UNCLASSIFIED 94 -0950

[redacted]

LECTURE ON THE SUPPLY OF AMMUNITION

TRANSLATED AT THE ARMY WAR COLLEGE
FROM A FRENCH DOCUMENT

SEPTEMBER, 1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

UNCLASSIFIED

16 JUN 1994

DOWNGRADED Unclassified
BY AUTHORITY OF DOD DIR 5200.1-R
BY Landahl Baker
ON 18 August 2005

WAR DEPARTMENT.

Document No. 670.

Office of The Adjutant General.

WAR DEPARTMENT,
WASHINGTON, *September 26, 1917.*

The following pamphlet, "Lecture on the Supply of Ammunition," is published for the information of all concerned.

(062.1 A.G.O.)

BY ORDER OF THE SECRETARY OF WAR:

TASKER H. BLISS,
Major General, Chief of Staff.

OFFICIAL:

H. P. McCAIN,
The Adjutant General.

WAR DEPARTMENT,
THE ADJUTANT GENERAL'S OFFICE,
WASHINGTON, *June 19, 1917.*

To all officers of the Army:

You are advised that this and all subsequent documents of a similar character, which may be furnished to you from this office, are to be regarded as strictly confidential. They are to be kept at all times in your personal possession, and are not to be copied, nor are any parts of their contents to be communicated either directly or indirectly to the press, nor to any persons not in the military or naval service of the United States. In Europe these documents are not to be carried into the front-line trenches, nor farther to the front than the usual post of the officers to whom issued.

Strict compliance with this injunction is enjoined upon every officer into whose hands any of these confidential documents may come.

BY ORDER OF THE SECRETARY OF WAR:

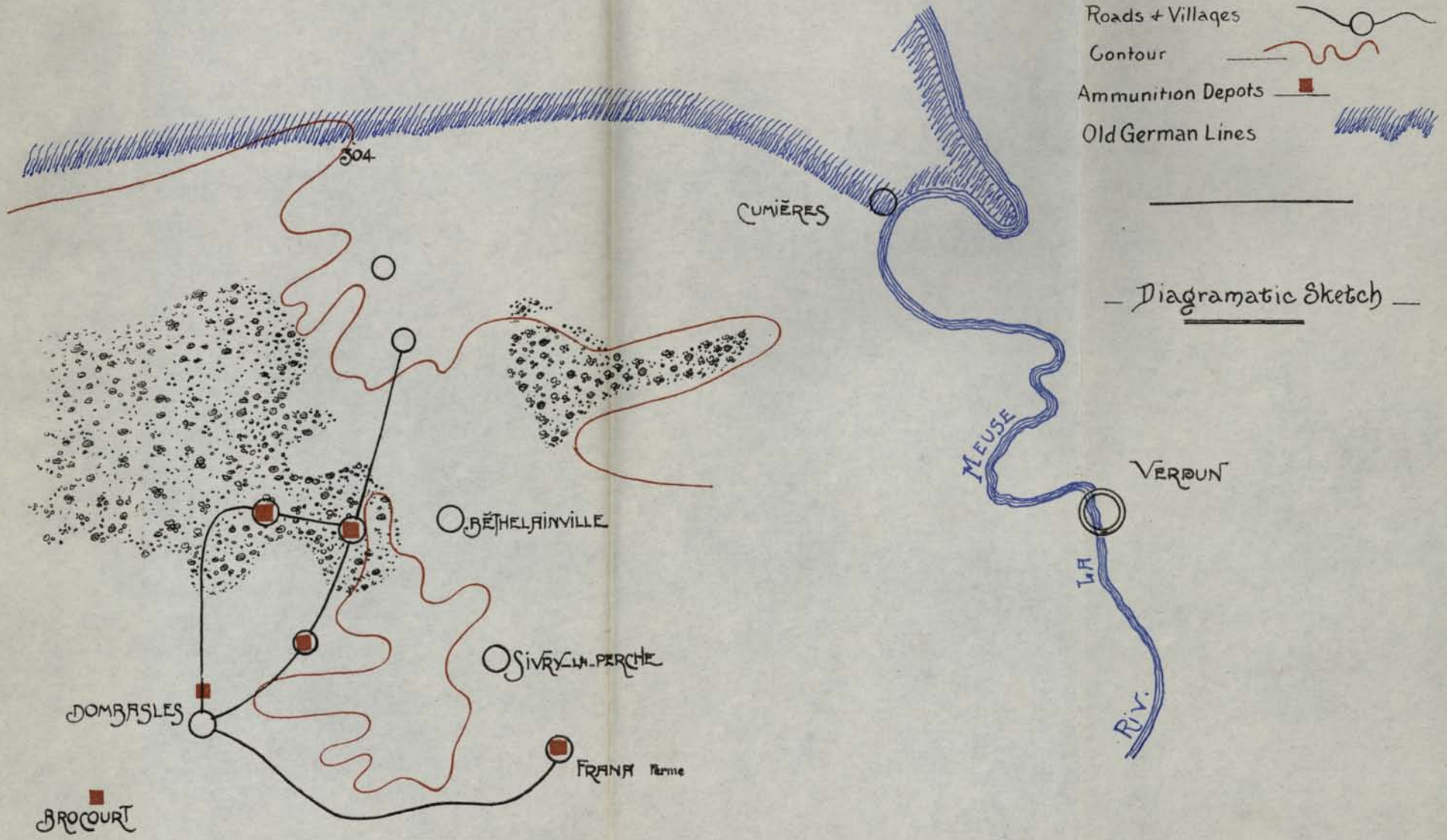
H. P. McCAIN,
The Adjutant General.

TABLE OF CONTENTS.

	Page.
The supply of ammunition	7
I. The Champagne battle—September–October, 1915	8
(A) Supply of field artillery ammunition	8
The present organization of the front of the Fourth Army	9
(B) The supply of ammunition for the heavy artillery	10
To each corps	11
To the commander of depots	11
Conclusions drawn from the experiences of September, 1915	12
II. The supply of ammunition at Verdun	13
(*a*) The bringing up of ammunition	14
(*b*) Establishing army depots	14
(*c*) Assignments of all the batteries to corps or similar organizations, so as to decentralize their supply	15
(*d*) The delivery of the projectiles to the batteries	15
Field artillery	16
Heavy artillery	16
III. Supply during the first phase of the offensive on the Somme (Sixth Army) beginning of July, 1916	16
(A) The heavy artillery	16
(B) Field artillery	17
Initial organization	17
The operation of supply	18
Characteristics of the different methods described	18
IV. Some precepts	20
(A) The importance of the expenditure of ammuntion; daily tonnage and its duration in a modern battle	20
1. Daily tonnage	20
(*a*) Field artillery	20
(*b*) Heavy artillery	20
2. Duration of this expenditure	21
(B) Direction of the service of ammunition supply	21
General organization	21
(*a*) At general headquarters and at the army group headquarters	21
(*b*) In the army	23
(*c*) In the corps	21
(C) Remarks on the means of execution	24
Personnel and matériel	24
Means of transporting ammunition	24
(*a*) Standard-gauge railroads and stations	24
(*b*) The 60-centimeter railroad	26
(*c*) Ammunition sections, park sections, and combat trains of the heavy artillery	26
(*d*) Field artillery ammunition sections and combat trains of the 75 mm. batteries	26
Depots	27

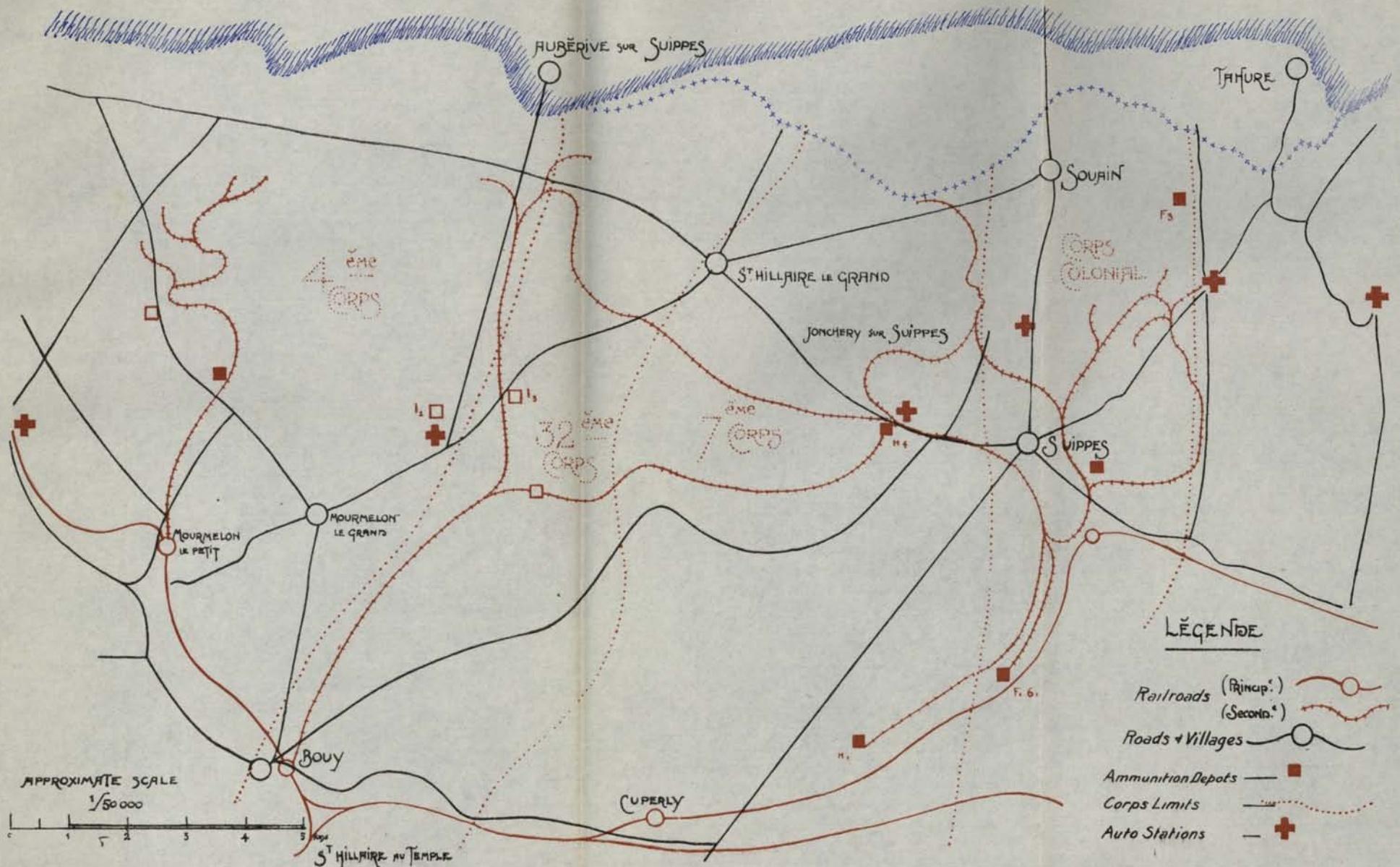
Page.

Appendix I.—Champagne battle 28
Expenditure in field artillery ammunition 28
Appendix II.—Champagne battle 28
Expenditure in heavy artillery ammunition 28
Number of heavy batteries in the Fourth Army 29
Appendix III.—Verdun 29
Expenditure of artillery ammunition (Second Army) 29
Expenditure of field artillery ammunition 29
Expenditure of ammunition for heavy artillery 30
Ratio between the actual expenditures and a theoretical daily fire 30
Appendix IV.—Some brief points on the supply of the infantry and trench artillery ammunition 31
Supply of infantry ammunition 31
Supply of grenades 31
Trench artillery 31



— Diagramatic Sketch —

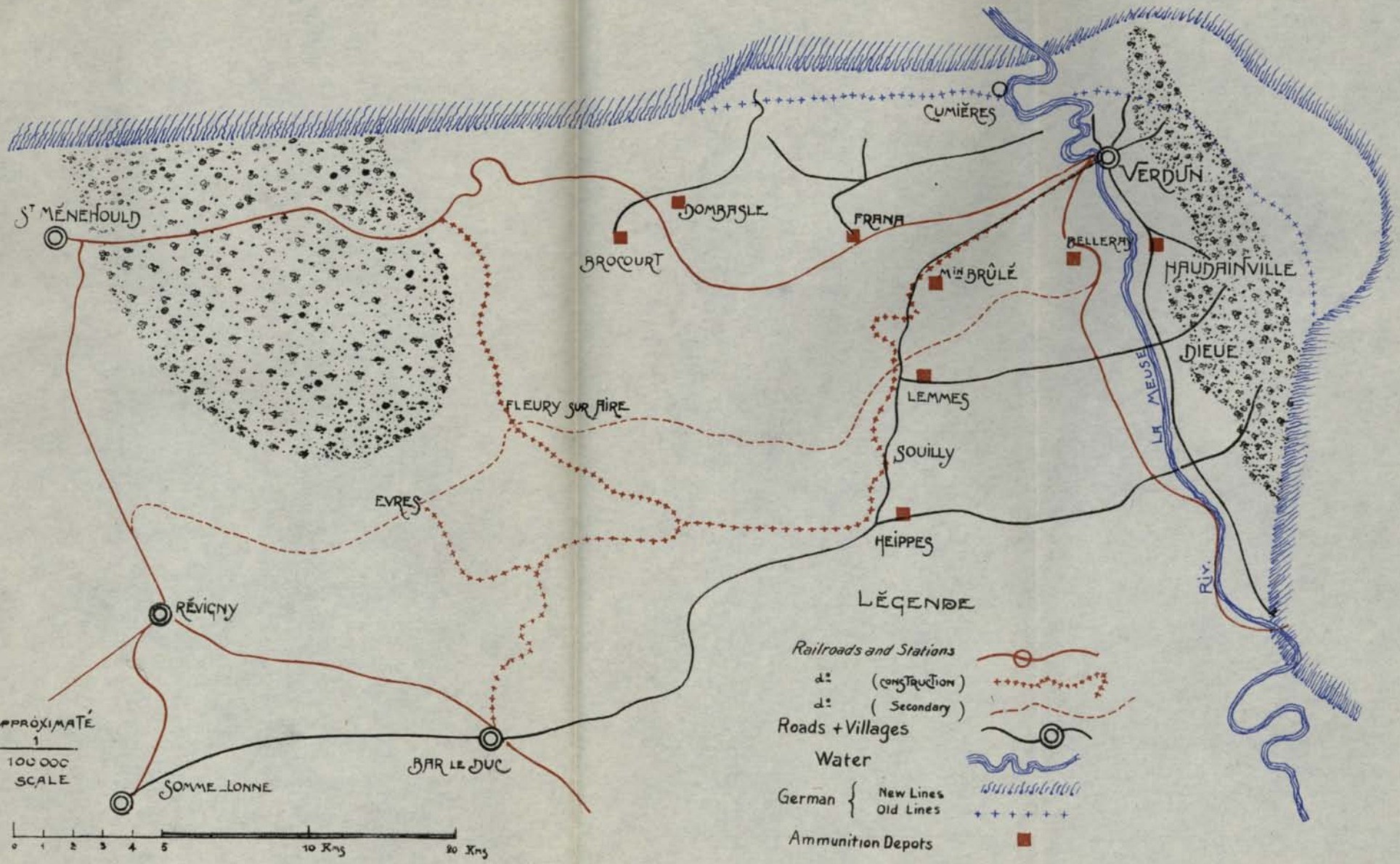
38382—18. No. 1


AUBÉRIVE SUR SUIPPES
TAHURE
SOUAIN
ST HILLAIRE LE GRAND
JONCHERY SUR SUIPPES
SUIPPES
4ème CORPS
32ème CORPS
7ème CORPS
CORPS COLONIAL
MOURMELON LE PETIT
MOURMELON LE GRAND
BOUY
CUPERLY
ST HILLAIRE AU TEMPLE
APPROXIMATE SCALE
1/50 000
LÉGENDE
Railroads (Princip.) (Second.)
Roads & Villages
Ammunition Depots
Corps Limits
Auto Stations

33332—18. No. 2


Albert
Curlu
Bray
Suzanne
23
Antenne A
a1
Somme
Herbécourt
Biaches
Amiens
Cerisy
Somme
Antenne B
b2
b1
Feuillaucourt
Estrées
Soyécourt
Longeau
Les Buttes
Guillaucourt
c1
c2
Lihons
Proyart
Rosières
Chaulnes
Bayonvillers
Beaucourt
Méricourt
Méricourt
La Neuville
Quesnel
Avre
Pierrepont
Légende
Water
German Lines
Standard R.R. - Old.
Standard R.R. - New.
60 c.m. Railroad
60 c.m. R.R. Principal Branch
Limit of Army Zones
Depot of Heavy Artillery
Depot of Field Artillery

33332—18. No. 8


CUMIÈRES
VERDUN
DOMBASLE
FRANA
ST MÉNEHOULD
BROCOURT
BELLERAY
MIN BRÛLÉ
HAUDAINVILLE
DIEUE
LA MEUSE
LEMMES
FLEURY SUR AIRE
SOUILLY
EVRES
HEIPPES
RIV.
RÉVIGNY
LÉGENDE
Railroads and Stations
do (CONSTRUCTION)
do (Secondary)
Roads + Villages
Water
German { New Lines / Old Lines
Ammunition Depots
APPROXIMATE
1
100 000
SCALE
0 1 2 3 4 5 10 Kms 20 Kms
SOMME-LONNE
BAR LE DUC

33332—18. No. 4

LECTURE ON THE SUPPLY OF AMMUNITION.

By MAJ. CONDÉ, of the General Staff of the (French) Group of Armies of the East.

OCTOBER, 1916.

THE SUPPLY OF AMMUNITION.

Having been called upon to deliver a lecture on the supply of ammunition at the artillery school, I shall not try to give a complete discourse on this subject, with which you are all familiar, and which is governed by regulations, as that would exceed the limits of a lecture altogether. But, having been one of the officers charged with the supply of ammunition to the Fourth Army during the Champagne offensive of September, 1915, I shall describe what occurred on that occasion, how the work was organized, the ultimate results, the lessons taught by this experience, and lastly how, in the light of this experience, we studied the question of supplying ammunition to the Fourth Army, in the hypotheses of great offensive or defensive operations in the Champagne. I shall then give you what information I was able to gather from the operations of the supply system at Verdun and in the present Battle on the Somme.

I shall attempt, in closing, to draw a few lessons for the future.

THE CHAMPAGNE BATTLE—SEPTEMBER-OCTOBER, 1915.

A. SUPPLY OF FIELD ARTILLERY AMMUNITION.

OPERATION DURING THE CHAMPAGNE BATTLE.

The ammunition supply system was arranged as follows:

At the regulating depot	Stored in depots. Loaded and ready to be sent on trains.
At Chalons (advanced echelon)	Stored in depots. Loaded and ready to be sent on trains.
Railroad station depots, handled through the main supply park (one back of each Corps).	Mourmelon (Fourth Corps). Bouy (Thirty-second Corps). Cuperly (Seventh Corps). Suippes (Second Colonial Corps).

In the last-named depots we kept on hand, as a rule, one or two lots of 75 mm. ammunition.

When it had been decided to supply a Corps, the latter was notified to come and draw its allotted amount from its particular railroad depot, and at the same time the railroad received orders to forward to this depot ammunition from Chalons or Troyes. The Corps could immediately take an initial supply from its railway depot, the rest of the allotted ammunition arriving in 20 hours at the most. In actual practice supplies arrived faster than the Corps could take them.

The supply of a Corps was generally based on its expenditure of ammunition (from which we deduced its situation) rather than on its demand for ammunition. The latter, during an action, is more often the result of temperament of the man who makes the request than of his real needs.

Such was the normal operation in the supply of ammunition.

It was expected, however, that the expenditure would be greater than the parks of the Corps could transport daily from the railroad depot to the battery combat trains. Two entirely different measures were taken in order to remedy this difficulty.

First. Each battery was given an initial quantity, to be drawn upon gradually, of from 900 to 1,000 rounds per piece. As the total expenditure of ammunition would take six days, it is easy to see that, by bringing up to the batteries 150 to 200 rounds per gun per day, when their average expenditure was approximately 300, this

initial supply at the batteries would make up the difference between the daily expenditure in ammunition and the daily supply brought up.

Second. An automobile section for the transport of matériel was assigned to the Seventh Corps (relatively distant from its railroad depot) and the Second Colonial Corps (in which the expenditure seemed to be especially great), to transport the 75 mm. ammunition or the ammunition for the Infantry from their railroad depots to points designated by the Corps (usually the ammunition park of the Corps). This method was necessary in the Seventh Corps, which was farther than the other Corps from its railroad depot (Cuperly) from which it was supplied. The ammunition was carried by auto to the Echelon Woods (near Jonchery).

Results justified the use of these methods. The field artillery ammunition was easily supplied, and the batteries always had enough, in spite of the high expenditure (126,000 rounds per day, on the average, from the 22d to the 28th of September).

If the hoped-for advance had taken place, the most important duty would have devolved on the automobile sections, which would have formed a close network between the railroad depots and the depots established by the Army, to which the parks of the Corps come to be supplied. Supplying by means of automobiles necessitates the previous rebuilding of the roads in the zone of the front. This had to be prepared for and organized. We had the supplies, gravel, personnel, and steamrollers ready for this work. The roads to be established were designated beforehand.

The present organization on the front of the Fourth Army.—At present, in the hypothesis of a French offensive, or great defensive battle on the front of the Fourth Army, our method of supply would not be changed. But of the two methods for making up the insufficient means of transportation of the artillery park (creating an initial supply and bringing up the ammunition by means of automobile sections), the later would do the most work.

As a matter of fact, the artillery park of an average Corps is reduced to four motor transport sections, and can not carry more than 80 rounds per gun per trip. If it must transport ammunition from a distance, say ten kilometers, the park is soon unable to meet the demands, and the initial supply sinks rapidly. A Corps should therefore have extra transportation facilities sufficient to transport

the necessary ammunition to one or more small depots near the battery combat train. Automobile sections are therefore put at the disposition of the Corps when necessary.

The battery combat trains, which represent considerable transport capacity (150 rounds per gun), can draw from these small depots themselves if the parks are unable to supply the combat trains under the existing conditions.

To facilitate bringing up field artillery ammunition to points near the front by automobile sections, we made special automobile shelter depots along the front of the Fourth Army. These depots were located in defiladed places near road junctions, and at intervals along a line at an average distance of less than 6 kilometers from the enemy front. Their location corresponded almost exactly to the usual positions of the battery combat trains. These depots consisted of a widening in the road, built of stone, with a platform upon which the cartridge cases could be unloaded from the ammunition trucks. The personnel of each, supplied by the Corps, consisted of about 30 laborers from the artillery park or Territorials from the Infantry Reserve, and one or two noncommissioned officers from the artillery park.

B. THE SUPPLY OF AMMUNITION FOR THE HEAVY ARTILLERY.

Col. Fetter, who had received orders to prepare a large force of heavy artillery for entry into action between the Montagne de Rheims and the Argonne, studied the situation before the zones of action of the Corps had been exactly defined. He therefore simply divided the batteries into supply zones, which eventually agreed, more or less, with the territorial zones of the Corps.

In each of these zones there were depots of the army, supplied by the 60-centimeter railroad. The latter transported ammunition from the stations of the standard-gauge roads to the depots, and from these depots to most of the batteries. The general scheme of this organization is shown in the first sketch map.

At the beginning of the Champagne Battle the heavy and the siege batteries were supplied with about three days' ammunition and the depots in the rear with about two days' supply. The personnel had already been assigned to the railroad stations and the ammunition depots. Foot batteries, with their officers, had been divided up and assigned to them in complements sufficient to carry out the necessary work.

But the heavy artillery had not as yet been developed as it has since been. A great part of the batteries were batteries of position and lacked all means of transportation and all personnel capable of directing or carrying out the supply of ammunition. The heavy artillery command was entirely improvised.

Under these conditions, the Organization Section of the Army Staff had to undertake the difficult task of directly supervising the supply of all the battalions and isolated batteries of the Army. The 60-centimeter railroads played the principal part in this transportation work.

Foreseeing the possible cutting off of the 60-centimeter roads, we tried by every means to organize against this eventuality. When the Corps were all in place, and their heavy artillery commands organized, a memorandum from the Army directed each Corps to consolidate all transportation then in the hands of the heavy artillery, supplemented by several ammunition wagons of the central park and by four ammunition trucks per Corps. This organization, under an officer especially detailed, was expected to use its own initiative in keeping up the supply, especially if the 60-centimeter road was interrupted.

As a matter of fact, this improvised organization was of very little use. It should have been more carefully prepared for its task, and the officers who directed it should have been more familiar with the depots, the battery emplacements, etc.

All the supply was therefore directed by the Organization Section at Chalons. Our method was as follows: Each morning we received: (1) A report from the commander of heavy artillery of each Corps on the expenditure of the preceding day for all his batteries; (2) a report from the commanders of the depots on their situation. These were used as a basis for our work of supply for the following night. From 10 a. m. to 3 p. m. we sent out orders, drawn up as follows:

To each Corps:

First. Batteries X, Y, Z, will receive this evening, over the 60-centimeter road, such and such amount.

Second. Battalions X, Y, Z, with their own transportation facilities, will transport so many rounds to the depots A, B, and C.

To the commanders of depots:

First. Send to-morrow night, by 60-centimeter railroad, so many rounds of — to Battery X —, etc.

Second. Battalions X, Y, Z, will transport with their wagons—

Then, according to the situation in the depots, we routed the ammunition allotted us by the Group of Armies of the Center. This routing was transmitted by the G. A. C. to the railroad regulating depot and to the depots. We regulated the movements between depots so that each depot was able to supply its demands. Our depot commanders operated the 60-centimeter roads so that they could carry out the transportation work required of them.

Our task was made complicated by the fact that the low reserve of supplies for heavy artillery and the many different calibers made it impossible for us to have a sufficient reserve in each one of our depots.

We had to consider a thousand other matters. Not all our depots were accessible by road. We had to see that the depots accessible by road received ammunition destined for those batteries or battalions which supplied themselves by horse-drawn or motor vehicles. The battalions changed in the course of the battle as the artillery moved forward, without reference to the conditions under which they had to be supplied. Battalions of 220-mm. guns, for instance, supplied by the 60-centimeter road, were moved to points in the Souain region not accessible to the 60-centimeter road.

CONCLUSIONS DRAWN FROM THE EXPERIENCES OF SEPTEMBER, 1915.

Although the supply had been systematic, and those involved had been unanimous in declaring that no battery lacked ammunition, at least as long as we were supplied from the rear, we concluded, from the experience of September, 1915, that never again would we undertake such a "tour de force," which would never have succeeded had it not been for the following circumstances:

First. The Germans employed their artillery rather ineffectually during the first days of the attack, and the 60-centimeter railroad was therefore able to operate without interruption.

Second. For the field artillery, the relatively short duration of the battle did not require more than half a day's supply of ammunition each day, on the average, while the initial supply near the guns was gradually being expended.

In case of a new great offensive or defensive battle, we will adopt a different organization. The basis of this will be the supply of the heavy artillery by Corps, while the Army limits itself to sending the heavy artillery ammunition from the large depots to the Corps.

The ammunition allotted to the Corps will be drawn from the large depots and forwarded by the 60-centimeter railroad, or by roads, to the Corps depots. (The latter depots already exist). From these Corps depots, the ammunition will be sent to the batteries, under the direction of an officer in each Corps specially detailed to direct the supply of the heavy artillery. The supply will be effected either by wagon or by 60-centimeter railroad, in which, until the events at Verdun, we placed great confidence, because of the service it rendered us in September, 1915.

II. THE SUPPLY OF AMMUNITION AT VERDUN.

On the first day of the Battle of Verdun, the 75 mm. batteries had two days' supply in boxes, or 300 rounds per gun, as well as their normal supply (312 rounds per gun). Moreover, depots had been established at different sheltered places.

The batteries of heavy artillery had one and one-half days' supply at their positions. Intermediate depots had been established and the supply was to have been effected by the artillery park of the Verdun Fortress, with its own means of transportation (park sections of the Third Army or 60-centimeter railroad).

The total amount of available ammunition in the Fortress of Verdun was not very large, when the enormous actual expenditure is considered.

The region of Verdun was connected with the country back of it by an ordinary double-track railroad (passing through Auberville, a little less than 7 kilometers from the front), by the Mensiens railroad (a single 1-meter gauge track), and by road.

At the beginning of the German attack the standard gauge road was cut near Auberville. The 60-centimeter roads of the local system were also destroyed in many places and could not be operated.

In order to meet any such eventuality the Chief of the Bureau for Regulating Railroads had asked that motor transportation for ammunition be organized. This emergency organization began to operate on the 22d of February, and from then on the supply of ammunition was carried out as follows:

1. Both heavy and field artillery ammunition was brought up to the Army zone by a great number of auto convoys.

2. A certain number of depots were organized. They were located out of range of the enemy's artillery.

3. All batteries of both heavy and field artillery were assigned to the Corps or other similar organizations.

4. A requisition system on the Army depots for the benefit of the Corps, according to their situation and expenditure, was organized by the Army. The Corps were required to transport the ammunition by the means at their disposal, and distribute it among the batteries.

These different points call for more details.

(a) *The bringing up of ammunition.*—The main railroad no longer existed. The Mensien railroad could scarcely handle the food supply and some evacuations. The ammunition had to be carried from the outset by convoys of motors. In order to effect the transportation of troops, matériel, ammunition, etc., the general-in-chief created an "Automobile Regulating Station" in the Verdun region. The Army made requisition on this regulating station for transportation from one point to another.

At first all the ammunition was unloaded at Bar-le-Duc and Sommelonne (south of Revigny), 60 or 70 kilometers from Verdun, and transported by the Automobile Regulating Station to the depots designated by the Army. Even up to the month of July the greater part of the ammunition was brought up in this way. The average daily tonnage (field and heavy) varied around 2,500 tons at the beginning of June, the greater part being for the 75 mm. guns.

From the begining of the Battle of Verdun, the traffic on the Mensien railroad was gradually developed. A standard-gauge railroad was also constructed from Nettancourt, and, at the beginning of June, certain food supplies (commissary) were operating at Eves and Fleury-sur-Oire. At this time (beginning of June), the Mensien railroad could supply four or five lots of 100 tons each for the use of the artillery (say 500 tons or so), which were transported directly to the depots at Heippes, Lemmes, and even (at night) to Maison-Brulee. A 60-centimeter road, constructed from Chermont to Brocourt, carried at that time about 300 tons per day. The rest of the ammunition, say 1,800 tons or thereabouts, were still handled by automobiles, although certain ammunition trains had already been pushed forward on the new line as far as Fleury-sur-Oire, thus considerably reducing the length of the carries to be effected.

(b) *Establishing Army depots.*—These were large depots, with a personnel of about 400 men (artillerymen, infantrymen, and even

cavalrymen). There were six of these depots (Heippes, Lemmes, Maison-Rouge, Belleray, Frana, and Brocourt.) The depot at Brocourt was first located at Dombasle (9 kilometers from the front at the nearest point). It had to be moved as a result of an enemy bombardment.

Up to the beginning of June it was impossible to form a reserve in these depots worthy of the name. The ammunition was delivered to the Corps as soon as received. The Second Army decided that, before establishing reserves in rear, it was necessary to establish them near the front, and therefore tried to increase the battery supplies. These depots were, therefore, really points of delivery. One of them (that of Lemmes), located behind the center of the Army, had a certain number of small spare parts, a reserve, of a few rounds of all calibers, etc.

(c) *Assignment of all the batteries to Corps or similar organizations so as to decentralize their supply.*—The tendency of certain artillery units of special caliber to make direct application to the Army was resisted. The Second Army was inflexible in this matter.

(d) *The delivery of the projectiles to the batteries.*—The Corps used their field artillery automobile sections, their horse-drawn and motor vehicles belonging to all attached heavy artillery units, and one or more (usually two) sections of horse transport of the grand park assigned them by the Army. With these means of transportation they got ammunition from the Army depots and effected their interior supply.

The 60-centimeter road remained almost completely idle. During the first attack in the northeast sector it could not operate—the enemy fire destroyed it. It no longer met the situation, and the proposition of bringing up 60-centimeter material for the construction of a new network or railroad was not considered, since we had all we could do to bring up the absolutely indispensable food, ammunition, and material.

For example, this is how the supply of ammunition of the Second Corps was effected when that Corps was on the front in the region of Esnes–304:

The service was directed by the commander of the artillery park. Two senior officers of the park specialized, one on the supply of ammunition for field and the other for heavy artillery. The Corps undertook the delivery of its ammunition from the Army depots at Dombasle and at Frana.

Field artillery.—The method of supplying field artillery ammunition was different in the two subsectors. In the right subsector a depot called "La Carriere" was established 1,800 meters north of Dombasle. This depot was fed by an automobile convoy section, aided by several wagons, carrying ammunition from the Army depot at Frana. The battery combat trains stationed in the Nermont Wood carried ammunition from "La Carriere" to the batteries. In the left subsector, the motor transports carried the ammunition from the depot of Dombasle to the battery combat trains stationed in the region of the Bois de Bethelainville.

Heavy artillery.—All the ammunition sections of the heavy artillery battalions (motor or horse-drawn) were centralized under the senior officer in charge of the supply of the heavy artillery. With these means of transportation, two Corps depots were maintained in the Bethelainville Wood (chiefly by the use of motor vehicles), and the guns themselves were supplied (principally by horse-drawn wagons) with ammunition from the Corps (and sometimes the Army) depots. Lastly, certain batteries (chiefly horse-drawn) used their combat trains to carry supplies from the B and C depots of the Corps.

III. SUPPLY DURING THE FIRST PHASE OF THE OFFENSIVE ON THE SOMME (SIXTH ARMY)—BEGINNING OF JULY, 1916.

A. THE HEAVY ARTILLERY.

Organization of the matériel.—Col. Fetter organized the 60-centimeter railroad and the depots.

In the zone of the Sixth Army it had been planned to use four Corps called A, B, C, and X. As a result, four branches of 60-centimeter railroad were established, joining the railroad at Cerizy, Buttes, Equipee and, for the branch of the X Corps, at Cayeux and Wiencourt.

At the junction stations there were important transfer depots, and there were also other depots along the 60-centimeter branches (a total of 13, including the depots at the branch heads).

The number of Corps was reduced from four to three, and branch C was used both by the Colonial and the Thirty-fifth Army Corps.

The depots belonged to the Army, but were devoted to the supply of the different Corps. They were more numerous and smaller than those organized at Verdun, and usually comprised a personnel of

battery specialists and some artillerymen (officers at the branch heads) and a company of Territorials to handle the supplies. This personnel was not sufficiently well trained, and gave some trouble.

On the first day of the preparation for attack (July 1), the depots and the batteries each had three days' supply of ammunition on hand. From this time on, the work of supply was very simple. Each day the Corps reported their expenditure, their ammunition on hand, and the number of guns in firing condition. The Army opened to each Corps the necessary credit on the Army depot assigned to the use of the Corps, for the replacement of the ammunition consumed. The Corps regulated the transport from the depot to the batteries (by means of the 60-centimeter railroad and the transport belonging to the batteries and battalions). The Army, in its turn, gave the necessary orders to refill its depots at the rate of three days' supply based on the actual expenditure at the time. The ammunition unloaded by the railroad at points where the branch lines connected was transported over the 60-centimeter railroad to the depots.

The Army was prepared to supplement the 60-centimeter railroad in case of a breakdown, with its motor convoy. But as a matter of fact, except for the first period, when the 60-centimeter railroad was not yet completed, the latter sufficed for the necessary transportation.

In the forward movement, thanks to these many means of transportation, the heavy artillery was still able to supply itself easily from the most advanced depots.

The expenditure of ammunition was reasonable. (The exact figures, average and maximum daily expenditure, etc., are shown in the appendix.) In fact, thanks to our superiority in the matter of aerial observation, we were able to silence and even destroy a certain part of the enemy artillery, and to prepare and execute the attack of July 1, with a mean daily expenditure of heavy artillery ammunition of only one-half a day's supply. The daily average tonnage of heavy artillery ammunition expended was about 1,400 tons during six days of preparation.

B. FIELD ARTILLERY.

Initial organization.—A railroad station was assigned to each Corps (Cerizy for Corps A, Buttes for B, Equipee for C). In addition to

these, depots were established and provisioned by the Army. These depots were assigned by the Army to the Corps at the beginning of operations (a1 and a3 to Corps A; b1 and b2 to Corps B; c1 and c2 to Corps C). There were 180 lots for the three Corps at the time of the assignment of the depots to the Corps. The ammunition was taken out of its cases, cleaned, allotted, and put in transportable cases by these depots.

The operation of supply.—The first allowance was a three-days' supply per gun, and three days' in the depots. Near the guns the ammunition was kept under shelters, covers, or in the 1915 caissons.

The Corps reported daily to the Army their expenditures of two days before. The Army resupplied them by shipments which it made to the Corps depots (by motor trucks or, more rarely, the 60-centimeter railroad).

The Corps had their ammunition sections and their combat trains at the depots. They were also assigned park sections and they even had wagons of the divisional supply train to bring forward the ammunition. We proved more than once the inability of the motor sections, and even of the combat trains of the batteries, to handle the total ammunition for the field artillery.

The expenditure was extremely high—almost too high. During the six days of preparation, an average of 290 rounds were fired per day per 75 mm. gun, that is 860,000 rounds in six days. On the day of the attack, 450 rounds per gun, or 266,000 rounds were fired. This meant 1,400 tons per day of preparation, and 2,600 tons for the day of the attack.

As soon as the advance began, advanced depots of 75 mm. ammunition were established. They were replenished by the Army by means of trucks. The old depots were gradually used up. Ammunition was brought up in special cases, which made the sorting and the proper preservation of it possible.

CHARACTERISTICS OF THE DIFFERENT METHODS DESCRIBED.

I have dwelt at length on the methods of supply just discussed, because I deemed it interesting to deviate from the domain of theory in order to present facts, which I consider most instructive since they are concerned with entirely different (I might almost say extreme) cases.

In the first case (Champagne) our offensive was prepared at leisure, in a region well provided with railroad platforms and yards which could have been still further developed. We had sufficient time to lay a vast system of 60-centimeter railroad. During the operations, the enemy was dominated and absorbed by the defense of his own lines. His artillery fire was weak, especially on the rear of the battlefield. Our supply system was therefore able to operate as planned. On the other hand, the batteries had few means of actual transportation on hand. The allotments of heavy artillery ammunition were carefully meted out, and, from the beginning of the battle, the ammunition was issued tardily, bit by bit, and rather reluctantly.

At Verdun, on the contrary, we were attacked with an extraordinary violence on a terrain chosen by the enemy. Our lines were bent, and the bombardment did great damage for a considerable distance back of our positions. The action took an unexpected turn, and the supply system had to operate under conditions bordering on complete improvisation. Lastly, the railroad base was very distant. But our heavy artillery had fortunately developed greatly. It had at its disposal automobiles and powerful horse-drawn vehicles, to which were added innumerable trucks. The ammunition allowance was large, and its prompt and regular arrival was largely due to the scheme of daily allotments. Large additions to this ammunition supply were sent on the request of the army when necessary. [Note.—In the first days of June, the daily allowance of the Second Army was 18 lots of 75, 3,000 rounds of 90, 6,000 rounds of 95, 500 rounds of 100 rapid fire, 4,000 rounds of 105, 11,000 rounds of 120 (gun), 7,000 rounds of 155 (howitzer), 5,000 rounds of 155 (gun), 3,000 rounds of 155 (rapid fire howitzer), and 360 rounds of 220.]

In the third case, we had at our disposal all the means available in Champagne, as well as the wealth of ammunition at Verdun. We were also able to create an adaptable organization with which to meet all the requirements of an enormous expenditure, especially in field artillery ammunition, and which has already been able to adapt itself to an advance movement on a part of our lines (the movement of more than half of the heavy artillery and the 75's between the 1st and 8th of July).

IV. SOME PRECEPTS.

I will now attempt to draw from my lecture several precepts for future use, without using any save the most characteristic points.

A. THE IMPORTANCE OF THE EXPENDITURE OF AMMUNITION; DAILY TONNAGE AND ITS DURATION IN A MODERN BATTLE.

1. DAILY TONNAGE.

(*a*) *Field artillery.*—The theoretical daily capacity of a 75 mm. gun is around 300 rounds per gun. For 100 guns of the 75 mm. type, the actual approximate figures in the corps is 30,000 rounds, or 5 lots, or 300 tons, or 30 cars, or a little more than one train. For an army of four corps, 120,000 rounds a day, or 20 lots, or 1,200 tons, or 120 cars, or 5 trains.

Experience has proven that this figure is approximately correct, though a little below the average figures for a corps in a heavy engagement, that is to say, a corps which is reinfocred in artillery and consists of more than one hundred 75 mm. guns. During the Champagne battle, this figure was a bit exceeded during the six days from the 22d to 27th of September (the average then being 126,000 rounds). At Verdun, from the 20th to the 28th of May, a daily mean expenditure of 130,000 rounds was recorded for seven corps or analogous commands, two of which were on more or less quiet sectors. To these figures we must add the expenditures of the 90 mm. and 80 mm. trench guns, etc. At the Somme, over a period of 10 days (25th of June to 4th of July), 1,400,000 rounds of 75 mm. were fired or, 1,400 tons per day for three reinforced corps.

(*b*) *Heavy artillery.*—The amount of heavy artillery to be sent into action in a corps sector is difficult to determine beforehand. Nevertheless, the minimum amount of heavy artillery to be foreseen in the case of a big attack is 100 heavy batteries of different calibers for an army of four corps. This means a daily allowance of 2,500 tons, or 8 trains of 30 wagons each. In the Champagne offensive we had 90 batteries, of which 37 were 120 mm. or 105 mm. The mean expenditure between the 22d and 26th was 1,200 tons. The theoretical daily allowance of these 90 batteries came to around 1,900 tons. The daily average tonnage expended by the heavy ar-

tillery at Verdun at the end of May, 1916, was much lower than this figure; around 1,100 tons. This was because, in a defensive action, we fire relatively few heavy caliber guns, especially the 220 mm. (only an average of 800 rounds per day from the 20th to 28th of May). It is the large caliber guns which raise the tonnage. Moreover, at Verdun we made no long preparatory bombardments to destroy the enemy's fortified lines. The average daily allowance for artillery in the Sixth Army in June–July, 1916, was about 3,000 tons, but up to now, over a period of operations lasting 10 days, we have hardly used one-half day's allowance per day, or 1,500 tons on the average.

2. DURATION OF THIS EXPENDITURE.

This rather large daily expenditure of field and heavy artillery ammunition should be prepared for, not only for a period of a few days but for a long time, both for offensive and defensive operations. This fact brings us to an interesting conclusion.

In the Battle of Champagne, foreseeing a daily expenditure beyond the supply, we met the situation by providing an initial supply near the batteries of 900 rounds per gun for the 75's and three days' fire allowance for the heavy artillery, a supply which we gradually allowed to diminish. But this procedure could not be followed to-day, since such an initial supply could not be considered save as a means of meeting an average attack. It is now necessary to provide for the permanent daily supply from the rear to the pieces themselves equal to the daily consumption at the time.

B. DIRECTION OF THE SERVICE OF AMMUNITION SUPPLY.

GENERAL ORGANIZATION.

(*a*) *At general headquarters and at the Army Group Headquarters* the ammunition, which was formally under direct supervision of the Staff, is now assigned by the latter to the Army Groups or Armies, either by the opening of credits on depots in their zones or by sending the ammunition through the regulating stations concerned.

(*b*) *In the Army* the question of the directing of this work is more complicated. Three organizations may take part in it—the Organization Section of the General Staff, the General Commanding the Artillery of the Army, and the Quartermaster General. The latter

is not in sufficiently direct communication with the Staff to be considered, except as to the means of execution at his disposition (great park of the Army artillery, personnel of the stations, supply depots, etc.). The Staff of the General Commanding the Artillery of the Army is usually not large enough to direct the difficult task of supplying ammunition to the Army. It is absorbed in tactical problems.

Here, as in the Army Groups, the distribution of duties is a prerogative of the Staff. In a serious battle, the Corps Commanders constantly make verbal or written requests to the Commanding General of the Army, and it is necessary that the office which replies should be part of the Staff and reply in the Commanding General's name.

Lastly, and above all, with the present expenditure, the supply of ammunition has become a question of adequate means of transportation. The Organization Section of the Staff is better fitted than any other to direct this transportation. It communicates directly in the regulating stations. It assigns railroad stations to the different services—commissary, ammunitions, evacuations, etc. It assigns transportation—motor and auxiliary convoys which need not be specialized but which must be assigned to this or that service—according to circumstances. This latter consideration is very important in case of an advance.

For these different reasons, I consider that it belongs to the Organization Section of the Army Staff, executing directly the orders of the Commanding General of the Army and the Chief of Staff, to direct this service. This will require almost the entire time of two selected officers. Therefore, with a view to large operations, an officer capable of directing the huge service of the supply of ammunition should be assigned to this Section. This is the solution which was reached by the Fourth Army in September, 1915, by the Second Army during the Verdun Battle, and by the Sixth and Tenth Armies during that of the Somme in July, 1916.

The work of the Army, to be effective, should consist exclusively of:

1. The distribution of ammunition at hand, first to the depots of the Army, and then to those of the Corps.

2. The bringing up of sufficient ammunitions to the Corps, so that they, in their turn, and with the means at their disposal, can supply the batteries.

The direct supplying of the batteries and battalions by the Army is to be avoided as much as possible. This was the procedure which

we were forced to make use of in the Fourth Army in September, 1915, because of unusual circumstances which I have mentioned (the improvised organization of the heavy artillery commands, the disposition of the 60-centimeter railroad, the many skeleton batteries without means of transportation, the lack of ammunition and its tardy delivery to the Army which obliged us to make trackage parallel to front in order to carry ammunition directly to the batteries as soon as delivered to the Army, etc.). But this procedure makes the task of the Army too great and exposes it to great disappointment.

(*c*) *In the Corps* the work of directing and carrying out the supply of ammunition naturally devolves on the artillery park, working under the authority of the General Commanding the Artillery and the General Commanding the Corps (Organization Section).

I explained the organization effected by the Ninth Corps at Verdun. It was very interesting. It was characterized by the fact that two senior officers of the park, with special means at their disposal, assumed charge, one of all supply of the field artillery and the other of all supply of the heavy artillery.

Two important remarks before leaving the general organization of the supply system:

1. The operation of this service is based *entirely on information as to expenditure.* It is therefore of the greatest importance that those doing the work, as well as the subordinate staffs, should be trained to get timely information on this subject—information which is at least approximate and susceptible of subsequent verification and correction.

2. There must be, at the minimum, the following heavy artillery ammunition on hand: One day's supply from the regulating station at the Army depots or branch heads; one day's supply from the Army depots at the Corps or advanced Army depots; one day's supply from the latter depots at the batteries. A battery commander who has but one day's supply of ammunition does not dare fire.

We may conclude that, during a battle, a large reserve fund (at least four days' supply) must be prepared, and that lack of ammunition may very easily result in a letting up of the fire in spite of the seemingly good paper situation of the Army. In other words, ammunition must be generously supplied *in advance*, so that, if the operations are arrested, we will find ourselves with a considerable quantity on hand.

C. REMARKS ON THE MEANS OF EXECUTION.

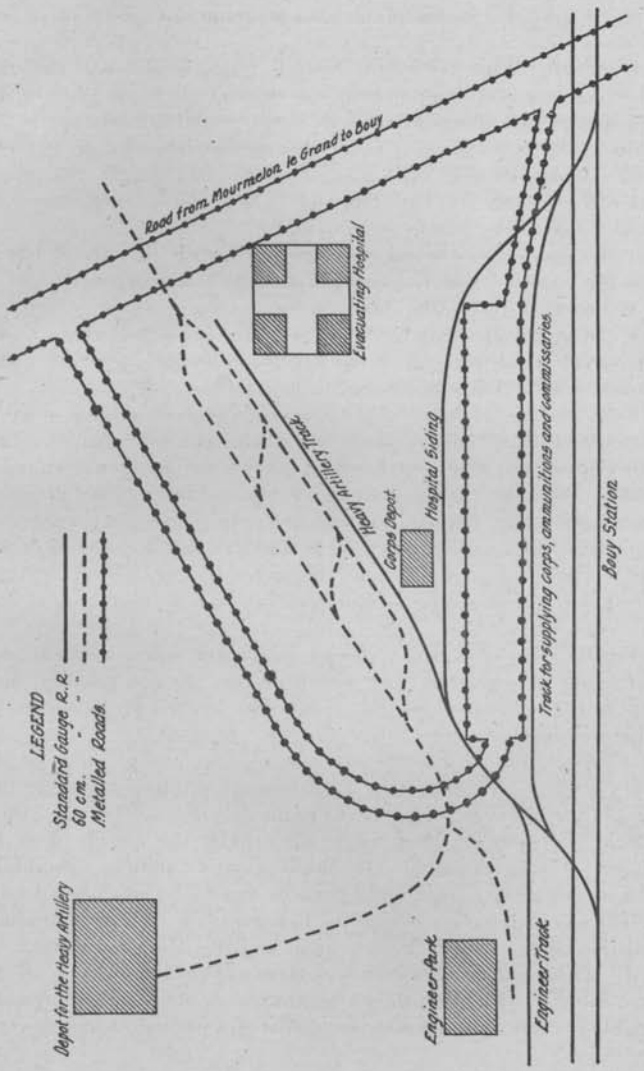
(PERSONNEL AND MATÉRIEL.)

Personnel.—The personnel charged with ammunition supply should have considerable technical ability. The calibers differ greatly, as well as the projectiles of each caliber (high explosive, shrapnel, case-bursting shrapnel, large capacity, cast steel, ordinary and special shells, etc.). There are many charges and innumerable fuzes, subjects to complicated rules for their usage. Lots must not be separated, or the projectiles of the same weight mixed up, etc. Depot chiefs and workmen must be well trained. As to the handling, there must be a large number of strong workmen; the service requires hard work night and day. In the Second Army, in May, the depots had about 400 men of all branches of the service—artillerymen, territorials, and even cavalrymen. The difference in the efficiency of these men was very great. In the Sixth Army on the Somme, the depots were more numerous and less important. The technical personnel was somewhat insufficient, both as to quality and quantity.

MEANS OF TRANSPORTING AMMUNITION.

(a) *Standard-gauge railroads and stations.*—The standard-gauge railroad is a very powerful means of transportation, but the unloading facilities must be sufficient. It will be necessary to have special yards for the heavy artillery (on account of the time required to unload a train of heavy-artillery ammunition). These yards must have a 60-centimeter transfer connection in order to facilitate the unloading and transporting of ammunition to the Army and Corps depots. If these yards also have raised platforms, the ammunition can be loaded directly onto the motor or horse-drawn wagons, and the greatest possible efficiency will result. Since it is necessary to provide about 10 trains per day for the heavy artillery of an army, there should be at least five of these yards. There must also be yards for the handling of field-artillery ammunition. The yards which handle the commissary supplies of the Corps may also be used for field-artillery ammunition.

The following sketch is an example of yard organization (Bouy, in the Fourth Army):


Road from Mourmelon le Grand to Bouy
Evacuating Hospital
Heavy Artillery Track
Corps Depot
Hospital Siding
Track for supplying corps, ammunitions and commissaries.
Bouy Station
Engineer Track
Engineer Park
Depot for the Heavy Artillery
LEGEND
Standard Gauge R.R.
60 cm.
Metalled Roads

(b) *The 60-centimeter railroad.*—In the first example of supply which I gave the 60-centimeter road rendered immense service and in the second hardly any. In the third it regained all of its former importance. What are we to conclude from the above? That the 60-centimeter is both a powerful and economical means of transportation, but that it has become absolutely unsafe to rely on in the zone of the batteries because of the present intensity of artillery fire. It may be used especially:

1. To establish the batteries and to provide the first source of supply before the battle.
2. To connect the standard-gauge roads with the Army depots and the latter with each other and with the Corps depots.
3. For work inside the depots.
4. To supply the batteries when we have fire superiority.
5. Even it this superiority has not been obtained, to connect the batteries with points accessible to motor trucks.

From this last point of view it may render great service, even if the system should fail to operate as a whole because of many breaks. Stretches of track several hundred meters in length may remain intact. They may be used for the transportation of heavy artillery ammunition from the road to the battery, the cars on the tracks being pushed by hand or drawn by horses. In this way the 60-centimeter railroad can supplement the motor transport, which is unfortunately confined to good roads, except on very good ground and in very good weather.

Finally, the capacity of the 60-centimeter railroad chiefly depends on the regularity with which its flat cars are unloaded and sent to the rear, after they have been sent forward to the batteries. The men in charge must know this.

(c) *Ammunition sections, park sections, and combat trains of the heavy artillery.*—These are the normal means of transportation in the zone of the batteries. In order to attain the greatest efficiency, they should be consolidated in each Corps under the command of an officer. The latter should effect the supply by a judicious combination of motor trucks (long transports on the roads) and horse-drawn vehicles (which have access to the batteries over all sorts of ground, but the loads of which must be light and the distances short).

(d) *Field artillery ammunition sections and combat trains of the 75 mm. batteries.*—Field artillery ammunition sections in the Corps are unable to carry more than 80 rounds per gun per trip, which is very

little. They must be aided, either by greatly reducing the length of their trips, or by making the combat trains run backward and forward. (The combat trains have a capacity of 150 rounds per gun per trip.) The regulation scheme of combat trains placed several hundred meters behind their batteries and supplied at their stations by the automobile ammunition transports, does not conform to present warfare. Its application would expose the most efficient and simple means of transportation which field artillery has at its disposal to needless destruction.

Depots.—Emphasis should be placed on the importance of choosing proper locations for depots, and of their convenient organization.

Two considerations should influence the choice of location: (*a*) Security—the best locations are in woods; (*b*) Proximity to all means of communication (standard-gauge railroad for Army depots, 60-centimeter gauge railroad and road). Always consider, when selecting the location for a depot, that it may rain, and that a depot can not be removed like a wagon park.

As for organization, place the shelters containing the heaviest projectiles between a 60-centimeter track and a metalled road. The powder must be separated as far as possible from the projectiles.

Finally, it is very convenient to have all the small spare parts possible and a reserve of some rounds of each kind of projectiles in a central depot, as was done in the Second Army. The multiplicity of calibers and charges prevents this being done in all the depots, but it can be done in a single depot, and we can then be sure of finding at any time all the necessary small articles. (In the Fourth Army this idea was pushed to an extreme. All the spare parts were consolidated in a single park of the Army Group, at Neuville, near Moreuil.) All requisitions must be addressed in writing or by telephone to this park, which delivers by means of its auto trucks. This extremely centralized system seems to give satisfaction.

APPENDIX I.

CHAMPAGNE BATTLE.

Expenditure in field artillery ammunition.

September, 1915.	Fourth Corps.	Thirty-second Corps.	Seventh Corps.	Second Colonial Corps.	Total.
Preparation:					
22d to 23d	13,000	30,000	50,000	30,000	123,000
23d to 24th	15,000	40,000	25,000	30,000	110,000
24th to 25th	25,000	35,000	35,000	35,000	130,000
Day of the principal attack:					
25th to 26th	35,000	37,000	35,000	47,000	154,000
26th to 27th	35,000	37,000	35,000	47,000	115,000
27th to 28th	35,000	37,000	35,000	47,000	125,000
Grand total					757,000

Average daily expenditure, 126,000 rounds.
(NOTE.—The Fourth Army Corps attacked on a small part of its front only.)

APPENDIX II.

CHAMPAGNE BATTLE.

Expenditure in heavy artillery ammunition.

September, 1915.	95	105	120	155	155 howitzer.	155 rapid-fire howitzer.	220	270
22d to 23d	1,800	1,100	6,000	3,600	2,600	3,000	2,100	170
23d to 24th	300	2,000	11,700	5,600	2,000	3,100	2,700	1,100
24th to 25th	2,800	250	17,000	6,900	2,800	2,300	2,900	1,700
25th to 26th	2,500	5,600	14,000	5,600	2,500	3,000	2,900	1,660
26th to 27th	1,700	3,450	7,400	2,300	900	1,100	1,300	700
Rounds	9,100	12,400	56,100	24,000	10,800	12,500	11,900	5,330
Tons	91	243	1,122	1,200	540	625	1,428	1,170

Total weight, 6,420 tons; daily average in tons, 1,280 tons.

CHAMPAGNE BATTLE—continued.

Number of heavy batteries in the Fourth Army.

Calibers.	Number of batteries.	Remarks.
105	6	
120	31	(Of which 6 or 8 consisted of 6 guns.)
155	20	
155 howitzer	9	
155 rapid-fire howitzer	7	
220	11	
270	6	

APPENDIX III.

VERDUN.

Expenditure of artillery ammunition (Second Army).

[May 20 to 28.—Phase of the battle covering the retaking of Douaumont and the violent German offensive which followed.]

May.	75	90	95	100	105	120	155	220	270
20	120,000	2,300	4,000	900	6,000	15,000	8,200	700	300
21	124,000	2,400	4,000	900	4,800	15,000	8,000	1,400	180
22	207,000	5,000	7,000	2,300	7,000	16,000	18,500	2,200	780
23	167,000	2,600	8,000	1,000	7,200	18,000	15,000	1,200	250
24	155,000	2,000	6,300	650	4,200	17,000	12,000	900	150
25	107,000	2,400	5,200	630	3,000	10,000	11,000	540	180
26	98,000	1,700	6,000	280	3,100	12,000	9,500	540	17
27	97,000	1,700	5,100	40	2,100	10,000	8,500	2,600	75
28	87,000	2,200	4,000	830	4,600	10,000	5,000	900	30
Total	1,162,000	22,300	49,600	7,500	42,000	123,000	95,700	7,700	1,960

SOMME OFFENSIVE.

Expenditure of field artillery ammunition.

	Calibers.			
	75	58		240
		Bomb of 16-kilogram weight.	Large model bomb.	
	Rounds per gun.	*Per battery.*		
Average expenditure during six days' preparation	290	400	36	20 (?)
Expenditure, July 1	450	(?)	(?)	(?)
Expenditure, July 2	200	(?)	(?)	(?)
Total expenditure in the six days of preparation	860,000	97,000	8,800	6,900 (?)

Expenditures: First day of the attack, 266,000; second day of the attack, 100,000; third day of the attack, 100,000.

SOMME OFFENSIVE.

Expenditure of ammunition for heavy artillery.

[Period from June 25 to July 2.]

Caliber.	95	100 rapid fire.	105	120	120 Schneider howitzer.	155	155 howitzer.	220	270
Average expenditure per piece per day over a six-day period	110	[1] 34	80	90	[2] 30	40	70	43	15
Total expenditure per gun during six days' preparation	660	[1] 204	480	540	[2] 180	240	420	258	90
Expenditure per gun, first day attack	200	[1] 150	200	200	[2] 250	170	160	95	70
Expenditure per gun, second day attack	120	[1] 115	120	120	[2] 25	85	55	30	6
Total expenditure per gun, eight days	980	[1] 469	800	860	[2] 455	495	635	383	166

[1] The expenditure was very much reduced because the number of rounds was very limited. The 100 rapid-fire gun has an enormous firing capacity.
[2] Analogous remark to that above.

Ratio between the actual expenditures and a theoretical daily fire.

[Period from June 25 to July 1.]

Calibers.	Daily expenditure of the heaviest day's fire (expressed in theoretical daily fire).	Ratio between average 10 days' fire and the theoretical daily fire.
95	1.3	0.6
100 rapid fire	2	[2] 0.4
105	1.2	0.6
120 gun	[1] 1.6	0.75
120 howitzer, Schneider	[1] 2.1	[3] 0.53
155 gun	[1] 1.7	0.6
155 howitzer	[1] 1.3	0.6
220	1.1	0.45

[1] Day of attack.
[2] Expenditure limited by orders.
[3] Lack of ammunition.

TRANSLATOR'S NOTE.—A theoretical day's fire is a day's fire computed from statistics, and might be called "average daily fire to be expected."

APPENDIX IV.

SOME BRIEF POINTS ON THE SUPPLY OF THE INFANTRY AND TRENCH ARTILLERY AMMUNITION.

Supply of infantry ammunition.—The expenditure in infantry ammunition has not increased in the proportion of that of the artillery. This is one of the characteristics of the modern battle. The infantry enters an engagement with a supply of cartridges which will last, practically, until the infantry is relieved. Under those conditions, the supply of infantry ammunition presents only the local difficulties (which are considerable, however), encountered by the carriers on their way to the first lines.

Supply of grenades.—In spite of the development of this means of combat, the weight of the grenades to be carried represents, to the services of the rear, a minimum weight and burden in comparison with the artillery ammunition tonnage. In this case, as above, the chief difficulty lies in the carrying of the grenades from the most advanced depot up to the combatants.

In open war the use of the grenades must probably be restricted. There are, however, several precautions to be taken. The infantrymen can not march while carrying grenades, as they are always dangerous, heavy, and cumbersome for the men. Wagons should follow the troops, carrying a supply of grenades for distribution to those units which are to use them. One requisitioned wagon per regiment will be necessary for the purpose. These wagons can be reloaded from special consignments brought by motor trucks.

TRENCH ARTILLERY.

The ammunition for trench artillery is heavy and cumbersome. At present this artillery is used chiefly for preparing an attack on the first-line trenches. The supply question usually consists, therefore, in building up a large initial supply. The 60-centimeter road is especially useful for transporting supplies up to the most advanced points possible. From there, the shells are transported by any means at the disposal of the batteries (park wagons, carts, and even men). The assistance of infantry auxiliaries is sometimes indispensable during this last portion of the trip.

After the taking of the first position it is almost impossible to put a trench battery of some size into action rapidly and to supply it. The state of the communication and the ground, as well as the enemy fire, prevent any large supply of heavy and cumbersome ammunition being brought up to the newly-won positions during the first days. The means of transportation assigned the batteries and transportation by hand are the usual ways of solving this problem whenever it can be solved.

PROPERTY OF U. S. ARMY