A., to withdraw one battery 18-prs. and one section 4.5″ Howitzers to original positions; the group commander would remain as group liaison officer (3) with 16th Infantry Brigade, but group headquarters would remain at 4 d 1/3.

Later, the whole 2nd and 161st Brigades, R.F.A., were withdrawn to their original positions, except two forward sections each. (Position No. 4.) The defensive barrage for the night was fixed at 21.45 hours on the protective line to the morning's first objective. It was proving difficult to communicate with the right group in order to fix a junction point. Ammunition had to be obtained and some guns sent to I.O.M.; casualties had been fairly heavy, especially in 14th A.H.A. Brigade, one of whose battery commanders had been killed. Harassing fire was arranged for the night at 21.26 hours.

The group commander had been able during the afternoon to visit most of the batteries in their forward positions, but was not altogether satisfied with the steps taken to attain tactical efficiency, such as "shooting themselves in," local observation, etc. (4)

The R.E. had not been required. No. 1 Section 6 D.A.C. had done excellently. Y/6 T.M.B. had failed because the animals provided could not bring the mortars into action.

Things were settling down and one was thinking of some rest, when at 23.55 hours arrived an order to renew the attack under a barrage at 05.30 hours on 19th. (5)

The infantry knew but vaguely where their men were, so mixed were units; the forward area was under heavy and continuous machine-gun fire and air-bombing—no doubt in accordance with the plans for defense of the Hindenburg Line; it was not feasible for a company commander to light a match to read an order. The group commander's line to group headquarters was smashed at 23.50 hours; there were no maps to issue, and most of the barrage maps had been destroyed by the rain. The original barrage must be modified to meet the right group barrage and had become more than complicated. (6) But what does one go fighting for except to meet such difficulties?

Warning was given at once and an operation order prepared by 01.40 hours, but—what was better—it proved possible to get subgroup commanders 2nd and 161st Brigades, R.F.A., to visit group

commander at infantry brigade headquarters; the former left the Quarry at 03.00 hours and the latter at 04.25 hours. The new divisional order had transferred 14th A.H.A. Brigade to right group. As already said, the real complication lay in applying the new barrage lines to the old barrage-map, for the right group had had their orders many hours earlier (and the right infantry brigade had not made as much progress). In the event, all batteries of 2nd Brigade, R.F.A., and two of 161st carried out the whole barrage, sheets for the later stages being prepared while the earlier ones were being fired; the remainder of 161st batteries joined in after a time. The attack failed[8]—but what could one expect under such circumstances? (6)

On 19th, the group commander, having now only two subgroups, resumed personal command of 2nd Brigade, R.F.A., replacing himself for the time at infantry brigade headquarters by a senior major. During the afternoon instructions were issued for reorganization of the newly constituted group, based on a temporarily defensive policy.

The batteries were now disposed (Position No. 4):

Two sections 161st Brigade, R.F.A.	In R.36 a	Range to Defensive Barrage Line 2800$^{\%}$
Remainder 161st Brigade, R.F.A.	" X 4	" " " " 5000$^{\%}$
21st Battery, 2nd Brigade, R.F.A.	R 34 d 9/6	" " " " 4400$^{\%}$
One Section, 42nd Battery, 2nd Brigade, R.F.A.	R 35 central	" " " " 3500$^{\%}$
Remainder, 42nd Battery, 2nd Brigade, R.F.A.	R 34 a 7/2	" " " " 4800$^{\%}$
(7) 53rd Battery, 2nd Brigade, R.F.A.	R 35 a 2/2	" " " " 3800$^{\%}$
1 Section, 87th How. Battery.	N.W. Corner of Copse R 35 Central	" " " " 3500$^{\%}$
Remainder " " "	R 34 d 5/8	" " " " 4500$^{\%}$

Forward sections to maintain active sniping policy in closest possible liaison with the infantry; remainder (at request of the infantry) to keep as quiet as possible. Observation, reconnaissance, and communications required early reorganization. A dividing line for bombardment was given, 161st on right, 2nd on left. The line being consolidated by the infantry ran junction of Douai trench and American Alley (M 33d 8/6)—old C.T. about M 27 d 1/3—spur

[8] We lost also the ground which had to be evacuated to allow the barrage to be fired at all. At least one company never received its orders to attack.

in M 27 a and c—M 21 c 3/2. Infantry brigade headquarters in Quarry, group headquarters at present R 34 c 3/5.

It had been a hectic time!

The French on our right had been unsuccessful. Our own right (71st) Infantry Brigade had failed against the Quadrilateral, the tanks having proved unable to provide the necessary support. The left (16th Infantry Brigade) had gained its first objective as had the right brigade of the 1st Division on our left, while their left brigade was well forward connecting up with the Australians beyond the second objective. The obstacle had been the continued possession by the enemy of Round and Manchester Hills, which permitted a very fine defense by 280th I.R. of 82nd (German) Reserve Division of an "advanced post," *viz.,* the Quadrilateral. The 6th Divisional Infantry were not to be denied, however, as time would show.

Comments on Chapter II.

(1) These moves of infantry brigade headquarters might have been settled beforehand, but, to the very end, the artillery was expected to bring instant fire to bear wherever wanted without being given a fair chance to lay the necessary communications.

(2) It should be one of our chief training duties to insist on good information in battle from batteries, and on messages correctly timed, dated, etc.

(3) No matter how inconvenient, it was here as everywhere, the first necessity for infantry and artillery commanders to be together. Only in a limited operation, when everything goes according to plan, can the gunner remain at home; it follows his home should be alongside the infantry home; if the infantry are to choose the home, they must choose it in time. As a matter of fact this should, if in any way possible, *be arranged by divisional headquarters* when organizing the battle.

(4) In his article dealing with the field artillery group in retreat, the writer laid great stress on the danger of allowing a certain inertia to overcome the personnel of a battery after changing position. It is the time of all others "to get a move on" and it is essentially the duty of the brigade commander to ensure this.

(5) It was a matter for regret that the *one* (Divisional) orderly, who brought this highly important operation message, came last of all to the only Infantry Brigade (16th) which had not had previous warning that the attack had to be renewed.

(6) Throughout his experience the author has never met a case in which an attack, renewed at such short notice and after initial failure, has succeeded—unless the circumstances have been exceptional. Such an attack has frequently been ordered, but the outcry of those who have to carry it out has generally availed to cancel the

order. A special circumstance is, when an objective has been already gained and is solidly held in certain places, which become pivots for the renewed attack, and provide flanking fire; a case of this kind comes to the author's mind in which a party of Highlanders had established itself on the final objective—and was thought to have gone West (or rather East!); as a result of their determination, on a whole divisional frontage, troops were enabled to occupy the original objective several hours late but (in their second effort) almost unopposed.

(7) We had become so used to attack with a limited objective, in which all could be arranged beforehand, during the early years of the war. The guns, more often than not, remained in their original position until the captured ground had been thoroughly consolidated. In a battle of movement, one may have to turn at any moment from attack to defense, or *vice versa*. It is therefore always sound to dispose a brigade or group of field artillery, to a certain extent, in depth. Fifty-third Battery position in this instance presents a good example of the advantages to be gained thereby—it was suitable for close support or defense. The officer at this time commanding 53rd Battery had a singular gift for choosing positions of tactical value for both offence and defense. Such positions have generally to be kept fairly quiet and are not much used for harassing fire, etc., consequently they require less haulage of ammunition—which may have had something to do with this officer's keenness in the matter.

CHAPTER III. SEPTEMBER 20/24

There was much to do during the interval before the next attack (to complete IX Corps objectives of 18th). Third Infantry Brigade (1st Division) extended its zone towards us, and was for a time covered by our left group—which meant a lot of visiting. There was some fear of counter-attack; advanced sections would have to repeat S.O.S. rocket signals for information of the main positions (because of the woods); a deal of counter-preparation (CPN) and harassing fire. Observation was organized by each sub-group in depth, very careful arrangements being necessary to ensure that certain specified areas could be seen; direct communication between certain O.P.'s and infantry brigade headquarters was established. It required constant attention to achieve the maximum efficiency from the signal section. (1) Positions had to be selected for the next attack, which would allow of emplacement of other (1st Division) batteries in the left group area. Sixteenth Infantry Brigade plan of attack was not decided for some time, because counter-attack from the Hindenburg Line against any initial success needed consideration. It is pleasant to relate that the infantry

seemed particularly well satisfied with our support on 18/19 and had written specially to the divisional commander; we knew what a difficult task was theirs, and there was great keenness in all ranks of the artillery to help them, based on a long-established divisional *esprit de corps* and a lucky lack of unfortunate incidents.

Orders were issued on September 23rd for the attack on 24th.

The barrage instructions were in greater detail and of more complicated nature than usual; in view of likelihood of counter-attack, one 18-pr. battery of each brigade was superimposed over the sub-group front, ready for eventualities; there were quite a number of special "tasks" to be allotted; gas was to be used on certain areas under particular sets of circumstances[9] (wind, early success, etc.). Y/6 T.M.B. followed 14th A.H.A. Brigade to the right group. Sixteenth Infantry Brigade had a first and second objective; two battalions in line with certain special flanking parties; infantry brigade headquarters in the old Quarry and all battalion headquarters in Trout Copse. The new "Loop (wireless) Set" was placed in a selected group O.P. as an alternative method of communication with either 16th Infantry or group headquarters; the various observation, intelligence, and liaison, officers were chosen with particular attention to their individualities; the travelling F.O.O.'s and F.I.O.'s were instructed to report personally in case of a serious hold-up with the most detailed information obtainable. All sorts of arrangements were made for early news of counter-attack, involving rockets, aeroplane signals, etc. The new positions (Position No. 5.)[10] were to be occupied early in the night 23/24, leaving sections in the old positions to carry out certain fire concentrations, which sections must join their batteries after completion of tasks. Batteries were to be ready to move directly the barrage had been fired into already reconnoitred forward areas; the eventual distribution of the left group to be in depth, this object being attained by withdrawal (if necessary) of a portion of 161st Brigade, R.F.A., to a range of 5500 from the final protective barrage line. And so we come to the attack.

The general trend of events on 24th was, briefly, as follows: The French captured Round Hill and a part of Manchester Hill; the 18th Infantry Brigade on our right was, in spite of considerable tank reinforcement, again held up by the Quadrilateral, but 11th Essex on its extreme left got a precarious footing in the southwest corner of it; 16th Infantry Brigade did well, getting its objectives,

[9] One has heard of a horse called "Circumstances," because no one ever had any control over it.

[10] Position No. 5 as marked on map shows not only the positions occupied for the battle of 24th, but includes a number of positions occupied by forward sections on the night 24/25 and used for sniping purposes during the period 25/28.

and securing the whole northern face of the Quadrilateral; 1st Division captured Fresnoy-le-Petit[11] and Gricourt. All was not yet over, however, for 1/Leicestershire Regiment of 71st Infantry Brigade, attached to 18th I.B., made a gallant and successful moonlight attack on Douai Trench at 23.00 hours, from which, during the 25th, the 18th Infantry Brigade completed the capture of the Quadrilateral by as fine a bit of genuine infantry trench-fighting as could be found in the history of the war. It is strange that on both occasions on which the old 6th Division came down to the Somme, it should have had to run its head against a "Quadrilateral"!

As for the group—the barrage, one may hope, was fired according to plan and assisted the infantry. One hundred and sixty-first Brigade, R.F.A., put down a heavy barrage against alleged enemy reinforcements in the course of the morning, and the 1st Divisional Artillery smashed an attempted counter-attack in M 17c; later the 1st D.A. right group requested our assistance in minor operation about Dum Copse. At 16.10 hours, during a personal liaison visit, the group commander was asked to support a local offensive by 3rd Infantry Brigade, to be flanked by 16th I.B.; B.G.C. 16th concurred; it proved possible to give orders verbally to most batteries and the barrage was fired at 17.30 hours. Our howitzers answered a few "zone calls." It was 02.00 hours before a personal visit to right group made it possible to fix the barrage for the night.

The search for information had this time been far more successful—but then the infantry had succeeded, which makes all the difference; two or three first-class reports were received; but unfortunately we lost an officer wounded at an O.P.—perhaps the most experienced of those detailed for intelligence duties. Second Brigade, R.F.A., was lucky not to lose also the services of one of its battery commanders, who was hit about this time, but only very slightly; anyway we lost same for a time when he went on leave. (2)

Comments on Chapter III.

(1) The composition of a Field Artillery Brigade Headquarters,[12] including as it did personnel from two separate corps, tended perhaps towards a certain strife. Also the brigade commander was not, strictly speaking, the brigade staff signaller's C.O. (as he was of the battery signallers). One did at times find a little difficulty in insistence on the best signal discipline plus perfect harmony. No doubt all this has been considered in the new organization, though the millenium is not yet.

[11] A "pocket" of Germans held out in the N.E. corner till night, giving much trouble. During night 24/25 they surrendered to the number of five officers and over one hundred men.

[12] Not peculiar to field artillery.

(2) Not the least of a regimental commander's tasks was to fill *suitably* temporary vacancies in responsible posts. The moment under consideration provides a good example; the brigade staff was in a crisis consequent on sickness and leave; two battery commanders' leave overlapped; one captain was suddenly promoted and another wounded. Leave was so much looked forward to, and so invaluable in its effects, that few C.O.'s would have thought of keeping an officer back whose turn for the shore had come; besides one could reasonably rely on his being alive for the next affray.

"He who three-monthly got his leave,
Did live to share more battle's grief."

CHAPTER IV. SEPTEMBER 25/30

By dawn 25th, left group had been reduced to 2nd Brigade, R.F.A., alone; from 10.33 to 11.15 hours it was engaged in answering an S.O.S. call. News arrived that during the previous night the horses, especially those of 87th Battery ("forward" wagon-lines, up against the railway embankment near Marteville) had suffered severe (46) casualties from air-bombing; it became advisable on "flying nights" to move horses after dusk and to disperse them in the open—extra work and inconvenience; what made things worse was the great distance back of the rear wagon-lines, due to "circumstances over which the group commander had no control." (1)

On 26th dispositions were modified; 21st and 42nd batteries were to cover right and left battalions, respectively—night lines to be arranged in consultation with battalion commanders; 53rd and 87th batteries were retained in the group commander's hands; forward sections to do as much as possible of the necessary shooting; defensively, batteries in case of S.O.S. were to fire on their night-lines till otherwise ordered. Lewis guns were now distributed, two at gun-line, one at forward and one at rear wagon-line. (2)

Very heavy harassing fire was ordered by IX Corps for night 26/27. (3)

On 27th it was notified that 6th Division might have to advance in sympathy with troops on its left, and arrangements for cutting passages through the wire had to be considered; also to push sections forward in close touch with the advancing infantry; these preparations were decentralized on to the shoulders of O's.C. 21st and 42nd batteries. Two German 77-mm. guns had been salved by us the previous night and were put into action.

On 28th the enemy disappeared from our front, probably (we thought, and correctly thought) to a line just east of Fayet, as shown on a just captured map; the infantry brigade on our right established patrols on three sides of Fayet. The rear wagon-lines were at last moved up to about some four miles behind the gun-line.

(1) An operation order was issued for coöperation by 6th Division with the attack further north; it might be necessary for our infantry to advance, but the O.O. contemplated principally a prolonged barrage against enemy reinforcements moving north towards the centre of disturbance—*i.e.*, the intended crossing of the canal at Bellenglise by 46th Division. There were three points of special notice in the O.O., (i) Action to be undertaken by the French, and possibility of action by the enemy, on our right, south; (ii) extension of front by the left group (2nd Brigade, R.F.A.) to cover also 71st Infantry Brigade coming in on the left of 16th Infantry Brigade in relief of 3rd Infantry Brigade; (iii) possibility of advance by 6th Division, which was interpreted at divisional headquarters into an order to 2nd Brigade, R.F.A., to move during night 28/29 to more forward positions whence the morrow's barrage would be fired—though it was perfectly possible to fire it effectively from present positions. To (iii) left group commander put in an objection, not only for the reason given, and that batteries would have to advance at the moment when, and into the area where, enemy harassing was at its height, but also because there was still a certain instability on our immediate right, southern, flank. The objection was overruled; the batteries advanced by sections (Position No. 6), so as to leave at any moment four guns per battery capable of firing on their night lines. A good few casualties occurred, as expected, during this move, which called for able battery-leading. (4) Group headquarters also moved, to Quarry X 5 b 9/9 alongside 16th Infantry Brigade. The brigade signal officer was wounded in an unsuccessful attempt in company with a wireless officer (also wounded) to get the C.W. (wireless) set into position. (5)

The night 28/29 had been an unpleasant one—very dark and wet, everyone on the move, heavy shelling and much gas, and quite a number of casualties; but the morning found us merrily firing our barrage, which lasted several hours (3000 rounds by zero + 512′) and left us in the immediate necessity to bring up more ammunition.[13] News arrived that the French would relieve 6th Division (infantry) during night 29/30 and that the French artillery would come in when the French commander was satisfied. The whole afternoon was spent in getting things ship-shape for them to take over our new area as a "going concern," and in preparing as best we could for our own relief; there was much to do in clearing ammunition, for by this time the countryside, in which we had been fighting since 18th, was littered with small dumps.

During night 29/30 the French Infantry (47th Chasseur Division) duly relieved ours. Our hearts were gladdened with knowledge

[13] Two hundred and fifty rounds per gun.

of 46th Division success at Bellenglise, by a rumor of American success further north, and by news of the advance of II Army in Flanders and of the retirement of the Germans before General Mangin from the Chemin des Dames; I Army had also achieved success in crossing the Canal du Nord on 27th and we knew the Canadians were moving.

At 13.35 hours on 30th arrived the French field artillery group commander (three 75-mm. batteries) who was to take over the whole 6th D.A. front (six 18-pounders and two 4.5″ howitzer batteries). He declined to look at the right group area, but walked with the left group commander round our positions, returning to group headquarters at 15.30 hours.

At 15.48 hours he came into the office and said, "We are going to attack under a creeping barrage at 17.00 hours. I cannot help" and vanished. There was a perfect uproar in the (now French) quarry, but it was "la mauvaise humeur du maréchal"—and that was all to be said about it! Very little talk of objections, evidently. It was an interesting exposition of Gallic psychology and of the discipline insisted upon in their higher ranks.

By the grace of goodness the telephone lines held. At 16.00 hours the (French) infantry commander gave the (British) group commander his objectives and general instructions for the barrage. Between 16.20 and 16.30 hours it was possible to give all batteries of the left group (now fourteen 18-pounders, five howitzers, and two 77 mm's.) the right and left flanks, the first line, the pause, the final protective line, lifts, and zero; and at last[14] at 16.50 hours connection was obtained with the right group, who promised to join in, while the British liaison officer with 47th Chasseur Division notified the right flank of a barrage about to be fired by 1st Division.

At 17.00 hours the barrage commenced. At 17.10 hours the French commander said his infantry had not started; would we begin again at 17.30 hours? Followed another hectic period and at 17.30 hours we reopened. The frontage of the left group barrage was 2000 contracting to about 1200; there were ten 3-minute 100-yard lifts, then a pause of 15 minutes, then another twenty 100-yard lifts to the final protective line. It began "intense" and went through "rapid" to "normal," using nominally about 360 rounds per gun.

[14] This was the third time during the period covered by Part I in which difficulty had been encountered over communication with our neighbors. It was due chiefly to the wood, but it was a warning against a similar contingency in the future. There is no idea of imparting blame to the right group for this failure; the right group had had its hands very full with the Quadrilateral in front of them, and the French to their right.

At 19.30 hours the group had finished its ammunition, reached the final protective line, and the utmost limit of gun-range (6). It was lucky the division had insisted on advance, and the group commander on the dumping of 250 rounds per gun after completion of the barrage of 29th! Whether this "lightning" barrage was satisfactory, or what measure of immediate success the French achieved, has never come to the writer's knowledge; one was doubtful at the time, but the French entered St. Quentin next day without a fight. During the barrage the French batteries had pulled in alongside ours—with their long range, the positions were good enough; and at 19.45, the 2nd Brigade, R.F.A., was allowed to go, spending the night in the wagon-lines and moving to Monchy Lagache next day.

Everyone knows Bairnsfather's picture of the battalion officers after completion of relief for the Nth time; but on this occasion there was some extra joy about. Good news had come from Palestine, Salonika, and the Argonnes, as well as from our immediate neighborhood; DOUBT had vanished. We had been engaged in four actions without any known loss of credit, and with, on the whole, light casualties (except in horses).

The period had been chiefly remarkable for intense activity at night. Every fold in the ground had received enemy attention; it was what one would expect when approaching a fortress—and indeed part of the Hindenburg Line defense scheme was published, which showed the areas needing the special attention of the German artillery and airmen, should the Allies ever attack the fortress. It is perfectly true that it does not matter where you meet the enemy, so long as you do meet him and beat him; but the Hindenburg Line possessed a very material strength besides great moral value as an outer wall of the Fatherland. Many British divisions had learnt that!

Comments on Chapter IV.

(1) The distance of the rear wagon-lines from the front exceeded that of Ypres days, when the guns were on the Ypres-Dickelbusch Line and the wagon-lines some miles west of Popperinghe.

(2) The Lewis-guns provided for the artillery were considered a part of the divisional anti-aircraft defense and were echeloned accordingly.

(3) It was a 2nd Brigade custom to get foolscap-sized sketch maps hektographed, and to illustrate all orders for harassing fire, etc. It gave a good deal of work in the brigade office, but the result was undoubtedly worth it, directly fighting came to a stand-still.

(4) The insistence of divisional headquarters on the advance of the left group batteries was justified by the unexpected turn of events on 30th, as well as by the possibilities of 29th; but there were

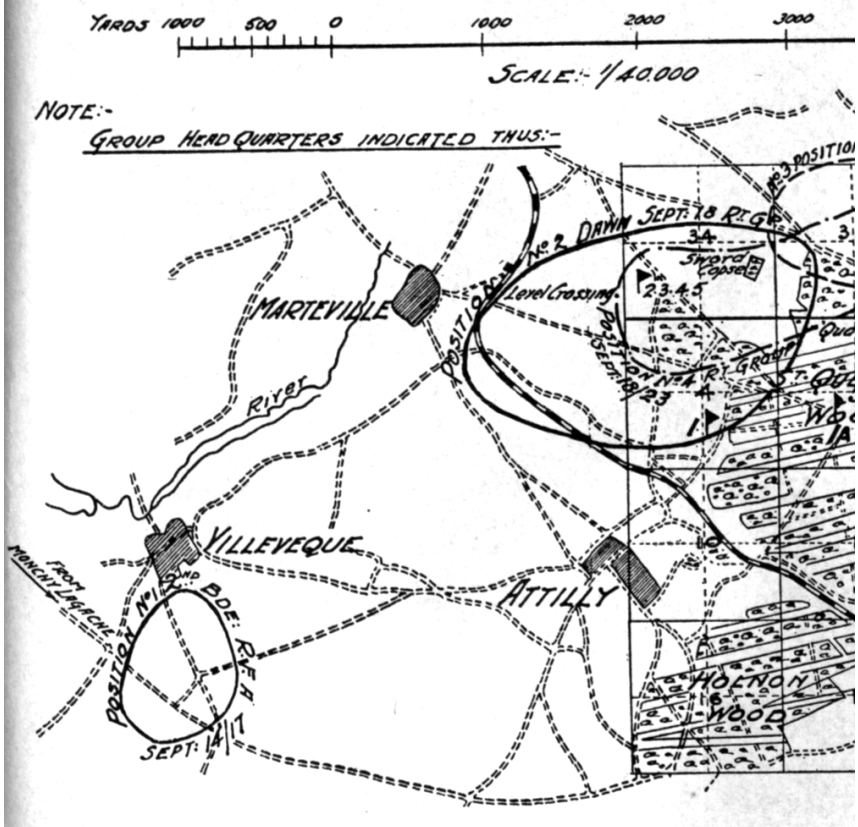
serious arguments against it, one of which (losses to the batteries) was also justified in the event. The incident illustrates fairly well the principle that, in the offensive, supporting artillery must provide for the future by getting as close up as safety permits.

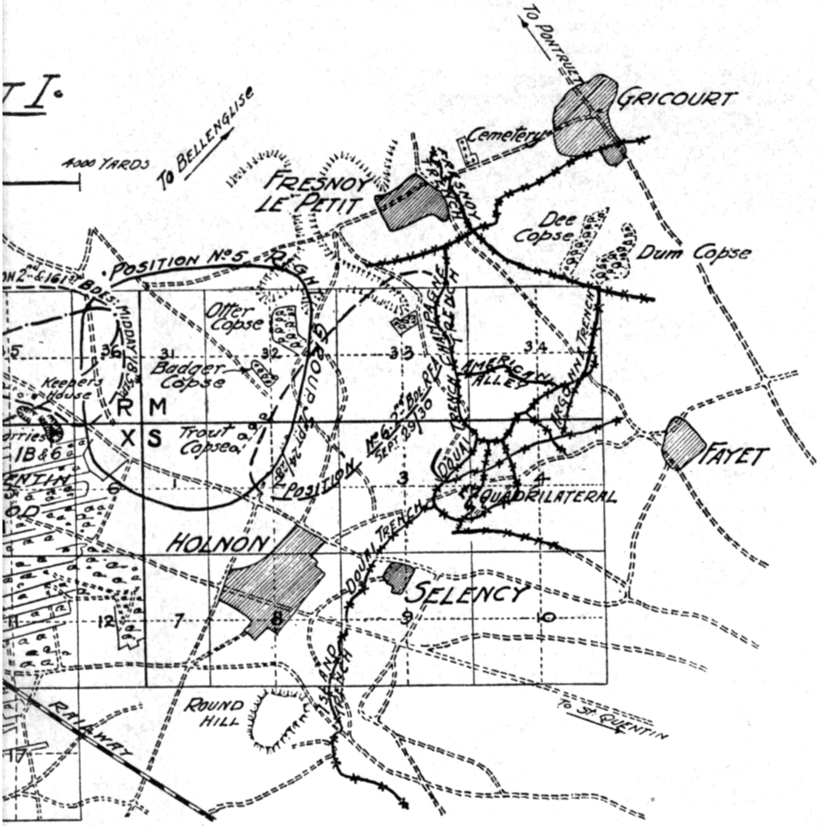
(5) Complete decentralization is not feasible where the battle is on a very wide front and each part dependent on its neighbor. Therefore one must control artillery. To control, one must have good communications. Communications were throughout the period covered by Part I a source of great difficulty. This was no doubt due in part to the system of command organization (*i.e.*, the splitting up of 2nd Brigade, R.F.A. staff, into sub-group headquarters, group headquarters, and infantry brigade liaison, on 18th September). Another, technical, difficulty was the interference of the high trees of St. Quentin Wood with wireless arrangements. But one certainly did at times think longingly after the old "bury" of trench-warfare days; one realized the need for that improvement in communications mentioned in the Preface (Lieutenant-Colonel Broad's article), especially in the efficient practice of wireless telegraphy.

(6) The simultaneous arrival at the end of ammunition, limit of range, and final protective line, was due to circumstances, and probably unique.

(*To be continued*.)

MAP No. 1 TO ILLUSTRATE PART




4000 YARDS
TO BELLENGLISE
TO PONTRUET
GRICOURT
Cemetery
FRESNOY LE PETIT
Dee Copse
Dum Copse
POSITION No 5
Otter Copse
Badger Copse
Keepers House
Trout Copse
R M
X S
AMERICAN ALLEY
FAYET
QUADRILATERAL
DOUAI TRENCH
HOLNON
SELENCY
ROUND HILL
RAILWAY
TO ST. QUENTIN

HIGH BURST RANGING

BY MAJOR H. E. MINER, FIELD ARTILLERY, U.S. ARMY.

SEVERAL methods of High Burst Ranging which give more or less accurate results were developed and used during the recent war. All these methods have faults and drawbacks. Some are rather complicated and require highly trained personnel and especially designed instruments. Others are simple enough, but do not give sufficiently accurate results.

It is desirable that an accurate and yet simple method be devised. The Field Artillery Board is working on this problem. If other officers of the service would study the matter some of them could probably give the Board some valuable suggestions.

In order that officers who may be interested can get a comprehensive idea of the subject, the following information is given:

High Burst Ranging is a method of adjusting the fire of a battery when the target can not be seen from any terrestrial observation station and when airplanes or balloons are not available. Projectiles are fired so as to give bursts in the air which are visible from terrestrial observation stations. The location of these bursts with respect to an adjusting point, located near the expected point of bursts, is carefully measured and corrections to the firing data are made so as to cause the mean trajectory to pass through the target.

The following points should be noted:

a. The observation station, the guns, and the target must be accurately located in three coördinates. Having accurate maps will greatly facilitate these operations; but in this country no sufficiently accurate maps are available except for limited areas. In the general case then, accurate, but rapid, topographical operations will have to be made.

b. At each observation station there must be one or more observation instruments for the purpose of locating high air bursts. These instruments should be of such design that they can be accurately oriented, and made absolutely level so that vertical and horizontal angles can be precisely measured. They must have a large field of view and in the focal plane should be a reticule etched with lines so that the observer can measure angular deviation from some established reference point. The battery commander's telescope with which the Artillery is at present equipped is not sufficiently accurate nor is the reticule well designed for precise High Burst Ranging, though it can be used for rough work.

c. The ammunition must be such that some visible point or path will be produced in the air. It can be either shrapnel or shell equipped with time fuze; or, perhaps with tracers. If the ammunition used during fire for adjustment is not the same as that which is to be used for the subsequent fire for effect, then there must be some method for transferring the corrections found for the former fire to the latter.

d. Some scheme must be devised for computing the corrections to the firing data for the target from the measurements made by the observer on the high bursts. It should be noted that there will be errors in height of burst, errors in range, and errors in direction with respect to some adjusting point; which, in the general case, is neither at the range nor in the direction of the target. The burst centre must be located with respect to the adjusting point and the fire shifted so that the mean trajectory will pass through the target.

Below is given a short outline of the various methods used during the recent war with references to articles and pamphlets which give more detailed descriptions of them.

a. In the False Angle of Site Method an adjusting point is selected directly above the target and a sufficient number of shots are fired to locate the mean centre of bursts. The firing data is then corrected for direction, range, site, and complementary site to shift the fire from the mean centre of burst to the target. It can be seen that if enough shots are fired the accidental error in the height of burst will be eliminated; but any systematic error in the fuze will be connected as an error in site and range so that the final data for firing on the target will be incorrect. This method is the most simple of any yet devised. As used during the war, the adjusting point was taken directly above the target, but there is no good reason why a point at a slightly different range and direction could not be used. However, the method as so far developed is not particularly accurate. This fault probably arises from the type of observation instrument used, and from the lack of any method of properly eliminating systematic errors in the fuzes.

References: Article in *Journal of United States Artillery* (C. A. C.), June, 1919. Article in the pamphlet, "Flash, Sound and High Burst Ranging," published by the Coast Artillery School, September 20, 1920.

b. In the Approximate Trajectory Method an adjusting point is selected on the normal trajectory passing through the target, and the fuzes are set so as to bring bursts in the vicinity of this point. The observers measure the horizontal and vertical deviation of the bursts and the computers locate the mean centre of burst as in the first method. Through this point an approximate trajectory is drawn and prolonged until it pierces the plane of the target, thus locating a point called the theoretical centre of impact. The distance of this point from the target is measured and the firing data corrected accordingly.

This method corrects for any errors in the burning of the fuze; but errors do arise from inaccuracies in the observations and from inaccuracies in the methods of drawing the approximate trajectories. Another disadvantage is that trajectory charts must be computed and kept on hand for every gun and type of ammunition that is to be used.

Reference: The same as for the false angle of site method.

c. In the Tangent Reticule Method, the adjusting point is located on the normal trajectory passing through the target. The observers are equipped with instruments which have a reticule which can be rotated, the amount of rotation being regulated by a graduated arc. On the reticule are drawn parallel lines; and, in practice, the reticule is rotated through an angle, previously computed, so that one of the parallel lines will appear as the tangent to the trajectory at the adjusting point. The bursts will be seen by the observers on or near one of the parallel lines in the reticule. The lines have the effect of projecting the bursts along the tangents into a plane through the gun and adjusting point called the reference plane. By means of the readings sent in by the observers the computing section is able to locate an imaginary point of impact in the reference plane corresponding to each burst; and from several bursts to locate the mean point of impact. By means of suitable charts and tables the firing data is corrected so as to transfer the fire from the mean centre of impact to the actual target.

The tangent reticule methods requires special instruments, and several charts or tables for each type of gun and ammunition to be used. The errors in the fuze are largely eliminated since the readings on the burst are taken at the point where the tangent line through each burst pierces the reference plane. However, several errors creep

in through the calculation methods used. This method has frequently given surprisingly good results; but it is not sufficiently accurate to be adopted for general use.

Reference: Article in the *Journal of the United States Artillery* (C. A. C.), August, 1919.

Article in the pamphlet, "Flash, Sound, and High Ranging," published by the Coast Artillery School, September 20, 1920.

Pamphlet entitled, "Provisional Instruction on High Burst Ranging," published by the Coast Artillery School, September 20, 1920.

d. The Telemetric Method of High Burst Ranging is said to be the most accurate method yet devised. It is, however, the most complicated and requires very high skill on the part of the observers, computers, and plotters. At each observation station two very elaborate observing instruments, one for measuring horizontal and one for measuring vertical deviations of the point of burst. These instruments can be levelled and oriented very precisely and are capable of measuring the deviations of the bursts rather accurately. The methods used in locating the adjusting point and the mean point of burst with respect to the target require considerable computation and the use of special abaques or charts for each type of gun and ammunition. This method resembles somewhat the Approximate Trajectory methods and eliminates errors in the fuze in much the same way.

The telemetric method is too complicated; it requires too elaborate equipment and too much skill on the part of the personnel.

References: Article in the *Journal of the United States Artillery* (C. A. C.), November, 1919.

Article in the pamphlet, "Flash, Sound, and High Burst Ranging," published by Coast Artillery School, September 20, 1920.

Article in "Professional Memoirs," published by U. S. Corps of Engineers, September-October, 1919.

Pamphlet, "Manual of Chief of Base High Burst Ranging Section, translated from the French, General Headquarters. (A. E. F., October 1, 1918.)

The foregoing gives an outline of the subject of High Burst Ranging with sufficient references to reading matter, so that those who are interested can study the subject in detail. Specifically the problems to be solved are as follows:

a. What is the best method or methods of locating the observation stations, guns, and targets quickly and accurately? What instruments are needed? Who should do the work?

b. What is the best type of instrument for the observation stations?

c. Should the ammunition for adjustment be shell with time fuze, shell with tracer, or shrapnel with time fuze? If the ammunition used during adjustment does not have the same ballistic characteristics as that used during fire for effect, what is the best method of transferring the corrections for the firing data as found during adjustment to the data for firing for effect?

d. How should the adjusting point be chosen—above target, on normal trajectory through target or elsewhere—and how should its position be calculated? How should errors in the time of burning of the fuze be eliminated? How should the correction to the firing data be calculated from the measurements made by the observers on the bursts?

It is hoped that some officers will make suggestions on one or more of the above problems.

REMARKS ON THE ORGANIZATION OF THE GERMAN ARTILLERY

TRANSLATED FROM THE REVUE, D'ARTILLERIE, APRIL, 1921, BY CAPTAIN C. G. BENHAM, 5TH FIELD ARTILLERY

GENERAL

THE artillery of the new German army (Reichsheer) consists of the artillery for its seven infantry and three cavalry divisions.

It comprises: 204 guns, 77-mm. calibre
84 howitzers, 105-mm. calibre.

The officers, at any rate the younger ones, will come from the Artillery School (Artillerieschule).

All of the artillery is under the control of the Inspector of Artillery, who is a member of the staff of the Minister of War.

SECTION I

THE ARTILLERY OF THE INFANTRY DIVISIONS

The artillery of an infantry division comprises the divisional artillery headquarters and one regiment of three battalions.

Divisional Artillery Headquarters

The divisional artillery is commanded by a general,[1] with the title of "Artillerie-Fuhrer der Division," who is assisted by the staff and detail listed below:

- 2 field officers (1 general staff officer, 1 artillery officer)
- 6 noncommissioned officers (including 1 draftsman and 3 communication specialists)
- 24 privates, including 17 radio specialists
- 13 horses
- 3 wagons (not drawn in time of peace)

The Artillery Regiment

The regiment comprises a regimental headquarters, three battalions of three batteries of four pieces each, and a depot battery.

Regimental Headquarters

- 1 colonel, commanding the regiment
- 1 field officer, second in command
- 3 captains, including 1 supply officer and 1 intelligence officer
- 1 captain, or lieutenant, adjutant
- 1 veterinarian, major
- 2 employees "Beamte"
- 18 noncommissioned officers, including 2 for communications
- 30 privates, including 7 for communications
- 49 horses

[1] Eventually by a colonel.

7 wagons, including 1 radio wagon, 1 telephone wagon, and 1 reel cart.

The composition of a battalion headquarters is as follows:

1 field officer, commanding the battalion
1 field officer, second in command
1 captain, intelligence officer
2 lieutenants, one of whom is the battalion communications officer
1 medical officer
1 veterinarian
5 employees
5 noncommissioned officers, including 3 for communications
25 privates, including 12 for communications
20 horses
8 wagons, including 1 observing tower wagon, 1 radio wagon, 1 telephone wagon, and 1 reel cart

One can, from this, see the care with which the service of communications has been organized, in the battalion, as well as in the regiment.

Each of the mounted battalions is composed of three batteries, armed, normally, as follows:[2]

The first battery is armed with four light field guns, F. K. 16.[3]

The second battery is armed with four light howitzers, F. H. 16.

The third battery is specially armed, as follows:

The third battery of the first battalion (the third battery of the regiment) is armed with four infantry cannon, model I. G. 18, and is called the "divisional infantry battery." This battery belongs to the artillery but is controlled tactically by the infantry.

The third battery of the second battalion (6th battery of the regiment) is armed with four cannon F. K. 16, and is called "Beobachtungsbatterie."[4] Besides serving its pieces, it has the following additional functions for the entire regiment:

Flash ranging
Sound ranging
Topographical service
Meteorological service[5]

For this purpose it recruits its personnel in a special way. It has also certain additional vehicles listed further on.

[2] See exceptions under Remark I.

[3] See further on the characteristics of artillery matériel.

[4] Observation battery.

[5] This battery is to function like the old Artillerie Messtrupp with the meteorological service added.

The third battery of the third battalion (the 9th battery of the regiment) is armed with four "auto-cannon" of 77 mm., old anti-aircraft pieces. Its personnel is taken from old antiaircraft organizations.

In other words, in spite of the avowed purpose of this battery—to fire on rapidly moving targets, especially tanks, this battery constitutes the nucleus of anti-aircraft artillery of the mobilized division.

The effective strength of the several kinds of batteries is given in the following table:[6]

	Mounted Battery	Mountain Battery	Auto-Cannon Battery	Remarks
Captains	1	1	1	(a) 3 for communications (b) 12 for communications (c) 56 pack animals (d) on trucks with amm. (e) 4 not harnessed (f) I observing tower 1 radio, 1 telephone, 1 reel cart, 1 pioneer (g) Nearly all have two horses, comprise the same vehicles except observing tower wagon (h) Including 5 equipped same as in (g) and 5 motor vehicles of which 2 are tractors with towing gear and 2 heavy trucks.
Lieutenants	4	4	4	
Noncom. Officers (a)	22	22	22	
Privates (b)	104	104	104	
Horses	93	110(c)	6	
Cannon	4	4	4(d)	
Caissons	8(e)	4	4	
Ammunition Wagon	8	8	8	
Wagons	15(f)	25(g)	10(h)	

The observation battery receives in addition to its normal quota of vehicles:

5 service wagons, 6 horse
2 reel carts, 2 horse
1 light truck
1 motorcycle.

Its specialized personnel, chosen from the whole regiment at the time the battery is formed, comprises, in addition to five battery officers: 15 noncommissioned officers and fifty privates. These numbers count in the effective strength of the battery, so it seems that this battery receives only an excess of vehicles and to have its personnel drawn from the élite. The officers, the noncommissioned officers, and a goodly portion of the privates are to have extended knowledge in mathematics, physics, and design.

[6] It includes mountain batteries, of which, as will be seen further on, there exist two examples in the 7th Division.

Some special courses have been provided to train these batteries at Juterbog, and the normal functioning of these observation batteries is provided for in the school of fire for 1921.

In addition to the headquarters and the three batteries, each battalion is provided with matériel to constitute a light ammunition train. This train is of a mixed type, for one battery F. K. 16, one battery F. K. 96/16, and one battery F. H. 16. Its vehicles comprise:

6 caissons, model 96 N/A, of 4 horse
3 caissons, model 98, observing ladders, 4 horse
27 field wagons, model 95, 2 horse
1 rolling kitchen, small, 2 horse.

Harness and stable equipage are provided for ninety-two draft horses, says the table; however, in fact, there is an excess of nine sets for the four-horse vehicles, twenty-eight for the two-horse vehicles, and seven single sets of collar harness.

Besides the three battalions, each regiment has a "Erganzungs-batterie" (supplementary battery), as its name implies, a sort of depot battery where recruits are sent for training until needed to fill the batteries of the regiment. This battery has no cannon, at least none fit to fire, and comprises:

1 captain
3 lieutenants
16 noncommissioned officers
159 privates, including 99 recruits
52 horses, including 50 saddle horses
19 vehicles of which only one is for use in garrison.

Among the other eighteen vehicles, we note:

8 caissons
1 observing wagon
1 radio wagon
1 telephone wagon
1 reel cart.

REMARK I.—As yet the theoretical organization indicated above had not been completed in all regiments on January 1, 1921, the date of the official constitution of the army of 100,000 men.

(a) In the seventh regiment belonging to the Bavarian Division, batteries four and six were armed with seventy-seven mountain guns instead of field guns.

(b) In several regiments the special batteries do not carry the numbers indicated above. In the third regiment the infantry battery

is the seventh battery instead of the third. In the seventh regiment the observation battery is number eight.

(c) A certain number of infantry batteries are not armed with the I. G. 18, which does not exist in sufficient numbers, but with the F. K. 96/16.

This armament is only a provisional one, yet if Germany conformed to the treaty, she cannot make new I. G. 18 guns, except to replace condemned field guns. The allowance of I. G. 18 guns can therefore be acquired only slowly.

(d) In the third regiment (Berlin Division) the third battery is furnished with heavy draft horses. This battery has certainly a special mission obviously contrary to the treaty. It appears probable that this battery is destined to haul, in case of need, heavy matériel. The neighboring arsenal of Spandau, the Artillerieschule, the fields for firing at Juterbog and Kummersdorf which have always been used for experiments, render legitimate this hypothesis.

REMARK II.—The abundance of officers and noncommissioned officers in the headquarters and in the batteries appear to permit them to double and even triple these units in case of mobilization.

The presence on the staff of the divisional artillery command of two field officers, at regimental headquarters of two field officers and three captains, at battalion headquarters of a second field officer and a captain, at each battery of four regular lieutenants, appears systematic. It is clear that the necessary complement of officers (to complete units newly formed) will be very easily found among officers and noncommissioned officers who served during the war.

As for the training units, they are not very strongly organized, but among the men are found a large number of former noncommissioned officers, enlisted as privates for twelve years in the army of 100,000 men.

Lastly, one must not forget the existence, many times mentioned, about the excess of clothing and harness; there is also equally for us to consider that there is a plethory of service vehicles, optical instruments and accessories of every sort. For example, each mounted battery has ten observing telescopes.

In support of this hypothesis comes first the numerous tables of organization of divisions at war strength which are established for manœuvres and war games; one can see in these documents not only a regiment of artillery, but in addition units of heavy artillery and anti-aircraft artillery.

The only difficulty remaining, at least after the allied commissions of control are removed, will be in the restriction as to the number of cannon.

SECTION II

ARTILLERY OF THE CAVALRY DIVISION

Each cavalry division has a horse-drawn battalion of three batteries of four cannon of 77's, probably model F. K. 96 n/a or perhaps 96/16. The battalion staff is similar to that of a mounted battalion in the infantry division except there are:

3 veterinarians in place of 1
7 noncommissioned officers in place of 5
24 privates in place of 25
36 horses in place of 20.

Besides this, only two noncommissioned officers and eight privates are for the communications, but there are three noncommissioned officers mounted as agents which have no equivalents in the mounted battalion, as to the batteries, they have:

1 captain
3 lieutenants
21 noncommissioned officers (2 for communications)
102 privates (8 for communications and 8 mounted for orderlies)
4 cannon
8 caissons, of which four are not harnessed
15 vehicles including 1 observing tower wagon, 1 radio wagon, 1 reel cart, 1 pioneer wagon.

The three-horse battalions are attached, for administration only, to the field artillery regiments, as follows: That of the 3rd Cavalry Division to the 6th Regiment where it forms a 4th Battalion. That of the 1st, and 2nd Cavalry Divisions to the Third Regiment of Field Artillery where they are the 4th, and 5th Battalions.

SECTION III

MATÉRIEL

From the preceding discussion it follows that the 77-mm. cannon in service in the German Army of 100,000 men are: The Field Cannon model 1916 (F. K. 16) with which the mounted batteries are armed using separate-loading ammunition. The infantry cannon, Model 1918 I. G. 18, in part completed and tested towards the end of the war but which has not yet been employed in battle; this gun constitutes the theoretical arm for the infantry batteries, but while it exists only in small quantities it does not appear to give complete satisfaction. This cannon fires fixed ammunition, or reduced charge. The field cannon, model F. K. 96 N/A and 96/16 (F. K. 96/16), which appears to be made from the tube of the

cannon F. K. 96 N/A placed on a howitzer model of carriage (model 1916 howitzer). It arms provisionally the infantry batteries which have not yet received their cannon I. G. 18. It perhaps arms also the horse batteries, where they do not still have the old model cannon 96 N/A.

The mountain gun 77 (Geb. K15) exists in three batteries of the 7th Division; it is impossible to tell exactly from information now on hand whether they have the Krupp model or the Erhardt model, both of which were used during the war but only in small numbers. Lastly, the 77 auto-cannon (77 K. G.) which is an old anti-aircraft gun. Certain documents show the adoption of an automatic gun, model 1919, improving that used during the war; it is impossible to say if all batteries have received them or if, following the stopping of the manufacturing of cannon by the allied commission of control, a certain number of organizations have had to content themselves with matériel left from the war.

The principal characteristics of these various models are recapitulated in the following table:

Matériel	Calibre mm.	Length in Calibre	WEIGHT		Maximum Range Metres
			In March Order Kg.	In Battery Kg.	
F. K. 16	77	35	2,260	1,400	10,700
F. K. 96 N/A	77	27	1,910	900	8,400
F. K. 96/16	77	27	2,100	1,100	8,400
I. G. 18	77	23	1,170	650	5,000
Geb. K15	77	17 or 20	1,170	?	7,000(a)
Kr. G	77	27	8 tons (a)		8,000(a)
I. F. H. 16	105	22	2,305	1,380	9,700
(a) Approximate					

Of course nothing is mentioned here except the matériel officially authorized by the treaty of peace. One is right to suppose that the Germans have some 37-mm. anti-tank guns, of which the characteristics are not known, and some examples of heavy artillery used during the war. Germany is allowed a definite number of these heavy guns to arm the fortresses allowed by the treaty, the number of which will successively diminish under the action of the commission of control.

Besides this, it is interesting to note:

1. That, contrary to their practice during the war, each piece is provided with two caissons (of which one is not used in time of peace).

2. That the number of special and service wagons is considerable. Most of them are field wagons, model 95, with two horses, arranged for use as radio wagons, pioneer wagons, not in use during the war.

PORTABLE ARMS

Artillerymen of every grade receive a carbine, model 98, a sabre bayonet model 84/98, and a hand grenade.

Officers, noncommissioned officers, guides, cyclists, etc., receive, in addition, a pistol, model 1908. Every vehicle, besides this, is equipped with a long special pistol (large pistol), having a drum type magazine containing 32 cartridges. Lastly, each battery receives, as during the war, two machine guns model 1908, or, more often, 08/18.

CONCLUSION

While conforming to the letter of the treaty in the organization of the army of 100,000 men, Germany indubitably has the means of furnishing artillery for the large units which she will raise. Independently of the anti-aircraft and of sound ranging units, of which the nucleus exists in the divisional artillery, the heavy artillery can, in fact, find the necessary elements for its re-constitution among the present units. A goodly part of the officers and soldiers fought the war with the foot artillery and there is also a large number of them in the trains. Clothing, horses, wagons, and special instruments exist in abundance; the only real difficulty to be overcome will be the cannon.

Until the commissions of the entente complete the destruction of matériel, the danger will subsist. After a period of some little risk it is possible that clandestine fabrication will be, if not discovered, at least prepared as soon as inter-allied control will have ceased. To say otherwise, it is necessary to overlook the zeal of the German artillerymen to revise their regulations which include those for high-powered heavy artillery and to execute manœuvres and firing which has for its basis war situations; one must also not forget that the German technical authorities have prescribed, "that for the future, the heavy guns from the fortresses will be made a subject of instruction in all camps in order that every artilleryman may become familiar with their handling."

FORMS OF ARTILLERY FIRE SUPPORT

[EDITOR'S NOTE.—*The following extract, prepared by the Artillery Subsection (Lieutenant-Colonel C. Deems, Jr., Lieutenant-Colonel R. S. Pratt, and Major N. B. Behkopf, Field Artillery, General Staff, U. S. Army) from Instruction Circular No. 2, The General Service Schools, Fort Leavenworth, Kansas, 1922–1923, lays down a concrete doctrine to be followed in the use of barrages and concentrations*.]

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Section VII
FORMS OF ARTILLERY FIRE SUPPORT

22. ARTILERY SUPPORT.—The question frequently arises as to whether the artillery can give its best support by a general reliance on the barrage or on some other form of fire. The principles and doctrines which govern the action of artillery in defensive and offensive situations are enumerated below.

PART A

THE DEFENSE

23. DEPLOYED DEFENSE.—*a*. In deployed defense, the kind of fire to be laid depends on the tactical scheme of defense. The artillery defense depends primarily on:

(1) Observed fire on targets of opportunity, used when possible to the exclusion of organized fire, and,

(2) Organized fire, prepared for emergencies, and when observation is impracticable. Whenever possible, data of this kind of fire is corrected by registration.

b. When original atmospheric data cannot be obtained, standing barrages for close defense cannot be accurately laid, and are dangerous. Due to the unsettled conditions during the first hours of the occupation of a line or position, patrols or troops in front, etc., adjustment close to the lines to be defended becomes impossible. Due to lack of precise knowledge of the enemy's dispositions before his attack is launched, counter-preparation is limited to special designated objectives.

c. In the counter-attack, the principles of offensive fire apply.

24. POSITION DEFENSE.—*a*. In position defense, there is time to prepare the artillery defense, which depends primarily upon:

(1) The use of observed fire to the exclusion of organized fire when conditions so permit. Prior registration is obtained when practicable.

(2) Organized fire when observation is impossible.

b. The artillery promptly attacks by observed fire all enemy targets, utilizing quick methods with which the trained artilleryman is familiar. After making suitable arrangements for observation, the artillery prepares organized fire (primarily counter-preparation) for use when observation fails or the situation demands.

c. The next fires arranged are organized fires asked for by the infantry, which may be in the form of standing barrages or concentrations. Standing barrages are generally prepared to be laid in front of the covering forces, and, later on, in front of the battle position. Concentrations may be laid in these places also, or, frequently in between, on any lines of entry between centres of resistance, or other organized places of local defense.

25. ZONE DEFENSE.—*a*. The principles which apply to the position defense apply in general to the zone defense, with the modifications noted below. Observed fire, based on prior registration, is always used when possible. The following relate to the organized defensive fires:

(1) *Shallow Zone*.

(a) Concentrations and standing barrages in front of the security, observation, and delaying systems, and in front of the battle position.

(b) Concentrations between the security, observation, and delaying systems, and the battle position on probable hostile lines of penetration.

(2) *Average Zone*.

(a) Concentrations and standing barrages in front of the outpost position, the delaying position, and the battle position.

(b) Concentrations, between the outpost and delaying positions, and between the delaying and battle positions, all on probable hostile lines of penetration.

(3) *Deep Zone*.

(a) Concentrations and standing barrages in front of each of the first, second, and third positions.

(b) Concentrations between the first and second positions, and between the second and third positions on probable hostile lines of penetration.

b. In the zone defense, a most careful system of counter-preparation is developed, based on information obtained from maps, aerial photographs, location of enemy works, and known and probable dispositions of the enemy.

c. In the defense of positions organized in great depth, it is necessary for the artillery to occupy successive positions. In order that effective fire may be delivered promptly from these positions, it is necessary that basic firing data be computed for each position prior to occupation.

d. Until the fourth position (unorganized) of a deep zone becomes organized, it is useless to prepare organized fires in front of it, but reconnaissance of the terrain should be made by the artillery in order to determine artillery positions and kinds of fire that may be executed from them.

26. PRINCIPLES.—*a*.In all situations, the most effective and most desirable method for the use of artillery is direct attack by heavy concentrations of observed fire on the visible or definitely located enemy.

b. Where observed fire cannot be obtained, use is made of organized fire. On the defensive, this includes concentrations and standing barrages.

c. Counter-preparation is most valuable and should be fired whenever due warning of an attack by the enemy is obtained.

d. The artillery defense of a line or position is by organized fire in the form of concentrations or standing barrages, to meet sudden surprises or unfavorable conditions of visibility which may render observed fire impossible.

e. In cases where lack of visibility prevents observed fire, the advance of the enemy along lines of penetration between centres of resistance, strong points, and similar places, is opposed by concentrations of organized fire laid on suitable places.

f. Since an attack is ordinarily made in depth, concentrations, searching a considerable depth, as an organized fire, is more often

preferable. The advantage lies in the fact that a succession of ranges gives certainty of securing some effect, by producing a series of barriers through which the enemy must pass, whereas, the standing barrage forms but a single barrier, which is quickly traversed, frequently with very small casualties. The effect of successive concentrations on the morale of the attacker is greater than that of a standing barrage, because the enemy is in doubt as to where successive volleys will fall, whereas the position of a standing barrage is plainly defined, and may be crossed in a single swift rush. It is not sufficient that the attacking front line only be held under fire. To gain success, supporting troops must follow, hence an attack on them by artillery assists in weakening the driving force of the enemy.

g. The standing barrage, when used, is utilized by laying an intense fire in strips on or near places (such as stream crossings and lines of wire) which form natural or artificial obstacles and which, in themselves, tend to retard or hold the attacking troops on the line on which the barrage is falling. To prevent dispersion, it should be laid only on the most sensitive fronts.

h. Thin barrages are practically useless. They cause few casualties, waste ammunition, and may give new infantry a feeling of false security, which may result in disaster.

i. If for psychological reasons, the infantry desires a standing barrage laid in its front, the artillery should make it dense while it lasts, thereby not only aiding the infantry morale, but weakening that of the enemy at the same time. The great amount of ammunition consumed by frequent responses to unnecessary calls for barrages and other organized fire must be considered by all concerned.

j. Even when conditions indicate an opportunity for reliance on observed fire, organized fire must be prepared for use when observed fire is not practicable.

k. Secrecy is preserved as to the positions of the batteries, as well as the places upon which they are to lay organized fire. On this account, occasions for registration may be greatly limited.

27. DOCTRINE.—From the above principles may be deduced the following doctrine:

a. Observed fire is used whenever possible.

b. Organized fires are used when observed fire cannot be obtained, and must be prepared early for emergencies.

c. Counter-preparation and concentrations form the bulk of organized defensive fires.

d. Standing barrages, although of limited application, are prepared to meet special situations.

PART B

THE OFFENSE

28. ROLLING BARRAGE.—*a. Advantages Claimed*.—The advantages claimed for a rolling barrage are as follows:

Pins the enemy to the ground all along the line, and protects the troops from short-range hostile fire and local counter-attacks immediately prior to an infantry assault.

Stimulates and maintains morale of troops which follow it.

Covers those targets which are initially unknown and which will not be discovered until the attack is launched.

Marks a definite line for the infantry to follow.

Execution is mechanical and does not require as high a degree of training on the part of the artillery personnel as do other forms of artillery fire.

Gives the infantry more intimate fire support.

No observation necessary.

Screens the advance of the infantry by smoke and dust.

Adverse effect on morale of hostile troops, especially when inexperienced.

b. Disadvantages Claimed.—The disadvantages claimed for a rolling barrage are as follows:

Enormous and uneconomical expenditures of ammunition, not readily obtainable except in a stabilized situation.

Limits initiative and flexibility of manœuvre of attacking infantry.

Exact regulation of fire by observation impossible.

Long time necessary for its proper and exact preparation and coördination.

Uniformity of density throughout, instead of heavy fire on important points.

Fails to protect troops from the fire of hostile troops located beyond the barrage.

Dependent upon accurate maps which may be difficult to obtain.

May run away from infantry.

Lack of flexibility of fire—too rigid.

Is a dispersion of effort; therefore, not sound tactically.

Gives enemy indication of movement.

Requires very large number of guns.

For a given amount of artillery and ammunition, limits the front of the attack.

Under certain conditions becomes dangerous to the infantry it is covering.

29. CONCENTRATIONS.—*a. Advantages Claimed*.—The advantages claimed for concentrations are as follows:

Permits powerful and demoralizing local effect on important targets and lighter densities on unimportant ones, therefore great flexibility of fire; at the same time, avoids waste of fire on unoccupied areas.

More economical in ammunition expenditure than rolling barrage.

Frequently offers opportunities for observed fire on known targets.

Permits more flexibility to meet changes in tactical situations occurring after the initiation of the attack.

Can be better adapted to varying rates of infantry advance, should unforeseen conditions render a change necessary or desirable.

Fire can be promptly opened without being dependent upon elaborate calculations.

Frequently not dependent on maps.

Allows infantry greater initiative and flexibility of manœuvre.

Permits infantry to use their rifles and auxiliary arms to greatest advantage on definite local targets.

Allows enfilade or oblique fire.

Surprise element more practicable than with rolling barrage.

Requires fewer guns for a given front.

Less affected by withdrawal of batteries for forward displacement than is the rolling barrage.

May be held on a strong position to neutralize it and permit the infantry to pass it by.

b. Disadvantages Claimed.—The disadvantages claimed for concentration are as follows:

Through inaccurate information may be misplaced and fail to properly cover advancing infantry.

Psychological effects less than in case of rolling barrage.

Requires greater skill in making accurate adjustments and therefore may result in limited effect on small targets.

Unless a concentration is fast, dense, and covers quite a wide area, the enemy can avoid it by moving elsewhere.

Unless timed concentrations are used, requires very efficient communications. Timed concentrations may restrict movements of infantry.

30. PRINCIPLES.—*a*. A rolling barrage to be effective, must be of sufficient density. This density is dependent on the number of guns available and their rate of fire. A thin barrage is a waste of ammunition, and does not give the infantry the support expected.

b. The basis of the rolling barrage is the 75-mm. gun. An effective barrage requires approximately one battery per hundred yards of frontage, with a sustained rate of fire of not less than two rounds per gun per minute.

c. Except for local actions of minor units, a barrage should be thickened by additional 75s, which may fire shrapnel and smoke, and by heavier calibres, which fire concentrations in advance of the true barrage line. The auxiliary arms of the infantry are also used to deepen the barrage.

d. Where progressive concentrations can be used successfully, the rolling barrage should not be utilized.

e. The rolling barrage is especially useful under the following conditions:

(1) Where a deep penetration is to be made through a highly organized defensive area;

(2) Where it is necessary as a factor to sustain the morale of new or badly shaken infantry;

(3) Where the details of the local defense of the enemy have not been well determined;

(4) Where there is an ample amount of artillery together with a plentiful supply of ammunition.

f. The rolling barrage is not possible in the earlier phases of a meeting engagement and is not to be expected in the later phases. Sometimes it may be employed in the attack of a prepared position, but its most frequent use is in the attack of portions of defensive zones.

g. The preferable form of artillery support is by observed progressive concentrations. This form of fire is flexible and is best adapted to meeting the varying tactical conditions of the battlefield, is economical in the use of ammunition and guns, is best adapted to celerity, permits the density of artillery fire to be adjusted to meet the character of targets to be neutralized, and frequently is independent of maps.

h. The better the liaison with supported infantry, the less need there is for the rolling barrage, since fire power can be more effectively concentrated on decisive points.

31. DOCTRINE.—From the above principles may be deduced the following doctrine:

Observed fire, when practicable, is the most efficient support artillery can give an attack. However, it is often necessary to employ prearranged organized fire in the form of concentrations or of rolling barrages. Observed fire is used much more than the latter, but at times the rolling barrage is advantageous, hence it is retained as one of the methods of artillery support.

R. H. ALLEN,
Assistant Commandant.

Approved.
H. E. ELY,
Commandant.

CURRENT FIELD ARTILLERY NOTES

Ordnance Notes[1]

DEMONSTRATION OF 2½-TON ROADLESS MACK TRUCK

THE International Motor Company, of New York, in coöperation with the Roadless Patents Holding Company, of Washington, D. C., has recently developed an adapter type truck of 2½-tons capacity, a very interesting demonstration of which was given by these two companies in Rock Creek Park, Washington, D. C., on Friday, December 22, 1922.

While this particular vehicle demonstrated was developed for commercial purposes primarily, the general principles of construction used are applicable to the various types of military vehicles, and the Ordnance Department was particularly interested in the demonstration given as indicating what the probable performance will be of the Army tractor, Model 1922, which incorporates this same type of chain suspension and flexible track. In addition to its use on the Army tractor, it is further contemplated that the suspension and track of the new Medium tank, Model 1924, will also be constructed along the same general lines.

The vehicle demonstrated in Rock Creek Park consists of a standard model AB 2½-ton Mack truck, from which the rear springs and wheels have been removed and the chain suspension with a flexible track applied. The rear axle is rigidly connected to the truck chassis and is so located that the drive sprockets which replace the rear wheels are normally not in contact with the ground. The track frames are mounted on an unsprung axle near their centre, and at the front of the track frame there is a connection to the truck chassis through a double acting coil spring. The flexible track is of the same type as that described in the Artillery Notes of the *Army Ordnance* for November-December, 1922, p. 173.

The total weight of this truck is 10,600 pounds, and on hard roads where only the rubber pads of the track shoes are in contact with the ground, the unit ground pressure is approximately 13½ pounds per square inch, which figure is reduced to 9½ pounds per square inch when on soft ground the steel shoe comes in supporting contact with the ground.

The power transmission system is practically the same as in the standard 2½-ton Mack truck, the only exception being the final fixed reduction, which in the case of the adapter type vehicle carries a greater reduction. With a governed engine speed of 1275 r. p. m.,

[1] Reprint from *Army Ordnance*, January-February, 1923.

the adapter track speed is 10.83 miles per hour in fourth speed, and 2.23 miles per hour in low gear, with a speed in reverse of 1.45 miles per hour.

Steering is accomplished by turning the front wheels in the usual manner as with the ordinary four-wheeled vehicle, and due to the universal action made possible with the track shoe construction used, the tracks are laid down in a curve of radius equal to the minimum turning radius as determined by the front wheels. Where the imprint of the track is shown on a road surface covered with flour, the rubber pads on the shoes are very clearly outlined, thereby proving that there is no side slipping of either track in effecting the turn.

In the demonstration given in Rock Creek Park, the vehicle was first manœuvred on a smooth road surface to demonstrate its ability to turn on a short radius without skidding on the tracks. The vehicle was also run over a series of obstructions, such as pieces of 2 × 4 lumber, showing clearly the flexibility of the chain suspension, which showed contact of the track on the road surface even when passing over such obstructions, thereby insuring an excellent traction with relatively low ground pressure.

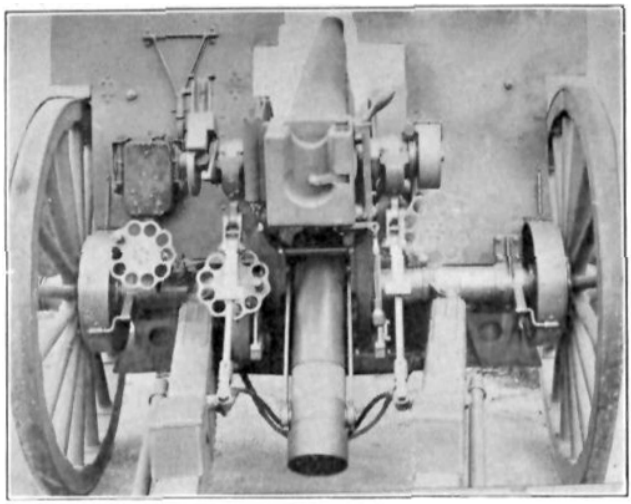
The demonstration in the Park consisted of manœuvring over muddy roads and uneven ground in an open field, and in testing the vehicle on all kinds of ground surface. During the manœuvring a ditch of approximately six feet in depth and ten feet in width was crossed without difficulty, and in attempting to recross in the opposite direction, trouble was encountered on account of the slippery condition of the ground surface. The vehicle pulled out under its own power, however, when the vehicle was manœuvred so that the tracks were able to grip properly on the ground. Throughout the demonstration the truck carried its normal load of 2½ tons.

TRAVELLING LOCK FOR FIELD ARTILLERY GUN CARRIAGE[2]

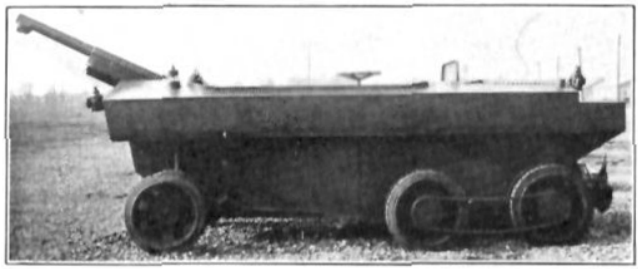
Divisional Artillery when limbered and being hauled over rough terrain is subjected to many stresses in the structural parts that cannot be computed. To facilitate manufacture it is necessary to provide clearance between fitting parts to permit of easy assembly. There is also some deflection in the axle and other parts due to the weight of the gun and recoil mechanism. In practice it has been found that these clearances, tolerances and deflections affect the whole carriage, causing noise, increasing the wear on loose parts and tending to cause rupture in other parts that have to carry added load due to its unequal distribution.

Travelling locks of various types have been tried to take up the lost motion between the gun and trails on the road. These usually

[2] Reprint from *Army Ordnance*, January-February, 1923.



75-MM. GUN CARRIAGE, MODEL 1923 E



75-MM. GUN CARRIAGE, CHRISTIE COMBINED WHEEL, TRACK-LAYING AND SELF-PROPELLED FLOATING TYPE

CHRISTIE LAND-AND-WATER TYPE OF MOTOR GUN CARRIAGE MANŒUVRING IN WATER

take the form of a bar pivotally attached to one trail and capable of being swung across to the other where it is securely fastened. Near the centre of this bar a seat is provided to attach the rear end of the gun or cradle. This construction generally resists both elevation and traverse of the gun. Any deflection in the bar or its attachments may interfere with its proper functioning. They have to be fitted to each carriage and are not interchangeable even among similar gun carriages in the same battery.

The travelling locks for the 75-mm. Gun Carriage, M. 1923E, are attached to lugs on the top carriage into which a short straight pin is driven. Two travelling locks are provided, one on either side, and are shown in the illustration of the carriage. One end is securely fastened to the trail in such a manner that it can be readily adjusted for length. It is mounted in a bracket on the trail so that it can swing freely. It is adjustable for length by threading the end and screwing it into the socket and is locked with a split pin. The upper end is shaped like an open hook, and engages the pin in the lug of the top carriage. An eccentric pin, operated by a handle, serves to release or engage the assembled tie rod. When in use it is practically an adjustable tie rod connecting the top carriage and trail. All parts are simple to manufacture. The adjustable feature makes it unnecessary to have the parts line up accurately when assembling. The eccentric and lever puts considerable tension in the rod, and takes up all the lost motion in the bearings in the axle and in the axle arms.

A cradle lock is also provided consisting of an "A" frame lock between the axle in front and the lower side of the cradle.

GRAVITY TANKS ON 75-MM. GUN CARRIAGE, MODEL 1917 (BRITISH)[3]

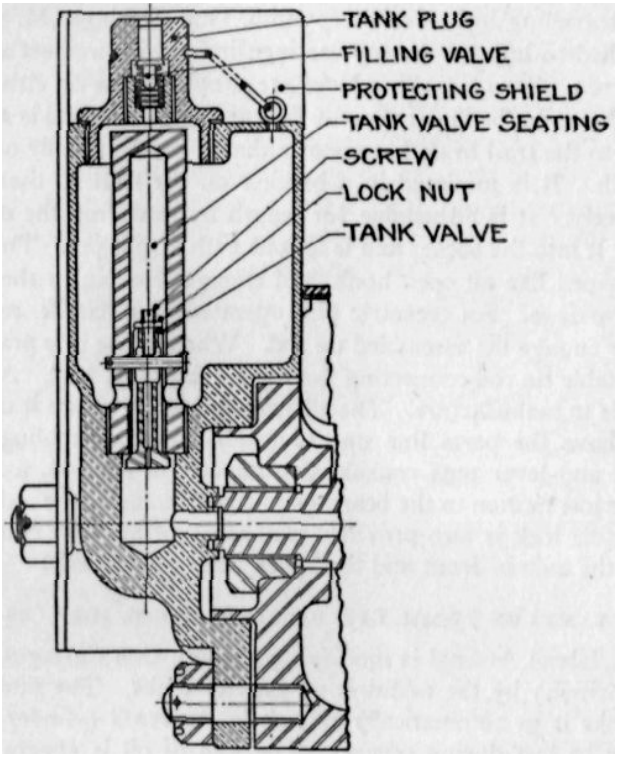
Rock Island Arsenal is modifying 75-mm. Gun Cariages, Model 1917 (British) by the addition of gravity tanks. The purpose of these tanks is to automatically replace in the recoil cylinder any oil that may be lost during service. The loss of oil is generally only that lost through the stuffing box packing.

The gravity tank is a bronze casting with a capacity of about three pints, secured to the front end of the cradle and protected by an armor plate shield. It is connected to the front end of the piston rod, and a hole through the piston rod permits the oil to pass through it to the buffer chamber in the rear of the piston rod. A filling valve is provided in the top of the tank, designed to admit atmospheric pressure, allowing oil to go into the mechanism or to close when there is pressure in the tank. A valve is located in the bottom of the tank to control the flow of oil from the tank during recoil and into the tank during counter-recoil. There is a throttling

[3] Reprint from *Army Ordnance*, January-February, 1923.

effect during counter-recoil that assists the counter-recoil buffer in controlling the return of the gun into battery.

In the final assembly and adjustment of the tank valve, it is necessary to adjust each valve to its carriage. This adjustment consists in enlarging the 0.33-inch opening at the bottom of the valve until the gun counter-recoils properly. It was found that shop test adjustment does not give the same



GRAVITY TANK ASSEMBLY

results as during firing. When retracting the gun in the shop the comparatively slow movement of the piece to the rear allows a larger amount of oil to pass from the gravity tank to the recoil system, so that when the gun is tripped to counter-recoil, it stops out of battery and then moves slowly into battery. The speed of going into battery depends directly on the size of the opening at the lower end of the tank valve. The final movement of the gun during the last few inches in counter-recoil is the only guide as to the proper adjustment of the tank valve, and this adjustment probably varies under different conditions of temperature and with different oil viscosities.

In order to provide an adjustment which can be easily made, it is proposed to provide a lock nut and screw in the upper end of the tank valve to give an adjustment of the lift, which controls the amount of oil entering the recoil system from the gravity tank during recoil of the gun. If upon firing it is found that the gun returns to battery too violently, the adjusting screw should be screwed out of the valve and the lock nut secured. This allows greater play to the valve and more oil may enter the system during recoil. If the gun stops some distance out of battery during counter-recoil, the adjusting screw should be screwed in, thus decreasing the play of the valve, and allowing less oil to enter the system, and permitting the gun to go entirely into battery. The adjustment of the valve may be made by means of this screw and lock nut to allow a vertical play of the valve from zero to 0.25 inch, and to increase or decrease the amount of oil entering the system between the limits made by these settings. An opening of 0.046 inch in the tank valve with this vertical play gave satisfactory results.

The tank valve is accessible for adjustment after removing the tank plug, which contains the tank-filling valve. To adjust the tank valve, the valve seating tank in which it is located must be removed from the gravity tank through the tank plug hole.

DEMONSTRATION OF LAND AND WATER TYPE OF MOTOR GUN CARRIAGE BY THE FRONT DRIVE MOTOR CO.[4]

An interesting type of motor carriage for the 75-mm. gun was demonstrated in New York recently as part of the program at the annual meeting of the A. S. M. E. The carriage shown was designed by Mr. Walter Christie, the President of the Front Drive Motor Company. This company has also built a number of experimental war service vehicles for the United States, incorporating the combined wheel and track feature. This latest vehicle made by the company on its own account, not only has the convertible track feature, but in addition, has been constructed to float and operate in water.

This vehicle, shown in the accompanying illustrations, can be operated on land or in the water. During the demonstrations in New York, the carriage crossed the Hudson River under its own power, climbed steep hills on the New Jersey side of the river on its tracks, and manœuvred over good roads on its wheels.

This carriage is of the combined wheel- and track-laying type which is adapted to run on solid rubber-tired wheels, or on tracks which pass over the wheels and are driven by the wheels at the rear.

The body is built-up of light plates, and is made water-tight

[4] Reprint from *Army Ordnance*, January-February, 1923.

for operation in water. Buoyancy is obtained by floats of balsa wood encased in sheet iron. These floats extend along the side of the body over the wheels. The transverse section of the body is shaped like the letter T, the vertical portion being between the wheels, while the top portion overhangs the wheels.

For manœuvring in water, two propellers are provided at the rear of the machine. These are connected to and driven by the transmission. The propellers revolve only when the carriage is in the water, and are engaged or disengaged by hand before entering water and when leaving.

The location of the gun is reversed from the mounting used on similar experimental carriages made by the same manufacturer for the United States. The muzzle points in the direction of forward motion and recoils back into the centre of the vehicle body which forms a recoil pit.

The gun is mounted on a sliding base which is moved forward and locked in place for firing. In the firing position, a centre post, cone shaped, with the small end down, extends below the centre of the gun mount, and is locked at the small end to the end plate of the vehicle body. This post takes the overturning effort and prevents the supporting plate from bending. In the travelling position, the centre post is released at the bottom and the entire mount moved back and is locked in place. In the travelling position, the gun is also supported in and locked to the end plate of the vehicle.

There are three wheels on each side, a steering wheel, a driving wheel, and a centre wheel between the steering wheel and the driving wheel. The centre wheel is not spaced midway between the steering wheel and the driving wheel, but is located just ahead of the driving wheel and is driven from the drive wheel by means of a chain and sprockets on the outside of the wheels.

The steering wheels are sprung individually in the usual manner, using coil springs housed in tubes above the wheels and in the body; the centre or auxiliary wheels are also individually sprung, using coil springs, while the drive wheels are not sprung. These wheels are driven direct from the transmission by internal spur and pinion. In operation on wheels, the centre wheels become the drive wheels through the drive chains from the rear wheels, the rear wheels being raised clear of the ground by lowering the auxiliary wheels.

When the vehicle is running on wheels, the tracks are separated into several short sections and carried inside of the vehicle. With this arrangement, the short sections of track must be thrown out of the vehicle before the gun can be manned.

As a track-laying vehicle, with the rear wheel acting as drive wheel for the track and with the rear wheel on the ground, the rear of the vehicle, the heavy part of the vehicle, is unsprung, excepting

for the spring effect on the auxiliary wheels. The track drive action is exactly the same as in all previous types of the Christie design.

When operating as a wheeled vehicle, steering is by the steering wheels assisted by declutching one of the driving wheels. When the tracks are used, the steering wheels are locked in position and steering is accomplished by declutching power to one track or the other.

The principal dimensions and characteristics of the carriage are given in the following table:

Weight with gun and tracks	14,000 pounds
Maximum height overall	16 ft. 5 in.
Maximum overall width (over wheels and floats)	79 inches
Height of centre line of gun	60½ inches
Length of track in contact with ground	144 inches
Width of track shoes	10 inches
Height of track drive lug	5 inches
Pitch of track shoe	10 inches
Diameter of drive wheels over tires	31 inches
Diameter of steering wheels over tires	31 inches
Diameter of centre wheels	31 inches
Centre wheel drive	By chain
Spring suspension, drive wheel	No.
Spring suspension, centre	Yes
Spring suspension, steering	Yes
Type of body	Hull, watertight
Engine, H. P.	.....
Type	T-Head
Number of cylinders	4
Bore and stroke	5½ by 7
Transmission	Gear
Number of speeds, forward	3
Number of speeds, reverse	3
Gear ratio, forward—high	1 to 7½
Gear ratio, forward—low	1:49
Final drive	Internal spur gear and pinion
Capacity of fuel tank	53 gallons
Number of propellers	2
Diameter of propellers	26 inches

RECONDITIONING RECUPERATORS FOR GUN CARRIAGE, MODEL 1897 (FRENCH)[5]

Rock Island Arsenal has just completed, nearly simultaneously, repair work on the disassembly and preparation for storage of 411 recuperators received back from service in France and which had originally been manufactured by and purchased from the French government, and the repair of a lot of recuperators for Gun Carriage, Model 1897 (French), which were manufactured in this country and which were in use by troops in this country from the

[5] Reprint from *Army Ordnance*, January-February, 1923.

middle part of 1919 to the Fall of 1922. The observations made during this work are of interest as indicating what may be expected in the maintenance of this class of matériel.

The 411 recuperators returned from France were entirely disassembled. In general, it was found that about one-half of one per cent. of all Belleville springs and one-tenth of one per cent. of all coil springs had to be replaced, all of the copper rings and silver rings had to be reworked, one hundred per cent. of all rubber and leather washers had to be replaced. In nearly all cases it was found that the leather and rubber washers were functioning satisfactorily, but when disassembled the leather washers were discovered to be very hard and brittle and unserviceable for reassembly. In many cases the leather washers were found to be severely scorched and burned, showing evidence of a high rate of fire to which they had been subjected. The corresponding gun books showed rates of fire of from 400 to 500 rounds per day during the early days of November, 1918. Recuperators were found which were filled with oil of all varieties, one being filled with linseed oil. These recuperators apparently had been still giving service. In many cases recuperators were found to be dented, evidently from being struck with projectiles. In cases where these dents were on the top surface and guide rails this damage was repaired by the insertion of small pieces. When the dent was in the cylinder walls it could, in some cases, be removed by lapping, but in several it was necessary to reject the recuperator. In one case it was found that the dent in the cylinder wall had worn a corresponding groove in the piston head, showing that the gun had continued to function even after being struck. In a great many cases where the Belleville springs were found broken, the gun had apparently continued giving service, but in some of these cases the broken Belleville springs had scored the piston rod so severely as to make its replacement necessary. In several recuperators it was found that there was no grease in the floating piston and even in these cases the air pressure had not been lost. In only four cases were recuperators found with the air pressure entirely lost. Due to lack of necessary funds, the 411 recuperators were not reassembled, but were thoroughly greased and placed in storage in a disassembled condition awaiting a time when the funds might be available. From cost records on a previous lot of 2000 recuperators returned from France and similarly reconditioned and reassembled, the cost of this work was found to be $325 per recuperator.

When the thirty recuperators which were in use in this country was received in the shop, work was started along similar lines, to recondition; that is, complete disassembly, replacement of worn out parts and reassembly. Two recuperators were actually torn down, but the condition of these was found to be so good that it was decided

not to go through the very expensive operation of complete disassembly, except in cases where absolutely essential. Instead, the recuperators were first subjected to a number of test pulls to obtain the time of counter-recoil. If this was satisfactory, the recuperators were next placed on a machine where the friction on the packing in the oil cylinder and in the floating piston was obtained. Only in cases of unsatisfactory friction on the floating piston was it considered necessary to completely disassemble the recuperator. From the actual check on these thirty recuperators only four were found that needed complete disassembly due to this cause. In other cases where the friction was poor in the oil piston, this piston was repacked. In all cases it was found necessary to add a small amount of air pressure. However, in all thirty cylinders the air was found to be only slightly below the required pressure. After adding this air, the recuperators were proof-fired and if they functioned satisfactorily, no further work on the reconditioning of them was done. In some cases proof-firing, however, developed difficulties which had not previously shown up, such as too long a recoil, air mixed in with the oil, foreign substances in the regulator, leaky packings, broken Belleville springs. Due to the defects developed in the proof-firing, it was found necessary to disassemble completely two more of the recuperators, making a total of eight recuperators out of the thirty which it was found necessary to completely disassemble. In these thirty recuperators, seven piston rods were found which were so badly scored as to necessitate replacement. Three regulators were found which had to be replaced due to leaking valves and four Belleville springs were found broken. The method of reconditioning these thirty recuperators was found to be much more inexpensive than the complete disassembly formerly used, the cost per recuperator amounting to $70 and this method is thought to be satisfactory for matériel which has not been exposed to the rigorous use of war conditions.

BOOK NOTICES

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THE MARNE—HISTORIC AND PICTURESQUE. By Joseph Mills Hanson. Illustrations by S. Andre Smith. A. C. McClurg and Co., Chicago, 1922. Review later.