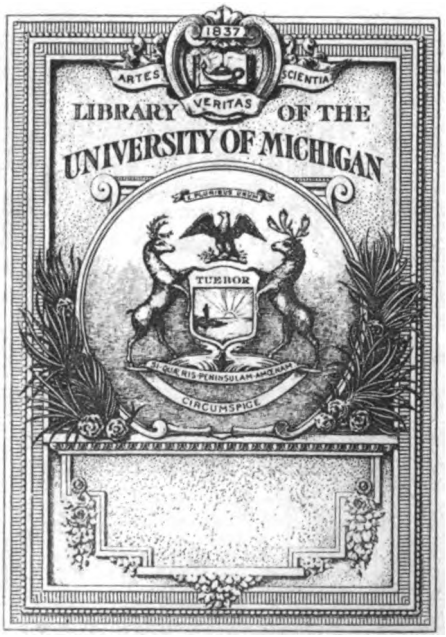

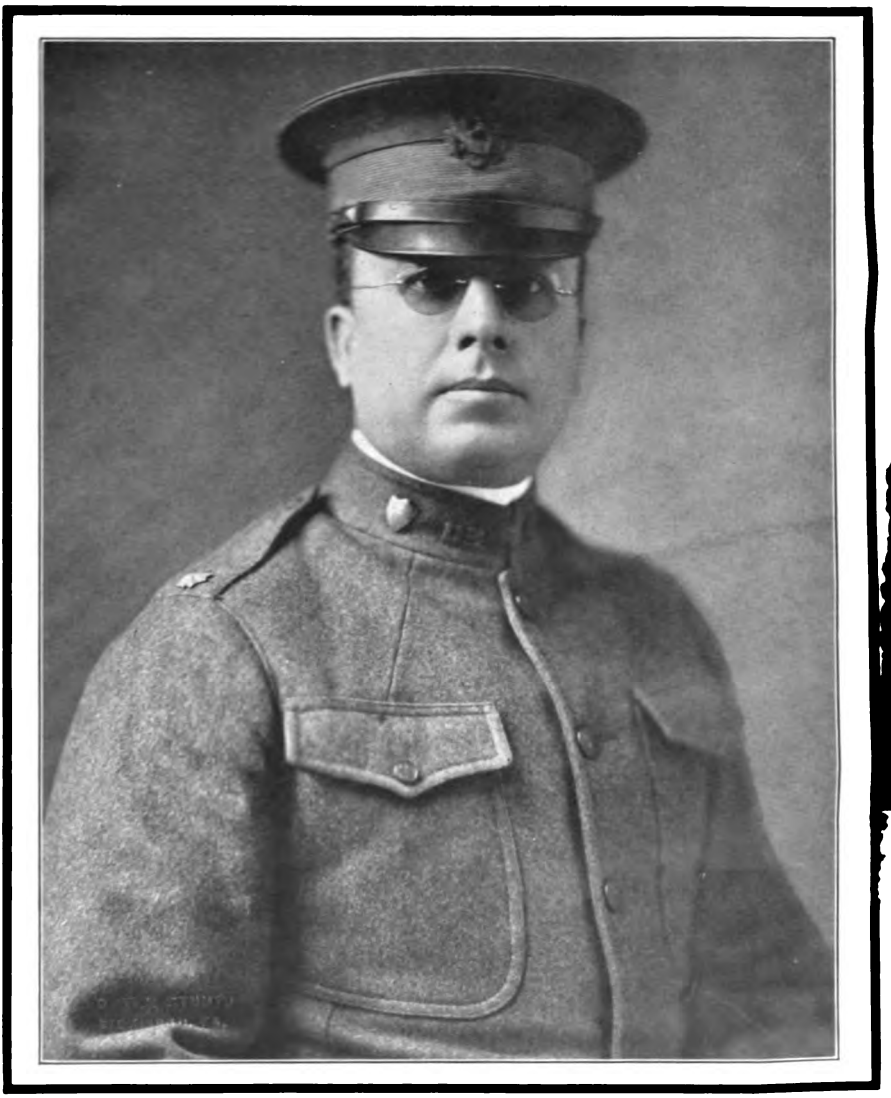

COL. HARRY L. HODGES

General Staff, United States Army. American Member of the Board, July, 1919–November, 1921

Allied and Associated powers.

REPORT OF THE MILITARY BOARD OF ALLIED SUPPLY

ERRATA

On page 32, of Volume I, in table showing the organization of the Military Board of Allied Supply, there appears (under Italian section):

3. Lieut. Rinaldo Stroppa Quaglia, April, 1919–October, 1919.
4. Maj. Giuseppi De Stefanis, October, 1919, to date.

This should read as follows:

3. Lieut. Rinaldo Stroppa Quaglia, April, 1919–August, 1920.
4. Maj. Giuseppi De Stefanis, August, 1920, to date.

701—25

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1925

NOTE

Charts, maps, and diagrams referred to in this book are contained in part two, Volume I

For index of charts and maps see Volume I, part one pages 4 to 24

THE ALLIED ARMIES UNDER MARSHAL FOCH IN THE FRANCO-BELGIAN THEATER OF OPERATIONS.

REPORT OF THE MILITARY BOARD OF ALLIED SUPPLY.

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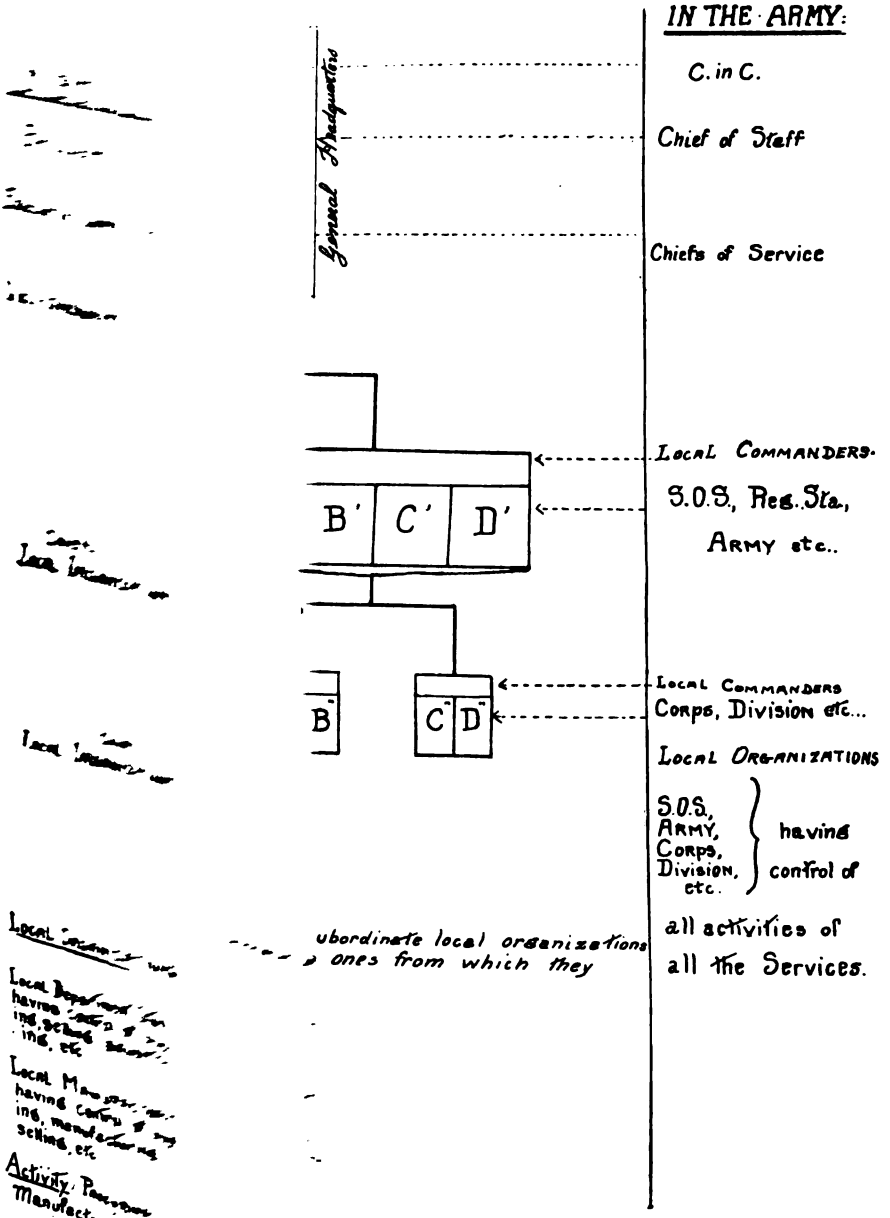


CHAPTER 1.

ORGANIZATION.[1]

Since this work is essentially a study and statement of the organization established by the Allied nations to effect the supply (in its broader sense) of their armies, it is therefore deemed advisable to set forth a brief exposition of the principles or fundamentals of pure organization. When applied to any of the subsequent chapters this will serve to clarify the organization adopted and the reasons therefor.

The first outstanding feature encountered in the examination of each, is that there are certain basic differences in the forms of systems or organizations adopted by the nations concerned.

Economists seem to agree that there are but three basic forms of organization and have arbitrarily given them the titles of: "Divisional," "Departmental," and "Military" organization, as best indicating their essential differences.

The divisional form of organization (shown in diagram 1) is defined as that organization which is subdivided along the lines of direct responsibility. Each subordinate is supreme within his limited field. He controls and coordinates all the essential activities of the organization within the scope of his operations. The duties of his superior are differentiated from his only by the amount and extent of power exercised. This system naturally tends toward territorial division and may best be illustrated by the organization of the combat forces of a nation. These are divided into groups of armies, corps, divisions, brigades, regiments, battalions, companies, platoons and squads. The commander of a division is supreme in his own local but restricted area, wherein he coordinates all activities, tactical and supply, under his particular jurisdiction. The next higher commander (corps) has a greater responsibility and a larger area of control. Above him, in succession, come the army commanders, the commanders of groups of armies and, finally, the commander in chief. Each of the foregoing exercises supreme con-

[1] Prepared for the Military Board of Allied Supply by Colonel Harry L. Hodges, G. S., U. S. Army, Chief of Staff of the American Section, M. B. A. S.

trol in his own particular area, coordinating all activities, tactical, supply, etc., incident to his command and differing from that of his subordinates only in the amount of authority exercised.

In the business world, the typical example of this form of organization is a railroad system, which is divided into operating divisions whose interior organizations are identical. Over the operating divisions of a railroad system there is one supreme commander, under whom operate the subordinate division commanders, each with similar duties but with more limited responsibility.

The departmental system of organization (shown in diagram 2) is that organization which is subdivided by activities or departments and which seeks to gain its object by the specialization of these activities, through the establishment of a group of parallel specialists. Each activity covers exactly the same area, physically or in population, as is covered by the operation of the organization as a whole. The coordination or control of each activity is, however, at the central office. Under this form of organization there will be found, in any particular territorial subdivision of the organization as a whole, the agencies of each department of activity actually, if not physically, separated and responsible to no general local authority but directly responsible to the chief of the particular activity at the central office.

In the business world, this form of organization is best examplified by a corporation which sells its own manufactured products. Gathered in the central office are the vice presidents of the concern, each in charge of one activity, such as purchasing or procurement, manufacturing, distributing or selling, accounting or finance. The activities of these several departments, while differing in their nature, cover exactly the same area. The various procurement agencies throughout the organization report to the vice president in charge of procurement, the manufacturing agencies report to the vice president in charge of manufacturing and similarly for each of the other departments.

The military man can best appreciate the departmental form of organization when he considers the military organization's subdivision into services, namely: the medical corps, ordnance department, quartermaster corps, etc.

Inasmuch as the departmental and divisional forms of organization are, to a high degree, complementary and not antagonistic, it is difficult at first to appreciate the distinction between the two. To emphasize departmental organization, let us consider the military organization organized on purely departmental lines. Under such a system, there would be found in each division, corps, or larger

Departmental Orga

in BUSINESS:		in the ARMY:
PRESIDENT		C. in C.
EXECUTIVE COMMITTEE		Chief of Staff
VICE-PRESIDENTS		Chiefs of Services
LOCAL ORGANIZATIONS	A' B' C' D'	S.O.S., ARMY, etc...
LOCAL ORGANIZATIONS	A' A' B' C' C' D' D'	CORPS, DIVISION, etc.
ACTIVITY. Procuring, Manufacturing, Selling, etc..	A,B,C,D LOCAL ATIONS either functior CONTI	ACTIVITY: Procurement, Distribution or Service, as: Ordnance, Q.M., etc..

unit, a surgeon not locally responsible to the division, corps, or larger unit commander but directly responsible to his chief at the central office, that is to say, at General Headquarters. Similarly, in each division or larger unit, there would be a quartermaster, a signal officer, or ordnance officer, etc., owing no, or but limited, allegiance to the division, corps, or higher unit commander in whose area he might be functioning, but owing allegiance primarily to his supreme chief at General Headquarters.

Together, at General Headquarters, there would be found the chief quartermaster, the chief ordnance officer, the chief signal officer, etc. Each would be supreme in all questions concerning his own particular activity, either at General Headquarters or in the lesser subdivisions. The activities of these chiefs would be coordinated solely by the commander in chief. Although these activities cover the same territorial areas, in each area would be found subordinates of each chief, responsible only to the chief of that activity and not under the authority of the local representative of the supreme command. The result would be that in order to obtain any final decision covering a matter of local coordination with other activities in a similar subdivision of the military organization, it would be necessary to refer the matter, whether local or otherwise, to the centralized authority at General Headquarters.

The divisional and departmental systems of organization are the only two (of the basic three) to be found in the business world or in organizations in civil life. It is obvious that there are certain advantages and disadvantages peculiar to each, hence, before proceeding to a discussion of the military organization, it may be well to digress for a moment and consider them briefly.

The advantages and disadvantages of these two systems of organization may be briefly stated as follows:

DIVISIONAL.

ADVANTAGES.

1. Each organization is more free to adapt itself to local conditions.
2. It favors prompt action (speed) in that the officer in charge is local.
3. It makes for responsibility, the officer being responsible for all operating conditions in his organization as a unit.
4. It promotes unity of purpose.
5. It increases individual initiative and competition between similar units.
6. It develops "all around" men.

DEPARTMENTAL.

ADVANTAGES.

1. It secures "expertness" and develops specialists.
2. It secures uniformity of method in each activity.

DISADVANTAGES.

1. The local directing head can not be a technical expert in all activities.
2. The uniformity of operations as a whole is difficult, on account of the varying experience and capacity of local commanders.
3. The responsibility of local representatives of an activity is divided, in some things they are responsible to the chief of the activity and in others (command) to the local commander; similarly, in procurement, to the chief of service and, in use, to the local commander.

DISADVANTAGES.

1. The chief of an activity will work for the showing of his service, even at the expense of some other service.
2. While uniformity of method in an activity is secured, it is secured by direct responsibility to the chief of the service and by direct reports to this chief, at the expense of time and power of local decision.
3. There is lack of harmony locally, because no local commander has authority to give a decision involving all the services at one time. This can be secured only at the "central office," where alone is centralized sufficient authority to make a decision affecting all services.
4. Responsibility is not so effective because: (*a*) authority is more remote; (*b*) it is not informed of local conditions; (*c*) there is difficulty in placing responsibility.

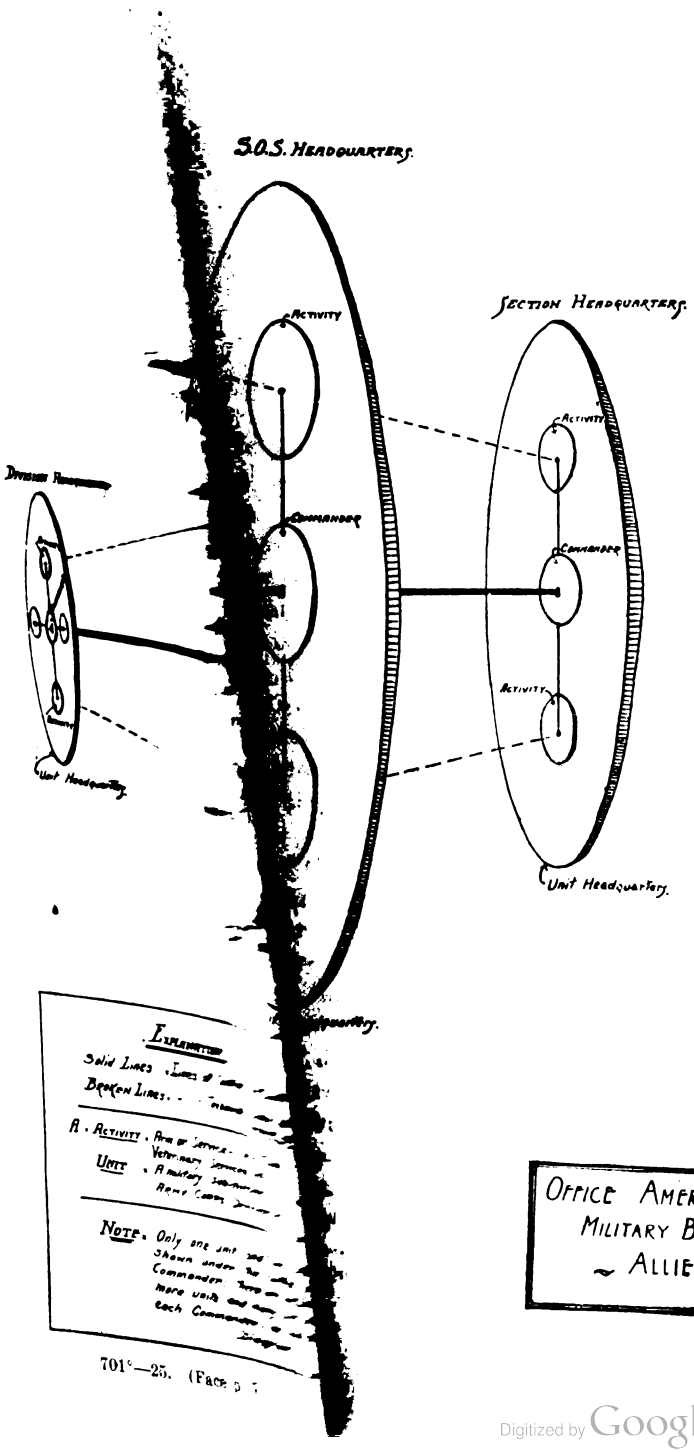
Summing up, it is the opinion of students of organization that the departmental form of organization is preferable where expertness, economy, and certain technical features are more important than the executive. On the other hand, where large numbers are involved, when the territory is extensive, when units must function independently and where speed and rapidity are essential, the divisional form of organization is to be preferred.

In the American Expeditionary Forces, the Commanding General of the Services of Supply exercised his control largely through various territorial sections which grew up around the ports of entry for supplies, in the interior, and in the advanced zone.[2] During the process of delimiting the duties of his various assistants, controversies arose:

The commanders of these sections were usually general officers appointed by the Commanding General, S. O. S. The relations between the section commander and the representatives of the various services in his section were similar to those between the Commanding General, S. O. S., and the chiefs of the services at the headquarters of the S. O. S., at Tours.

From time to time differences arose between the section commanders and the local representatives of services, generally in connection with the execution of various projects in the sections by the services; questions also arose concerning the personnel of the various services operating in the sections. The chiefs of the services, at Tours, considered that their representatives in the sections were the

[2] A map showing these various sections will be found in Chapter VIII, Volume I. (Chart 2.)



Office American Member
Military Board of
~ Allied Supply ~

proper channels for the transmission of instructions, while the section commanders, as direct representatives of the Commanding General, S. O. S., considered that they themselves were the proper channels.

The approved policy covering these difficulties was that the section commanders, who were responsible for the proper performance of duties, as well as for the discipline, supply and sanitation of all personnel in their respective sections, were the proper channels, exception being made in the case of communications of a purely routine or technical nature between chiefs of services and their representatives in the sections (divisional organization).

Headquarters, S. O. S., informed the section commanders of all enunciated policies and the latter were guided by these policies in the operation and administration of their sections. The tendency of growth was toward increasing the authority of the section commanders. Policies were enunciated by headquarters, and section commanders were responsible for their enforcement. As a matter of fact, the American S. O. S., was so vast territorily, it contained such a large personnel and covered so many different activities, that decentralization (i. e. divisional organization) was necessary.

These controversies were not, in reality, conflicts of personalities. Their origin was deeper than that and they were caused by the inevitable conflict between two differing and basic systems of organization, the divisional and the departmental. This is only a single instance of the ever recurring contest between centralization and decentralization.

The military organization (diagram 3) is really a combination of the departmental and divisional systems. Its basic elements are: direct responsibility, speed, (obtained through the establishment of territorial command), and expertness, but the latter must not be obtained at the expense of the first two items.

To secure these three basic elements military organization must be largely divisional. Therefore we have companies, regiments, brigades, divisions, corps, armies, all similarly and "divisionally" organized and each having control, within specified limits, of all activities.

When fighting units were small, when activities were neither diversified nor extended, and when nature provided each man his weapons or he provided them himself, the military organization could be purely divisional. However, the growth of armies and of activities would have required that each commander be fully competent in all activities; in other words, that he be a "Jack of all trades." As weapons became more complicated and could no longer

be provided by each individual, departments and services were formed, because, the more technical the weapon, the higher the degree of expertness which the provider must possess. Departmental organization was the natural result of this necessity for expertness.

Between the numerous departments and services and the essentially military units, divisionally organized, there must be local and immediate coordination. It is the establishment of this local coordination which differentiates the military organization from either the departmental or the divisional systems. It will be found that such a coordinating agency has existed in the military establishment or the military organization from time immemorial. The "adjutant" was the coordinator between the services and the units, divisionally organized, in the regiment and in the larger organizations and, through this coordination, the "adjutant" made it possible for the commander to exercise direct command over those units.

With the advent of larger organizations, larger coordinating agencies became necessary and this was logically followed by the employment of a "chief of staff." Finally, when the "chief of staff's" duties became too numerous, an "executive staff" (call it "General Staff" or otherwise) was established as the coordinating agency between the units, divisionally organized, and the services, departmentally organized. This duty is obviously a delicate one, as the coordinator can in no sense take away the command of the units, which are "divisionally" organized, or the control of the services, which are "departmentally" organized. There is a tendency among the sections of the "executive staff" of the various units that are divisionally organized, that is to say, divisions, corps, armies, etc., to communicate directly with similiarly designated staff sections in the other units. This is an unconscious attempt on the part of the members of the executive staff to establish within itself a "departmental" form of organization; in other words, to make it a service. In order that it may function without friction, it is necessary that the executive staff of each unit concern itself solely with coordination in that unit. All matters which are not within the jurisdiction of the commander of that unit should be taken up by him, or with his consent and knowledge, with the commander of the next higher unit.

As has been previously stated the military organization binds together the divisional and the departmental systems, therefore, in all military organizations, there will be found elements of both in greater or lesser proportions. The divisional organization, to secure direct command and speed; the departmental organization, to insure expertness.

The most difficult feature in all military organization is to determine where the departmental organization, which flourishes in

time of peace, gives way to or merges into the divisional organization, which seems to be made necessary by the rapidity of operations in time of war. It will be found that there is a tendency toward the departmental system where distances are short and when the local cooperation of capable men is, therefore, possible. Where the transversal shipment of troops or supplies is not a necessity or when intercommunication can be rapidly established, as in stabilized warfare, it can be used in a General Headquarters or War Department, but when distance places one remote from central authority and when celerity is an essential, the divisional system must be employed. Commodity procurement, when necessary, demands time and can be used effectively when time is available, but procurement by and for a local organization must be employed whenever time is limited and immediate use is required.

In none of the armies was there a failure of the supply system to adequately provide for the troops and there is no record of a "Tommy," or a "Poilu," or a "Yank," ever having been starved to death.

The French supply system followed more closely the divisional than the departmental organization, while the British, in the procurement and distribution of supply, followed more closely the departmental than the divisional system. The latter case may be illustrated by the manner in which supplies were obtained and distributed to the British armies in France. The "Q" representative of a unit made request to the "Q" representative of the next higher unit. This request finally found its way to the Quartermaster General, at British General Headquarters, who approved it in whole or in part and then forwarded the request, as approved, to the "Q" representative at the base for compliance. At the central office (G. H. Q.), the Quartermaster General gave the necessary instructions to the Director General of Transportation to insure the delivery of the supplies from the base to the railhead. These supplies, in their movement forward, passed through a Regulating Officer who was charged solely with transportation and who had no local control over the quantity or distribution of supplies. The control of all of the services was centralized at General Headquarters and at General Headquarters only. This is a basic element in departmental organization.

However, no military organization can be entirely departmental, for the unit commanders in the armies, in order to secure speed, must have control of all services in their organizations, but there was a greater tendency to follow departmental lines of communication in the procurement and distribution of supplies here, and in the armies of Belgium and Italy, than in the other armies. Due to the short distances and consequent ease of communication and conference, there was not the need for the exercise of complete "local con-

trol." The British system, therefore, could and did function perfectly; to have decentralized there would have been straining a point for the sake of form and not because there was any necessity. Increased distances would have necessitated greater local control (the basis of divisional organization), as was evidenced by the British in handling their six other expeditionary forces.

The Italian Army's organization, while divided territorially into a "Zone of the Interior" and a "Zone of the Armies," in all other respects followed more closely the departmental system of organization. The American organization, in which the departmental system had thrived through years of peace training, because of the absence of necessity for speed and due to the desire for enconomy and expertness, had a tendency at first to follow departmental lines of organization. However, the long distances to be covered and the necessity for the exercise of speed and immediate action by the local commander, caused this organization to become more divisional than departmental.

In the United States, the World War demonstrated that, in the formation at top speed of an immense army, divisional organization must take precedence over departmental organization and that military organization, as defined above, becomes a necessity.

NOTE.—An interesting incident illustrative of this fact is told concerning the 77th U. S. Division, which, when relieved from duty with the British, left a small guard in charge of a food dump that the division was unable to remove on account of a shortage of transportation. Several months afterwards, the division having meanwhile participated in most of the larger actions, found itself in the Meuse-Argonne. The division commander one day received a formidable looking official document, forwarded to him from the British High Command, informing him that the two men left in charge of the dump had eaten it up and requesting either another dump or the relief of the men.

LIEUT. M. F. J. BRUNOW

Secretary, American Section Military Board of Allied Supply

CHAPTER II.

SECTION I—PART I.

BRITISH WAR OFFICE.[1]

HISTORICAL RECORD.

The War Period—August, 1914, to February, 1919.

The outbreak of war on 4th August, 1914, the mobilization of the Expeditionary Force and the rapid enlistment of the new armies, caused not only a number of changes in the organization of the War Office, but also a very large increase in staff, which grew in just over four years from less than 2,000 to approximately 19,500. No allowances is made in these figures for audit staff in the commands or certain other staff stationed outside of London. This expansion in personnel resulted in the scattering of many branches outside the main building and in the employment of women in considerable numbers. The process which was general in all Government Departments connected with the war continued throughout this period and led to the appointment by the War Cabinet in June, 1918, of a committee to enquire into the numbers and organizations of the clerical staff. By January, 1919, there was but little reduction in the numbers of the staff generally, and in certain branches the work of demobilization had caused considerable increases, so that no less than 52 buildings in London were either wholly or partially occupied by the Department.

From the War Office (and the Admiralty) sprang three Ministries, viz., The Ministry of Munitions of War, the Ministry of Pensions, and the Air Ministry, while another, viz., the Ministry of National Service, added to its existing duties by taking over, in the autumn of 1917, from the Adjutant-General's Department the very important task of obtaining men for the Army. Further mention will be made in the appropriate place of the causes and origin of these new departments of State.

The Army Council[2] itself was increased during the period under review by three military members: (1) The Deputy Chief of the

[1] Extract from the Administrative Directory, British War Office.

[2] The Army Council in February 1919, consisted of:
The Secretary of State for War (President),
The Under Secretary of State for War (Vice President),
The Chief of the Imperial General Staff,
The Master-General of the Ordnance,
The Adjutant-General to the Forces,
The Quartermaster-General to the Forces,
The Deputy Chief of the Imperial General Staff,
The Financial Secretary (Finance Member),
The Director-General of Movements and Railways and
The Surveyor-General of Supply.

Imperial General Staff, in December, 1915; (2) The Director-General of Military Aeronautics, in February, 1916, who ceased to be a member upon the institution of an Air Ministry; (3) The Permanent British Military Representative at the Supreme War Council, Versailles, in February 1918, who ceased to be a member shortly afterwards, his name being omitted in the Letters Patent of 20th April, 1918; and by two civilian members: (i) The Director-General of Movements and Railways, in February 1917, and (ii) the Surveyor-General of Supply, in May 1917. This post had been anticipated in December 1914, by the appointment of Sir George Gibb as an additional civilian member of the Army Council to supervise Army contracts. An Order in Council dated 14th October, 1915 (see page 20, Administrative Directory, British Army, 1919) laid down that the precedence of the military members of Council while the war lasted should be according to Army seniority.

From July to December 1916, and from April 1918, to January 1919, the Under Secretary of State for War acted as the deputy of the Secretary of State in all matters affecting administration. He became also the Vice-President of the Army Council, an arrangement which still continues, and the title of "Civil Member" lapsed.

In January 1919, upon the reconstruction of the Government, the Secretary of State for War took charge also of the Air Ministry, to which an under Secretary of State was appointed to act as his deputy and to preside at meetings of the Air Council.

It will be convenient to show, seriatim, the principal changes affecting each Member of the Council.

1. *The Chief of the Imperial General Staff.*—Immediately after the outbreak of war a Press Bureau was formed in conjunction with the Admiralty with a branch in the War Office, to exercise the censorship of the Press and to serve as the channel through which official information should be supplied to newspapers. The administration of the Bureau soon passed to the Home Office.

In December 1914, a Director of Home Defense was appointed. In December 1915, a Deputy Chief of the Imperial General Staff was created by Letters Patent and constituted a member of the Army Council. On the appointment in January, 1916, of a Commander-in-Chief, Home Forces, much of the work of the Directors of Home Defense and Military Training was transferred to him and these posts were abolished in the War Office. About the same time a Director of Military Intelligence was appointed in addition to the Director of Military Operations, and a complete reorganization was undertaken in the Department of the Chief of the Imperial General Staff. The work of the Department was now constituted under three Directors, viz., (1) the Director of Staff Duties,

with the charge of training and of that part of the work previously undertaken by the Directorate of Military Training which had not been transferred to the Commander-in-Chief, Home Forces; (2) The Director of Military Operations, with the charge of military operations; and (3) the Director of Military Intelligence, with the charge of the organization which had grown up during the war in regard to military information and censorship. The work connected with the censorship was very great and necessitated the employment of a large staff not only in London but also at Liverpool. At the same time a Sub-Director of Military Intelligence, called the Director of Special Intelligence, was appointed. He became the Deputy-Director of Military Intelligence in March, 1918. On 1st January, 1919, a new appointment was made to the Directorate of Military Intelligence, viz., an Assistant Director of Special Intelligence.

An Order in Council of January 27th, 1916 (see page 21, Administrative Directory, British Army, 1919) entrusted to the Chief of the Imperial General Staff the responsibility for issuing the orders of the Government in regard to military operations, by which means the General Staff was intended to be brought into more direct relations with the Cabinet.

Letters Patent of 19th February 1918, included the then holder of the office of Permanent British Military Representative, British Section, Supreme War Council of the Allied Governments, as a Member of the Army Council. By an Order in Council of 27th February 1918 (see page 26, Administrative Directory, British Army, 1919) both the Chief of the Imperial General Staff and the Deputy Chief of the Imperial General Staff were made responsible, like the other Members of Council, to the Secretary of State for such business as should be assigned to them from time to time, and the special position assigned to the Chief of the Imperial General Staff in January, 1916, was thereby altered.

In 1917, as a result of the increased use of tanks in war, a Director-General, Tank Corps, was appointed under the Chief of the Imperial General Staff with charge of questions relating to the supply and employment of tanks and the personnel of the Tank Corps. The Directorate continued to 1st August 1918, when its work was taken over by branches of the Staff Duties, Artillery and Organization Directorates.

In May, 1918, a new section of the Staff Duties Directorate was formed to deal with questions of policy and co-ordinate all questions concerning the signal service, an adjustment of duties being made with the Military Intelligence Directorate.

In August 1918, a Deputy Director of Staff Duties (Education) was appointed to direct and co-ordinate into one authorized educa-

tional training scheme the various schemes of educational work which had for some time been unofficially in operation among the Armies at home and abroad.

II. *The Adjutant General.*—The Directorate of Recruiting and Organization was soon split up into two directorates, viz., Recruiting and Organization. The state of recruiting in the autumn of 1915 led to the appointment of a Director-General of Recruiting. This office lapsed shortly after the passing of the second Military Service Act in May 1916, and the Directorate was organized to meet the new conditions. In the summer of 1917, the methods of the recruiting offices were subjected to examination by a Committee of the House of Commons, and the business of recruiting was, by an Order in Council dated 23rd October, 1917 (see page 23, Administrative Directory, British Army, 1919) transferred from the War Office to the Ministry of National Service, to which department was entrusted the administration of all other man-power problems. A further Order in Council, dated 18th December, 1918 (see page 27, Administrative Directory, British Army, 1919) revised the position by leaving it to the Director-General of National Service to exercise all powers conferred by the Military Service Acts, and by re-transferring to the Army Council and the Secretary of State, to be exercised concurrently with the Director-General of National Service other powers conferred by the Army Act and the Reserve Forces Act of 1882.

During 1917 the Directorate of Mobilization was reconstituted to take over questions regarding demobilization and certain functions of the Director of Recruiting, which were not transferred to the Ministry of National Service. At the end of May 1918, the Directorate was placed under a Director-General responsible to the Under-Secretary of State as Deputy of the Secretary of State for War. In November, in view of the cessation of hostilities, the organization of the Directorate was considerably expanded and the work was transferred to the Adjutant General.

In February 1915, a Director of Prisoners of War was appointed to deal with the policy and administration of enemy prisoners of war; a Prisoners of War Information Bureau had, as provided by Article 14 of the Regulations respecting the Laws and Customs of War on Land, been created in August 1914, to collect information from internment camps and to keep all records connected with those interned.

In July 1915, a Graves Registration Commission was constituted under the Adjutant General, General Headquarters. In May 1916, upon the extension of the system to other theatres of war, the headquarters of the Director of Graves Registration and Enquiries

were transferred to London and became part of the Adjutant General's Department. In October, 1918, the holder of this post was created a Director-General.

For the purpose of taking over the work of the Directorate of Graves Registration and Enquiries after the war a National Committee for the care of Soldiers' Graves was appointed in January 1916, under the presidency of H. R. H. the Prince of Wales.

This committee was replaced by a permanent Imperial Organization under the title of the Imperial War Graves Commission, which was constituted under Royal Charter on 21st May, 1917.

The Directorate was responsible for seeing that all graves were registered and marked and the cemeteries put in proper order. When this work was completed in any cemetery the commission was to assume responsibility for the maintenance of the cemetery and for the erection and upkeep of permanent memorials therein.

In April, 1916, the control of the Territorial Force Medical Service was transferred from the Director-General of the Territorial Force to the Director-General, Army Medical Service.

The employment of women with the Army led, in March 1917, to the formation of a section under the Adjutant-General to administer and organize all arrangements connected therewith.

In December 1918, the Director of Organization took over from the Military Secretary's Department certain duties in respect of officers. The effect of this was to concentrate in one branch the administration of both officer and " other rank " personnel of each arm of the service.

III. *The Quartermaster General.*—In September 1914, the Directorate of Supplies and Quartering was divided into two directorates, viz., that of Quartering and that of Supplies (later termed Supplies and Transport). The office of Deputy Quartermaster-General was revived in March 1916, the holder combining the duties of that office with those of the Director of Quartering. In the autumn of 1917, the two offices were separated, the Deputy Quartermaster-General assuming also the functions of Inspector-General of Communications, the Forces in Great Britain.

In February 1915, a Board of Control of Regimental Institutes was formed to deal with all questions of administration in connection with garrison and regimental institutes at home. In April 1916, the canteen contractor was eliminated, and the powers and duties of the Board of Control were taken over by the Army Canteen Committee, which was later expanded into the Navy and Army Canteen Board, and in the autumn of 1917, a civilian official with the status of a Deputy Quartermaster-General was appointed to act as the sole channel of communication between War Office and the Navy and Army Canteen Board and the Expeditionary Force canteens.

In December 1918, the appointment was notified of a Trustee known as the Army Trustee, in whom was permanently vested the custody of central, regimental and other funds the property of Army units or formations (see A. O. XIII of 21st December, 1918).

IV. *The Master General of the Ordnance.*—Early in the war an Assistant Director of Artillery was appointed in charge of a branch formed to deal with the provision of high explosives in conjunction with the Committee on the Supply of High Explosives. In April 1915, contract business relating to warlike stores was transferred to the Department of the Master-General of the Ordnance under the Director of Artillery. An Order in Council dated 16th June, 1915 (see page 19), defined the duties of the Ministry of Munitions of War which was formed under the Ministry of Munitions Act, 1915, to take over for the period of the war matters relating to the supply of munitions. This included questions dealing with high explosives and propellants, munitions contracts, trench warfare, contracts for electrical stores, machinery, mechanical transport (transferred from the Quartermaster-General's Department) and the administrative and financial control of Ordnance factories (Woolwich Arsenal, the Enfield Small Arms Factory, and the Waltham Powder Factory). Part of the War Office staff dealing with these questions was transferred at the same time to the Minister of Munitions.

In March 1916, the responsibility for designs, patterns, specifications, and testing of arms and ammunition, and for the examination of inventions bearing on such munitions, was transferred to the Ministry of Munitions, the Army Council still retaining the responsibility for fixing the requirements of the Army as regards the general nature and quantity of weapons and equipment, and for the distribution of munitions to the troops and their maintenance. The Ministry of Munitions also took over the administration of the Research Department, Woolwich, the Experimental Staff at Shoeburyness, and the Experimental Officer and subordinate Experimental Staff at Hythe.

In 1917, to ensure the maintenance of complete association between the Ministry of Munitions and the War Office, the Master-General of the Ordnance became an additional member of the Munitions Council, while a member of this council was placed at the disposal of the Army Council for the purpose of advice and consultation on all matters coming before them affecting the supply of munitions to the troops.

V. *The Director-General of Military Aeronautics.*—At the outbreak of war, the Director-General of Military Aeronautics, though not a member of the Army Council, was directly responsible to the Secretary of State, but in February 1916, owing to the rapid growth and expansion of the Royal Flying Corps, he was given a seat on

the Army Council. In February 1917, the Air Board was created by an Order in Council (see page 21, Administrative Directory, British Army, 1919) and on it as representing the Army Council the Director-General of Military Aeronautics had a seat. Others with a seat on the Board were a Lord Commissioner of the Admiralty and two representatives of the Ministry of Munitions (viz., the Controller of Aeronautical Supplies and the Controller of the Petrol Engine Department). In April the responsibility for the design and supply of material for the Royal Flying Corps was transferred from the War Office to the Air Board, who were in future to obtain their supplies through the Ministry of Munitions. The continued growth of this department led in the autumn of 1917, to the Air Force (Constitution) Act, which established an Air Council under a Secretary of State. An Order in Council of 21st December, 1917 (see page 24, Administrative Directory), defined the constitution of the Air Council, and a further Order in Council of 2nd January, 1918 (see page 26, Administrative Directory) fixed the date for the establishment of the Air Council as 3rd January. The new Royal Air Force, in which were amalgamated the Royal Naval Air Service and the Royal Flying Corps, came formally into being on 1st April, 1918.

The post of Director-General of Military Aeronautics lapsed after a brief period during which he acted as liaison officer between the Army Council and Air Council, and with the exception of certain services which were left to the Army Council for the period of the war, the control over the Royal Flying Corps passed to the Air Council as from the 1st April, 1918.

In April 1918, a liaison officer was appointed with the object of keeping the Army and Air Councils in close touch. In order to ensure this and to enable him to supply each department with any information it required he was given full liberty to deal direct with the branches and directorates of each department.

VI. *The Under Secretary of State (Civil Member).*—In the department of the Civil Member, questions relating to the Territorial Force and individual members thereof were at the outbreak of war transferred to the branches of the office dealing with similar questions relating to the Regular Army and Special Reserve. The Territorial Force Directorate, however, retained the bulk of the military secretarial work of the Force.

In April 1917, a reorganization of the Territorial Force Directorate took place, consequent both upon the transfer of certain duties to the Military Secretary and the Director of Organization and upon the great increase in work connected with the administration and organization of the Volunteer Force which was taken over by the War Office in 1916, under the Volunteer Act. The head of the Di-

rectorate became the Director-General of the Territorial and Volunteer Forces.

In July 1916, the Under Secretary of State for War was appointed to be in all matters affecting administration the deputy of the Secretary of State and to be Vice-President of the Army Council. This arrangement lasted only to December 1916, when the then Under Secretary of State became Secretary of State, but in April 1918, the arrangement was revived, and continued till January 1919. The Under Secretary of State still remained the Vice-President of the Army Council.

In January 1917, the Land Branches of the War Office and the Ministry of Munitions were amalgamated under a Director-General of Lands, who, on behalf of the Admiralty and the Air Council also, administered questions relating to the acquisition, etc., of lands.

VII. *The Finance Member.*—In April 1915, a Committee outside the War Office was constituted on behalf of the Army Council to decide on appeal all questions of assessment of separation allowances for soldiers' dependents upon which local pension authorities were not agreed.

In December 1915, the Central Army Pension Issue Office was formed under the Director of Army Accounts to pay pensions awarded since the commencement of the war in respect of soldiers below the rank of warrant officer, Class 1. In October, 1916, the administration of this office was placed under a newly created Paymaster-in-Chief. As a consequence of the Ministry of Pensions Act, 1916, the Central Army Pensions Issue Office, together with part of the pensions work of the Finance Department, was transferred, as from 15th of February 1917, to the Ministry of Pensions (see page 21, Administrative Directory).

A Director of Departmental Finance was appointed in October 1916, to relieve the pressure of work arising from the war. Upon the transfer of the Central Army Pensions Issue Office to the Ministry of Pensions the duty of Chief Inspector of Army Pay Offices was allotted to the Paymaster-in-Chief as well as special charge of the pay arrangements in connection with eventual demobilization. The post of Director of Army Accounts was left vacant and a Sub-Director of Finance was appointed.

In April 1917, a new section under the Director of Departmental Finance was set up to deal with the finance and accounts in connection with the purchase of raw materials by the Surveyor-General of Supply.

In January 1918, following upon the transfer of certain members of the Finance Department to the Air Ministry, the Director of

Financial Services, the Sub-Director of Finance, and the Director of Departmental Finance were replaced for the war period by three Directors of Finance (a) (b) and (c), and a re-allocation of the Finance branches among the three directors took place.

In March 1917, a Director of Timber Supplies was appointed to report to the Finance Member. His duties were to control the supply of timber for the Army and effect economies in its use in the United Kingdom while stimulating its production. This directorate, however, was in June transferred to the Board of Trade.

VIII. *The Director-General of Movements and Railways.*—Questions connected with railways and transport belonged at the outbreak of war to the Department of the Quartermaster-General, but the growth of the work led eventually to the creation of a new department. Before the war there had been a Director of Transport and Movements, and afterwards transport duties were undertaken by the Director of Supplies and Transport. Early in 1915, a Director of Movements was appointed. In August 1916, Sir Eric Geddes was entrusted with an investigation into the transport arrangements connected with the British Expeditionary Force both in this country and overseas, and from 25th September 1916, all papers and letters relating both to railway stores and establishments for overseas, and to Inland Water Transport, were passed to him. He was shortly afterwards detailed to act as deputy to the Quartermaster-General in matters of transport with the title of Director-General of Military Railways, and was appointed also to direct and organize such services in France under the General Officer Commanding-in-Chief with the title of Inspector-General of Transportation. The supply of railway material and personnel, and of Inland Water Transport, was also handed over to him.

In January 1917, the Director-General of Military Railways ceased to be a deputy to the Quartermaster-General and was authorized to report direct to the Secretary of State and to attend those meetings of the Army Council at which matters pertaining to his department were under discussion. The Director of Movements was to report to him. The duty of settling all questions affecting the priority of moves of personnel, stores and supplies required to meet the demands of the various forces in the field was left to the Quartermaster-General, the Adjutant-General, and the Deputy Chief of the Imperial General Staff in consultation, the Director-General of Military Railways being responsible for carrying out the movements.

In March the title of Director-General of Military Railways was changed to Director-General of Movements and Railways, and the holder became a civilian member of the Army Council. To him was

allotted both the duty of dealing with all questions of movements at home and to and from the various theatres of war and elsewhere, and the responsibility for all demands for transportation of personnel and material made from overseas. A separate Inspector-General of Transportation in the War Office for all theatres of war was appointed and charged with the general supervision of transportation by rail and water and through docks in the various theatres of war so far as supervision was exercised by the War Office. He was to report to the Army Council through the Director-General of Movements and Railways.

IX. *The Surveyor-General of Supply.*[3]—The Directorate of Army Contracts was wholly reorganized. At the outbreak of war this directorate was under the control of the Finance Member, and it remained thus until the appointment of the Army Council of the Surveyor-General of Supply. In the early days of the war the directorate expanded considerably to meet the enormous demands upon it for the equipping of the new armies, but during 1915, part of its work was transferred to the Ministry of Munitions. The protraction of the war caused a vast increase of work, as shortages of raw materials began to be experienced and special measures were necessary to ensure an adequate provision of all the materials necessary for the feeding, clothing, and equipment of the Army.

In March 1916, a Contracts Advisory Committee was formed to advise the Director of Army Contracts on questions of special importance or difficulty.

In March 1917, Mr. Andrew Weir was invited to report upon the organization of the supply branches of the Army, and in May was given the title of Surveyor-General of Supply and made a civilian member of the Army Council. He was to take over from the Quartermaster-General, the Master-General of the Ordnance, and the Finance Member, and to coordinate such of their functions as related to the commercial side of the business of supplying the Army; he was to organize those industries necessary for ensuring adequate supplies, and to advise and consult with the military departments with a view to forming economical demands. The military departments concerned retained responsibility for the fixing of designs and specifications and for the tests to be applied, as well as for research and experimental work. The Surveyor-General was further enjoined to enquire into existing systems governing the consumption of and demands for stores and supplies with a view to suggesting methods by which economy might be effected without prejudice to efficiency.

[3] Arrangements for the transfer of the duties performed by the Surveyor-General of Supply to a Ministry of Supply, to be constituted by statutory action, have been under consideration, and most of the duties transferred provisionally as from 10th March, 1919. (This did not materialize.)

An Advisory Board of six members was set up, of which the Quartermaster-General, the Master-General of the Ordnance, and the Finance Member (or their representatives) were to be members, the remaining three being nominated by the Surveyor-General of Supply.

This was not the first attempt to secure economy, for the appointment of two committees in January, 1916, should be noticed: (1) an external body appointed by the Cabinet to enquire into the possibility of effecting economies in the expenditure charged to Army Votes; (2) an internal body appointed by the Secretary of State to consider the possibilities of economy in Army expenditure and to initiate any necessary action.

The Directorate of Army Contracts was now brought under the Surveyor-General of Supply. There were three main branches (1) Demands, (2) Contracts, (3) General. The Demands Branch was to formulate the demands arising out of requisitions made by or in anticipation of the requirements of military departments, and for these the military directors concerned were to be responsible to the Surveyor-General of Supply.

The Contracts Branch was organized in three main divisions dealing with (*a*) purchases, (*b*) controlled industries in raw materials, and (*c*) branch administration, viz., costings, statistics, labor, commercial relations with the Allies and general questions.

To coordinate the work between the Demands and the Contracts Branches, various committees were set up to examine and, if necessary, to suggest revision of demands in the light of available information, to consider possible revision of patterns and specifications in order to secure greater economy or remove difficulties of supply, and to consider the adequacy of the provision for existing and probable future requirements.

In July the Raw Materials Section of the Contracts Directorate was detached and made a separate Directorate under a Director of Raw Materials immediately responsible to the Surveyor-General of Supply, while an Assistant Surveyor-General of Supply was appointed to supervise the other work of the Contracts Branches.

Towards the end of 1917, a branch was formed in the Surveyor-General of Supply's Department to deal exclusively with demands from the American Expeditionary Forces for stores and supplies. In December the Directorate of Army Priority was established and was charged with the settlement of all questions of priority affecting the Department of the Surveyor-General of Supply, with the final review on his behalf of all Allied demands, and with the determination of the general policy in regard to export and import licenses. To this directorate was transferred from the department of the Civil Member the branch known as Allies Munitions' Requirements.

In May 1918, the Director, as a member of the Joint Priority Board of the Admiralty, War Office and Ministry of Munitions, became chairman of the War Office Standing Priority Committee which was constituted to decide the relative urgency of the requirements of the various branches of the War Office.

A Director of Wool Textile Production was appointed in December 1917, to supervise all contracts for wool textiles, and to carry out the executive work of the Board of Control of Wool Textile Production.

In September 1917, a Contracts Board was established to supervise the work of the Contracts Branch and to deal with important questions of policy, while a further Committee was set up to enquire into the storage, distribution, consumption and salvage of stores and supplies and the system governing demands with a view to suggesting methods of economy.

From the last-mentioned Committee was developed in February, 1918, the Army Salvage Branch, the work of which was placed under a Controller of Salvage on behalf of the Departments of the Quartermaster-General and Surveyor-General of Supply jointly. Its functions were defined as those of assisting in the general public duty of collecting, sorting and returning such materials as may have become the proper subject of salvage due to usage, the incidence of war operations, neglect or departmental rejections, and of taking possession as trustees of such materials as have been condemned by the Supply Departments with a view to their utilization in remanufacture for national purposes or for disposal by sale or otherwise. This branch was, in effect, part of the larger organization known as the National Salvage Council, under the Chairmanship of Lord Derby. The Council consisted of representatives of various Government departments, and under it an Executive Board was formed and a Director-General of National Salvage appointed, the two main objects in view being to conserve national resources and to reduce the tonnage required for the importation of new raw materials.

In April 1918, an office was organized in Dublin under the Surveyor-General of Supply, with a view to developing the manufacturing resources of Ireland for Army purposes. The officer in charge was to report weekly to the Surveyor-General of Supply, and was placed administratively under the Irish command.

From 1st July, 1918, the Supply Section of the Directorate of Inland Waterways and Docks was placed under the Director of Army Contracts and made responsible to the Surveyor-General of Supply, so far as the purchase of stores by tender or otherwise was concerned.

The appointment in July of a Standing Committee marks an important phase in the development of this department. The object was to consider the general procedure to be adopted by the Admiralty, War Office and Ministry of Munitions, as regards certain contract questions.

X. *The Secretary of the War Office.*—In the Department of the Secretary a large section was necessary to deal with the casualties of the rank and file.

In October 1916, a second (Acting) Assistant Secretary was appointed and a further temporary appointment, viz., Assistant to the Secretary, was made with the charge of a central statistical department to collect and collate information bearing on the general state of the Army as a whole and of the armies in the different theatres of war.

In January, 1919, an Assistant Secretary (additional) was appointed for the War Office and Air Ministry.

During the period under review there was established in France and other theatres of war an organization called the Army Printing and Stationery Services. The department was charged with the production of printed matter (including in France and Italy photographic printing) and its distribution, the supply of material and machinery necessary to office administration and the issue of Army forms, books and stationery generally. In effect the service was an offshoot of the Secretary's Deparment, from which at the outbreak of war it was staffed. The senior officer, who went out to France with the original Expeditionary Force, was latter appointed Director of the Services.[3]

[3] Chart 1, Chapter II, Vol. I.

SECTION I—PART 2.[1]

THE DUTIES OF THE VARIOUS SUBDIVISIONS OF THE ARMY COUNCIL.

"MILITARY SECRETARY TO THE SECRETARY OF STATE FOR WAR AND SECRETARY TO THE SELECTION BOARD (M. S.).

The Military Secretary to the Secretary of State is charged with the clerical and executive duties connected with appointments, promotions, and retirements of officers of the Regular Forces, including the Special Reserve; with selections for appointments to the Staff, &c; with the grant of Honours and Rewards, &c., and with regulations for the admission of candidates to the Army. He also acts as Secretary to the Selection Board."

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"DEPARTMENT OF THE SECRETARY.

Duties connected with his office as Secretary to the Army Council. General control of War Office procedure and the conduct of official business and the issue of all orders of the Army Council on these subjects. Preparation of papers for the decision of the Army Council. Receipt, registration, distribution and custody of all official letters, telegrams, &c., received in the War Office. Control and distribution of the clerical and subordinate staff. Parliamentary business of the office, including all references to the Parliamentary Counsel and the Law Officers of the Crown. Editing, publication and distribution of the Army Lists and of all Army Regulations, Army Orders and Army Forms. Control of all printing and stationery. Correspondence relating to the appointment of Royal Commissions, of Interdepartmental Committees, and of Intradepartmental Committees where more than one branch is concerned; receipt of their reports and distribution of copies. Circulation of news and official publications in the public press. Preparation of actuarial calculations and statistical returns. Domestic economy of the War Office. Administration of the Chaplains' Department."

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[1] Extracted from the War Office Lists and Administrative Directory for the (British) War Office.

"DEPARTMENT OF THE CHIEF OF THE IMPERIAL GENERAL STAFF.

All questions of military policy affecting the security of the Empire. Advice as to the conduct of operations of war and orders in regard to military operations. Collection of intelligence. Censorship, and measures of military secrecy and publicity. International Law. War organization, fighting efficiency and training of the military forces. Organization, training and employment of the Army Signal Service and Tank Corps. Selection and administration of the General Staff. Education of officers and selection of candidates for commissions in the combatant branches. Educational training."

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"DEPARTMENT OF THE ADJUTANT-GENERAL.

Raising and organizing the military forces. Maintenance of the Army abroad in officers and men. Distribution of units. Discipline. Martial, military and international law. Administrative arrangements connected with training and education. Medical and sanitary matters. Selection and administration of the Adjutant-General's Staff. Personal and ceremonial questions. Prisoners of war. King's Regulations. Recruiting. Mobilization and other Regulations dealing with the above Services. Registration of graves."

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"DEPARTMENT OF THE QUARTERMASTER-GENERAL.

Administration of Transport, Remount, Veterinary, Ordnance, Supply, and Barrack Services (other than Works). Selection of officers for, and organization, administration and training of, personnel employed on these Services. Custody and issue of all military stores. Settling reserves of food, clothing, equipment, general stores, and material to be held in depots, garrisons, and mobilization stores; and the scales of such articles to be in possession of the troops. Arrangements for the execution of Postal Services in war."

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"DEPARTMENT OF THE MASTER-GENERAL OF THE ORDNANCE.

Armament, including lights, and all accessories. Sites, designs, and armaments for coast defences. Settling scales of reserves of arms of all kinds, of ammunition, of vehicles, and of technical equipment of R. A. and R. E. units, and the scales of such articles to be in possession of the troops. Patterns, provision and inspection of guns, small arms, ammunition, and Royal Artillery and Royal Engineer technical stores and of vehicles. Technical committees on

war matériel. Direction and financial administration of manufacturing departments, except clothing. Patents and inventions. Construction and maintenance of fortifications, barrack, hospitals and store buildings. Artillery and rifle ranges. Administration of Royal Engineer staff employed in the above works. Technical examination of works services in certain instances. Personnel of the manufacturing and technical inspection staff. Administration of the Ordnance College and advise as to technical instruction at schools of military engineering, and technical questions affecting Artillery and Engineer services generally."

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"DEPARTMENT OF THE UNDER SECRETARY OF STATE.

Administration of (1) Territorial Force Associations and Volunteer Force; (2) War Department Lands."

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"DEPARTMENT OF THE FINANCE MEMBER.

Consideration and compilation of the Parliamentary estimates. Finance Committee. Review of proposals for new expenditure, or for redistribution of the sums allotted to the different subheads of the Votes. Financial adjustments and relations with other Departments and Governments. Accounts and Audit. Non-effective Votes. Administration of the Army Pay Department."

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"DEPARTMENT OF DIRECTOR-GENERAL OF MOVEMENTS AND RAILWAYS.

General supervision and co-ordination of Railway, Light Railway, Road, and Inland Waterway and Dock requirements overseas, and policy in regard thereto in all theatres of war; provision of Railway Light Railway, and Road plant, material, and rolling stock, waterway, port, and dock plant and material, and the personnel for above; exercise of the War Office control of ports and movements in United Kingdom and movements by sea; co-ordinating control over home railways under Act of Parliament; communications with the Railway Executive Committee and the Admiralty."

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"DEPARTMENT OF THE SURVEYOR GENERAL OF SUPPLY.

Provision of all stores, supplies and works services required by the Army, other than those specifically assigned to other Departments, and of all stores and supplies other than munitions required by the Allied Governments, so far as they are purchased in this country. Organization of industries and control of raw material

to ensure adequate supply. Purchase (after consultation with the Finance Member) in anticipation of requisition. General supervision of contracts and contractors. Collection from the Military Departments of all information bearing on their possible future requirements, and advice to those Departments with regard to existing trade conditions as affecting their demands. Inspection of stores and supplies and the selection of inspectors in consultation with the military branches concerned. Commercial and accounting functions in connection with the main Army store depots which the Surveyor General of Supply, in conjunction with his Advisory Board, may consider it advisable to take over from the Military Departments. Enquiry into the consumption of, and demands for, stores and supplies."

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CHAPTER II.

SECTION II.

ORGANIZATION OF THE FRENCH MINISTRY OF WAR.

In time of peace the preparation for war, the supplying of the needs of the armies engaged in the various theatres of operations with personnel and matériel and the centralization of information relating to the conduct of the war, rested in the hands of the Ministry of War.

In the theatre of operations of the Armies of the North and Northeast, the national territory was divided into two zones: A Zone of the Armies placed under the orders of the Commander in Chief; a Zone of the Interior where the authority of the Minister was exercised directly.

In 1914, the Ministry of War was organized essentially as follows:

A. The *Cabinet of the Minister* composed of: (*a*) The Minister's staff, charged with coordinating relations between the Ministry of War and the other ministries and with Parliament; the preparation of important questions for final decision by the Minister, particularly with questions relating to the personnel of the general officers. (*b*) A civil affairs section and private secretaryship, which were charged with the examination of political questions, the study of parliamentary debates insofar as they related to the Ministry of War, relations with the Press, and which handled Minister's private correspondence.

B. *The Under Secretaryship of State*, which dealt with administrative questions concerning the Directions and all services belonging to the central administration. It also handled legislative matters and examined litigation claims.

C. *The General Staff of the Army*, functioning under the orders of the Chief of Staff of the Army and charged with the preparation of all questions relating to the Army (organization, mobilization, concentration, etc.).

D. *The Directions of the Arms and Services*, charged with questions particularly affecting the arms (branches) and services of the Army (Infantry, Cavalry, Artillery, Trains, colonial troops, Mili-

tary "Intendance," Medical service, Powder and saltpeter service, Military justice and laws, Engineers.)[1]

E. *The Geographical Service*, which formed a special organ under the direct orders of the Minister.

This organization soon became insufficient. The development of operations, the continually increasing quantities of food, ammunition and sundry materials required for the armies, the progressive increase in the use of special arms or the appearance of new weapons, obliged the Minister of War to adopt a more decentralized organization and caused him to delegate, under his responsibility, some of his duties to a number of Under Secretaries of State (Under Secretary of Administration, Under Secretary of Medical Service, etc.). This resulted in a reorganization of the Ministry of War and particularly of the Directions, some of which passed under the control of the Under Secretaryships thus formed.

In addition there were created:

1. A Ministry of Armament and War Production (Ministère de l'Armament et des Fabrications de Guerre), which centralized all questions relating to the purchase and manufacture of armament material and munitions.

2. An Under Secretaryship for Supply (Ravitaillement), which was attached successively to the Ministry of War and then to the Ministry of Agriculture, charged with assuring the procurement of supplies for the armies (formerly the task of the General Inspection of Subsistence (Inspection Générale des Subsistences) of the "Intendance" Direction) and also with the general supply of the country at large.

Whatever the modifications brought about in the organization of the Ministry of War, the principle of "complete authority in the Commander in Chief in the Zone of the Armies" was always strictly observed. This authority covered not only the direction of operations, but all questions affecting the troops, the functioning of the services and the territory in the Zone of the Armies. It was thanks to this "liberty of action and command" allowed the responsible chief, that the latter was enabled to meet all difficulties no matter how unforeseen or how great.

The final organization of the Ministry of War and that which was in effect on November 11th, 1918, is shown in chart 4, Chapter II, Vol. I.

The Minister was assisted by a "Cabinet." This was a centralizing and distributing agency, divided into a military and a civil cabinet, and handled the following matters:

[1] Including one aviation section.

MILITARY CABINET AND MINISTER'S STAFF.

Officer personnel, particularly general officers.

Promotions, transfers, decorations. Relations with the various Ministries.

Military information service (Intelligence).

Moving picture service.

Military kennels, (war dogs).

Various military activities.

CIVIL CABINET.

Relations with Parliament and with other Ministries.

Civil personnel of the War Ministry.

Economic service.

Service for invaded districts (régions).

Service for Alsace-Lorraine.

The following organs functioned under the direct orders of the Minister:

A. The Under Secretaries of State.

B. The General Staff of the Army.

C. The Directions.

D. Geographical Service.

A. *Under Secretaryships.*

The Under Secretaryship of State of the War, Personnel (effectifs) and Pensions administration, dealt with the questions relating to administration, labor, pensions, welfare and home services. It's executive agencies were the Direction of the "Intendance," the Pension Service and the general personnel administrations.

The Under Secretaryship of Justice included: the Direction of Military Justice, a "Direction of claims" (Direction du Contentieux) which was charged with the settlement of damages, and the general inspections for prisoners of war (P. A. in the Interior).

The Under Secretaryship of the Medical Service was charged with the organization of hospitalization, the administration of hospitals, all questions concerning medicine, surgery, gas, etc., providing for the purchase and manufacture of medical supplies and the establishment of Medical (Sanitary) Service installations.

The Under Secretaryship of Aviation had charge of all questions pertaining to aviation: organization, administration, training of personnel, handling of matériel, manufacture and purchase, schools and depots.

B. *Alongside the Under Secretaryships* was the General Staff of the Army (Etat-Major de l'Armée), which functioned directly

under the Minister and under the orders of the Chief of Staff of the Army. It was charged with the settlement of all general policies and questions of principle affecting the Army.

War conditions necessitated dividing the territory into two zones (Zone of the Armies and Zone of the Interior), and this resulted in the subdivision of the General Staff of the Army into two groups; the Group of the Advance (Groupe de l'Avant) and the Group of the Interior (Groupe de l'Intérieur).

The Group of the Advance was charged with the study of questions concerning the general war administration (Direction générale de la Guerre); it was simply an organ of liaison between the Ministry and the Command of the Armies and did not interfere in the conduct of operations.

It consisted of a First Section (1er Bureau) charged with the distribution of personnel and matériel among the various theatres of operations and it also had a special section charged with the study of questions concerning the general war administration.

A Second Section (2ème Bureau) centralized the information concerning foreign armies and coordinated relations with neutrals.

A Third Section (3ème Bureau) followed and studied military operations on all fronts.

The group of the Interior, in so far as the national territory in the Zone of the Interior was concerned, carried out the functions of the peace time General Staff.

Its duties were divided among the various sections (bureaux) as follows:

First Section (1er Bureau). Organization and mobilization of the French and allied Armies, personnel, equipment, armament, munitions. Requisition and purchase of animals. Military legislation. Labor. Fortified regions and coast defences.

Second Section (2ème Bureau). Military statistics. Organization of foreign armies. Research work pertaining to and study of economic questions. Study of foreign press, enemy industries and, in general, of all military intelligence questions. Espionage.

Third Section (3ème Bureau). Military operations. General training of the Army. Schools and barracks.

Fourth Section (4ème Bureau). Communications, supplies, and transportation by land and sea. Railroads. Storage of all kinds. (In the Zone of the Interior only.)

The last named section handled the questions pertaining to the American lines of communication on the systems of the interior and concerning American installations in the Zone of the Interior. All

similar questions concerning the Allied Armies in the Zone of the Armies devolved upon the Commander in Chief.[2]

A "Central Military Bureau" (Bureau Central Militaire) for the Postal Service functioned under the direction of the 4th Section of the Staff.

The General Staff of the Army included also:

The Historical Section—classification and publication of historical documents.

The African Section—questions concerning North Africa and the Orient.

The "Exemption Office" (Bureau des Sursis) which granted temporary exemptions from service with the colors.

The Slavic Bureau.

INFANTRY DIRECTION (DIRECTION DE L'INFANTERIE).

This Direction studied all questions relating to the Infantry. Organization, personnel and equipment, including cyclist troops and infantry troops mounted on skis. Organization of depots, preparation of legislation, training of officers on the active and reserve lists, physical training of soldiers and also of young men belonging to societies for preparation for military duty.

CAVALRY DIRECTION (DIRECTION DE LA CAVALERIE).

Centralized all questions relating to the organization of the Cavalry. Training, use of men and animals, remount service, armament (including motorized machine guns and armored cars). It was also charged with the organization and control of the Gendarmerie; to sum up, all questions concerning Cavalry personnel.

ARTILLERY DIRECTION (DIRECTION DE L'ARTILLERIE).

Centralized all questions relating to the Artillery, excepting those which were handled by the Ministry of Munitions (Ministère de l'Armament). Organization, training, as well as the organization of anti-aircraft defense and narrow gauge railways. Two sub-directions were attached to it; one for the Motor Transport Service and the other for the Tank Corps. These two sub-directions handled questions of manufacture and purchase.

[2] With reference to the British and the Belgian Armies, the bases of these Armies always remained in the Zone of the Armies. Those bases which were located in the Department of the Seine-Inférieure, became "islands" (îlôts) in the Zone of the Interior when that Department no longer formed a part of the Zone of the Armies.

ENGINEER DIRECTION (DIRECTION DU GÉNIE).

Had charge of all questions concerning the Engineer Corps. Organization, personnel, training, engineer matériel of all kinds, including explosives, camouflage, telegraph matériel. It also handled barracks, cantonments and quarters.

DIRECTION OF COLONIAL FORCES (DIRECTION DES TROUPES COLONIALES).

Coordinated all questions concerning colonial troops (organization, personnel and discipline, training and employment).

DIRECTION OF FINANCE (DIRECTION DU CONTRÔLE).

This Direction functioned under the direct orders of the Minister of War and was charged with assembling and presenting estimates for appropriations (budget), the preparation of articles to be inserted in the finance bills, auditing the accounts of the central administration and of the corps and services.

Finally, numerous interallied committees and interministerial commissions were attached to the War Department.

CHAPTER II.

SECTION III.

ORGANIZATION OF THE BELGIAN MINISTRY OF WAR DURING THE CAMPAIGN OF 1914–1918.[1]

The organization of the Belgian Ministry of War is shown in chart 2, Chapter II, Volume I.

Shortly before the war, the Minister of War (Monsieur de Broqueville), had undertaken the reorganization of the Belgian Army. The proposed reorganization was being developed and the plans which had previously been provided for the mobilization and concentration of the Army were undergoing a complete change when the war broke out.

Upon the mobilization the Minister of War immediately determined the role which his department was to fulfill: furnish the Army with men and supplies.

The Minister of War's Cabinet was reduced to two officers, one of whom was charged with furnishing men and the other with the supply of matériel. The "General Directions" (Directions Générales) of the War Department were also reduced to a strict minimum through the mobilization of their personnel.

This rudimentary organization sufficed, nevertheless, to meet the requirements of the Belgian Army during the early operations on the Meuse, in the Province of Brabant and around Antwerp.

The seat of the Government had been transferred from Brussels to Antwerp and, when Antwerp was evacuated, it moved to Ostende. Shortly afterwards, during the memorable battle of the Yser, the Belgian Government embarked for France. The Belgian Ministers with their principal services proceeded to Le Havre where, at Ste. Addresse, they received the generous and cordial hospitality of the French Government.

However, in order to thoroughly acquaint himself with the needs of the Army and enable him to remain near the person of the King, who was the Commander in Chief of the Army, the Minister of War established himself at Dunkerque with his military cabinet.

[1] Prepared for the Military Board of Allied Supply by Lieut. Col. Ellery Farmer, U. S. Army, from data supplied by the Belgian Ministry of War for the purpose. Now on file in the Historical Branch, War Plans Division, in the records of the M. B. A. S.

The personnel of the First General Direction (Première Direction Générale), General Administration of Personnel and Recruiting (Administration Générale du Personnel et du Recrutement), and of the "Secrétariat Général" also went to Le Havre, where they undertook the reorganization of their services. They were followed by the Cabinet officer who had been charged with the organization of the service for the supply of matériel. Finally, the "Map Department" (Service Cartographique), which had succeeded in saving its valuable equipment, took refuge in London and placed its equipment at the disposal of the British authorities, who used it to prepare a complete map of the Belgian theater of operations.

At the conclusion of the Battle of the Yser the effective strength of the Belgian Army was greatly reduced. The cavalry was exhausted, the motor transportation was practically unserviceable, the heavy artillery hardly existed (there were only two groups of heavy howitzers), the field artillery was worn out through intensive use and through the employment of French ammunition, the infantry armament was dangerously depleted and the reserve stocks of clothing, shoes, harness, medical supplies, field kitchens and camp equipage were expended. Such was the precarious situation of the Belgian Army at the beginning of the winter 1914–1915 and the Minister of War was obliged to take immediate and energetic steps to reorganize the Army.

This task was accomplished progressively, through the organization of training camps for the instruction of recruits and volunteers, the establishment of hospitals for the sick and wounded and of factories for the repair of the matériel, in France.

The organization of the training camps devolved upon the "Inspector General of the Army" (Inspecteur Général de l'Armée), (a lieutenant general), and the training of recruits was pushed actively.

The "Inspector General of the Medical Service" (Inspecteur Général du Service de Santé—I. G. S. S.), thanks to the assistance given by the French authorities, was enabled to shelter the Belgian sick and wounded in temporary hospitals or in French hospitals which had been placed at the disposal of the Belgian Army.[2]

Establishments for the repair and manufacture of artillery and motor transport matériel were improvised and established at Le Havre and Calais. Engineers, soldiers belonging to the oldest classes and who had been relieved from duty at the front, together with a few specialists (artisans) who had arrived from Belgium, constituted the personnel of these establishments.[3]

[2] See chapter on the Medical Services.

[3] See chapter on the Ordnance Services, describing the activities of the Belgian "Artillery Establishments."

Purchasing commissions were organized in Paris, London, and New York, to procure the matériel and raw materials which were indispensable to the Belgian Army.

An officer of the "Intendance" service worked in conjunction with the Cabinet of the Minister of War; first at Dunkerque and later at Le Havre. The officer was known as the "Director of the "Intendance" and supply services" (Directeur des Services d'Approvisionments et d'Intendance—D. S. A. I.) and he handled the questions of supply for the Intendance (forage, clothing). The D. S. A. I. was discontinued upon the creation of the "Ministry of the Military and Civil Intendance" (Ministère de l'Intendance Civile et Militaire). (See further.)

As a result of these measures in the spring of 1915, with the arrival of trained and newly equipped recruits and thanks to the matériel which had been repaired by the "Repair Shops" (Ateliers de réparation), the Belgian Army was enabled to face the future with confidence.

All the repair and maufacturing establishments operated directly under the section of the Minister of War's Cabinet which was located at Le Havre. It also effected all transports, particularly maritime transports.

In 1916, it became apparent that the existing organization would have to be modified. The increasing importance of overseas transports necessitated the creation of the "General Maritime Transportation Office" (Bureau Général des Transports Maritimes—B. G. T. M.). This office was in direct relations with the Ministry of the Navy (Ministère de la Marine), which furnished the necessary ships for the movement of supplies destined for the Army. Later, the B. G. T. M. was attached to the "Direction of the lines of communication" (Direction des Voies de Communications—D. V. C.) at the Ministry of War.

During the same year, the Minister of War decided to create a service which would be independent of the Cabinet for the purpose of directing and coordinating all the services, stores, and establishments of the Belgian "Intendance" which were located in France or in the rear of the Army.

This service was known as the "General Inspection of the Intendance Service" (Inspection Générale du Service de l'Intendance—I. G. S. I.). It also became necessary to organize a "Superior Direction of the Technical Engineer Services" (Direction Supérieure des Services Techniques du Génie) to assure the supply and coordinate the requests of the various special services, such as: Aviation, Ballooning, Searchlights, etc.

This direction was subsequently discontinued and became the "General Direction of the Armament and of the Technical Services of the Army" (Direction Générale de l'Armement et des Services Techniques de l'Armée—D.G.A.S.T.A.) (See further.)

Finally, to meet the ever increasing requirements for shelter, resulting from the constant bombardments and the increase in units, there was created a "General Direction of Military Construction" (Direction Générale des Bâtiments Militaires—D.G.B.M.) which functioned until August 1917.

In August 1917, the continually increasing quantities of matériel required by the Army, as well as the desire to relieve the Minister's Cabinet of questions pertaining to the manufacture of matériel, brought about the organization of the "General Direction of the Armament and of the Technical Services of the Army" (D.G.A. S.T.A.) and this direction was charged with the handling of these questions. The "Direction of the Artillery Establishments" (Direction des Etablissements d'Artillerie—D. E. A.) and the "Directions of the Purchasing Commissions" (Directions des Commissions d'Achat) at Paris, London, and New York, passed under the control of the D. G. A. S. T. A.

About the same time, the Belgian Government decided upon the creation of the "Ministry of the Military and Civil Intendance" (Ministère de l'Intendance Civile et Militaire) for the purpose of obtaining better coordination in the purchase of food, clothing, etc., for both the Belgian civilian population and the Army. This organization functioned until the end of the war.

NOTE.—There was no General Staff organization in the Belgian Ministry of War in the sense that is understood in the American War Department. The only Belgian General Staff body which functioned as a directing or coordinating organization was with the army in the field. The General Staff officers at the Ministry of War were there as experts, but not in a General Staff capacity.

CHAPTER II.

SECTION IV.

ORGANIZATION OF THE ITALIAN MINISTRY OF WAR.[1]

The organization of the Italian Ministry of War is shown in Chart 5, Chapter II, Volume I.

In the interior of the country the Ministry of War was responsible for the discipline and exercised supreme authority in the administrative and technical control of the troops, military schools, institutions and services. It was also responsible for the supply of men and various materials for the army in the field.

Despite the continual increase in the consumption of materials and supplies, the Army, as well as the civilian population, had to be supplied and best possible results obtained through the collection and distribution of available resources. The impossibility of centralizing such functions in one ministry soon became apparent and the following new organizations were therefore created:

The Ministry of Arms and Munitions.

The Ministry of Supply and Consumption.

The Ministry for Military Assistance and War Pensions.

The Under Secretary for Aviation.

The "Commissariato Generale" for National Fuel.

Generally speaking, the Ministry of War (Ministero della Guerra) centralized the functions of the Government pertaining to the supply of men, while most of the functions pertaining to the supply of materials and foodstuffs were controlled by the above mentioned organizations. The advantages of such decentralization are evident, particularly when the necessity for giving equal satisfaction to the needs of the Army and of the civilian population is taken into consideration.

Notwithstanding these additional organizations, the duties assigned to the Ministry of War involved a tremendous amount of work. Moreover, the creation of new or special units, together with the replacement of casualties, threatened to exhaust the resources in man power and necessitated increased activity in the recruiting centers.

[1] Prepared for the Military Board of Allied Supply by Major G. de Stefanis, General Staff, Italian Army, by direction of General Ugo Cavallero, Italian Member of the Supreme War Council.

The Italian Ministry of War was subdivided into large divisions known as: "General Directions" (Direzioni Generali), "Autonomous Divisions and Offices" (Divisioni ed Uffici Autonomi) and "Inspectorates" (Ispettorati). The chiefs of these divisions signed their documents: "By direction of the Minister" by whom they were directly controlled. The work of these various divisions was coordinated by the General Staff Division, which interpreted the will of the Minister and studied the principal questions which concerned the Army. The General Staff Division enunciated policies, based on these studies and interpretations, and the various questions were worked out by the different authorities at the Ministry of War in accordance with these policies.

Whenever the Secretary of State was a civilian, he was assisted by a "Chief Military Advisor" (a General), who worked in close cooperation with him and transmitted the orders of the Ministry to the military authorities.

The keeping of administrative and financial accounts was a special function of the General Auditing Administration and of the Technical-Administrative Artillery Division. Moreover, Office Division No. 2 of the General Secretariat, maintained current records of War Department accounts, compiled balances, issued statements and recorded all transactions pertaining thereto.

The orders of the Minister were carried out by:

(*a*) The various authorities at the Ministry.

(*b*) The Commands of the Territorial Army Corps.

(*c*) The Commanding General of the Royal Carbineer troops.

The details of the organization of the Ministry of War and the principal duties and powers of the different authorities which formed the Ministry, are shown in the twentieth issue of the official "Military Journal" of March 28, 1919.

For the purpose of obtaining unity of purpose in the solution of the more important military problems, in view of the fact that ministers were liable, for political reasons, to remain in office but a short time, there was created a special organization known as the Army Council. Its personnel possessed eminent technical ability and had sufficient authority to accomplish its task. It was composed of:

The Minister of War.

The Assistant Secretary of State for War.

The Chief of Staff of the Army.

General Officers, commanding armies.

When the nature of the questions to be treated required it, the following also took part in the council:

The Commanding General of the Artillery.

The Commanding General of Engineers.

The Commanding General of the Cavalry.

The Inspector General of the Army.
The Inspector of Military Sanitation.
In time of war, the "Intendente Generale" also participated.

The Army Council was presided over by the Minister of War and, in his absence, by the Secretary of State (neither of whom had a vote). The Army Council had to meet not less than three times every six months.

There was also a "Supreme Mixed Commission for the Defense of the State." The purpose of this commission was to coordinate and strengthen the national defense. It organized and maintained close liaison between the high authorities of the Army and Navy for the determination of the more important questions concerning the national defense. This commission was composed of the President of the Council of Ministers, the Minister of War, the Minister of the Navy, General officers of the Army (Chief of Staff and army commanders) and Navy (Chief of Staff of the Navy and commanders of naval forces) and was presided over by the President of the Council (without vote) or by the Ministers of War or of the Navy (without vote). It convened at least once a year.

ANNEX.

CHAPTER II—SECTION IV.

TABLE I.—*Distribution of the Central War Administration in Branch Divisions of Service, Sections and Offices.*

General Staff Division:
- Education and schools.
- Discipline and public order.
- Mobilization and defense.
- Orders.
- Prisoner of War Office.
- Colonial Office.
- Central Military Publications Office.

General Secretariat:
- Personnel Division of the Ministry.
- War Compensation Office.
- Intelligence Office.
- Physical Training and Target Practice Division.
- Veterinary Inspection Office.
- Clerical offices[a]:
  - 1st Division.
  - 2nd Division.
  - War Office.
  - Special Office.
  - Office for Arms and Munitions.

[a] Two divisions were headed by superior inspectors.

General Administration for Officer Personnel:
- Office of the Director General.
- Discipline Division.
- 1st Officer Personnel Division.
- 2nd Officer Personnel Division.
- 3rd Officer Personnel Division.
- Office for movement of Officer Personnel.
- Autonomous Section Royal Carbineers and Military Justice.
- Autonomous Section of War Veterans.

General Administration for Civilian Personnel and General Affairs:
- Office of the Director General.
- Personnel Division for dependents.
- Pensions Division, Interior Economy and Finance Service.
- Military Justice Division.

General Administration of the Artillery:
- Office of the Director General.
- Portable Arms Division. (1st Division.)
- Artillery Division. (2nd Division.)
- Artillery Administrative Division.

General Administration of the Engineer Service:
- Office of the Director-General.
- 1st Engineer Division.
- 2nd Engineer Division.
- Division of Military Property (fortifications etc.).

General Administration of the Military Sanitation Service:
- Office of the Director General.
- 1st Personnel Division.
- 2nd Division, Sanitary Inspection and General Affairs.
- 3rd Division, Materiel.
- 4th Division, Technical Services.

General Administration for Supply and Administrative Services:
- Office of the Director General.
- Mobilization Office.
- 1st Division, Permanent Assignments and Compensations.
- 2nd Division, Corps Administration.
- 3rd Division, War Service Compensation and for troops in Colonies and abroad.
- 4th Division, Subsistence.
- 5th Division, Clothing and equipment.
- 6th Division, Fuel, Storage and billeting.
- 7th Division, Transportation and Postal and Telegraph Service.
- 8th Division, Colonies.
- Inspection offices.[3]

General Administration for Conscription and Troops:
- Office of the Director General.
- Division 1—Conscription.
- Division 2—Conscription.
- Division 1—Troops.
- Division 2—Troops.
- Division—For induction into the service.
- Inspection Office.[4]
- War service office.
- Statistical office.

[3] A superior inspector and 1 inspector.
[4] A superior inspector and 8 inspectors.

General Administration for Auditing:
- Office of the Director General.
- Division 1—Auditing.
- Division 2—Auditing.
- Special Auditing Office.
- Office for auditing war matériel accounts.
- Office for specification of matériel.
- Office for auditing accounts of Italian Auxiliary Troops in France.

Veterinary Inspection:
- Technical Office.
- Administrative Office.
- Office for the survey and requisition of animals and vehicles.

Motor Transport Office:
- Technical Office.
- Motor Transport supply office.
- Gasoline commission.

CHAPTER II.

SECTION V—PART I.

WAR DEPARTMENT ORGANIZATION (AMERICAN).[1]

Reorganization of the General Staff.—One of the most important matters taken up by the Department during the earlier part of the war was the reorganization of the General Staff. Prior to the Act of February 14, 1903, the United States Army had no General Staff. Since the early history of the country there had been a Commanding General of the Army and a system of semi-independent War Department bureaus which was loosely coordinated either with the line of the Army nor with one another. There had long been uncertainty and dispute as to the respective functions and authority of the Secretary of War, the Commanding General, and the bureaus. When Mr. Root became Secretary of War on August 1, 1899, he became convinced that there was fundamental organizational defect in the War Department bureau system as it had grown up through more than a century of history. He pointed out that this system had developed in such a way as largely to tie the hands of the Secretary of War himself. He recommended to Congress, and succeeded in securing the enactment of, the organic Act of February 14, 1903, which abolished the office of Commanding General of the Army, and created a General Staff Corps of 45 officers, having at its head a Chief of Staff, who under the direction of the President and the Secretary of War was charged with the supervision of all troops of the line and of all War Department bureaus.

The National Defense Act of June 3, 1916, increased the strength of the General Staff Corps to a maximum of 55, exclusive of the Chief of the Militia Bureau and of the Chief of Coast Artillery, this maximum to be attained, by five annual increments, by 1920. This act, however, in effect still further decreased the strength of the General Staff Corps by providing that "not more than one-half of all the officers detailed in said corps shall at any time be stationed, or assigned to, or employed upon any duty in or near the District of Columbia." It also prohibited the Chief of Staff from attaching to his office for more than 30 days at a time any officers not members of the General Staff Corps.

[1] Extract from Report of the Chief of Staff, U. S. Army, 1919.

On April 6, 1917, the date of the declaration of war, the General Staff, which was organized under the provisions of the Act of June 3, 1916, had an authorized strength of 41 officers, the first annual increment only having been added. Under the limitations imposed by this act, the General Staff, on the date referred to, consisted of 19 officers stationed in Washington and 22 stationed elsewhere. The task of preparing the plans for creating, mobilizing, organizing, training, equipping, transporting to Europe, and of maintaining and supplying there the future Army of the United States accordingly devolved upon a group of 19 officers, who constituted the General Staff, authorized by law to be stationed in the city of Washington. This personnel was, of course, ridiculously inadequate, not only for the gigantic task confronting it, but for any General Staff work commensurate with the responsibilities of that corps. It is of interest in this connection to note that at the beginning of the war the strengths of the General Staffs of Germany, France and England were, respectively, approximately 650, 644 and 232.

The Act of May 12, 1917, increased the General Staff to 91 and removed, for the period of the emergency only, the restrictions of the Act of June 3, 1916, relative to the number of these officers authorized to be stationed in Washington. This act was followed by the Act of May 18, 1917, which authorized the President "to provide the necessary officers, line and staff", for the forces raised under this act, and removed, for the period of the emergency, the legislative restrictions as to the strength and organization of the General Staff Corps.

On June 30, 1919, the strength of the General Staff Corps was 253, including 130 detailed under the Act of May 18, 1917, for the period of the emergency. There were at this time 395 officers detailed for duty with the General Staff, a reduction of 549 since the signing of the armistice.

The first steps taken to organize the General Staff in such a manner as to enable it to perform its proper function of effecting the coordination of the activities of the various War Department agencies, which was recognized as being necessary to the successful accomplishment of the military program, was the issue on February 9, 1918, of General Order No. 14. This order organized the General Staff into five main divisions, namely, the Executive, the War Plans, the Purchase and Supply, the Storage and Traffic and the Operations Divisions. It charged the Chief of Staff with "the planning and development of the Army program", and it provided that the chief of the Purchase and Supply Division should "have cognizance and supervision of the purchase and production of all munitions and other supplies" and should be charged with "the supervision and

direction of all purchases, procurement and production activities of the several bureaus, corps, and other agencies of the War Department."

The General Staff was organized under this order on March 4, 1918, when I became Acting Chief of Staff.

The congestion at the ports had, however, become so acute by that time that unless adequate corrective measures had been taken without delay the movement of supplies overseas, both for this country and for the Allies, would undoubtedly within a few months have been practically blocked. Experience had shown that the interior organization of the various bureaus was such as to render an effective supervision of their activities by the General Staff, as contemplated by General Orders, No. 14, impossible. As the result of a careful consideration of the matter I became convinced that a consolidation of procurement, except of certain specialized equipment, of storage, of finance, and of transportation, together with a positive and direct central control of these activities by the General Staff, was essential to the elimination of the unsatisfactory conditions existing and to the rapid, efficient, and economical utilization of the resources of the country to the development of the Army program as a whole. The magnitude of the task, the diversity of conflicting interests, and the intimate correlation required by the different agencies involved permitted no division of responsibility or of effort if the War Department machine was to function with that degree of efficiency which was essential if the urgent and constantly changing needs of our Army were to be met.

On August 26, 1918, with your approval, General Orders, No. 80. was issued. This order provided:

> The Chief of the General Staff is the immediate adviser of the Secretary of War on all matters relating to the Military Establishment, and is charged by the Secretary of War with the planning, development, and execution of the Army program. The Chief of Staff by law (Act of May 12, 1917) takes rank and precedence over all officers of the Army, and by virtue of that position and by authority of and in the name of the Secretary of War he issues such orders as will insure that the policies of the War Department are harmoniously executed by the several corps, bureaus, and other agencies of the Military Establishment and that the Army program is carried out speedily and efficiently.

This order definitely charged the Chief of Staff with the responsibility for the execution of the Army program and delegated to him the authority commensurate with the responsibility.

It further consolidated the previously existing Purchase and Supply Division and the Storage and Traffic Division into the Purchase, Storage and Traffic Division, under the Director of Purchase, Storage and Traffic, who was specifically charged with the

"control of the * * * procurement and productive activities, including real estate, of the several bureaus, corps, and other agencies of the War Department, * * * the storing and warehousing of property for all departments, bureaus, and corps of the Army, * * * the movement of all property of the War Department, * * * and the transportation of troops and supplies overseas * * *."

Under the general authority contained in the Overman Act, which had been approved May 20, the Director of Purchase, Storage and Traffic was immediately upon the issue of General Orders, No. 80, authorized by me to effect a consolidation of the procurement (except in the case of the procurement of certain technical or specialized equipment pertaining to the technical corps) and of the storage functions of the various brueaus and services. The details of the procedure followed in this connection are given elsewhere in this report. In effect the result was to transfer these functions to the Quartermaster Department, already handling about 80 per cent of the procurement and storage activities of the Army, the Quartermaster General, who was designated as the Director of Purchase and Storage, reporting direct to the Director of Purchase, Storage and Traffic. The transfer of storage functions, had, however, progressed much further on June 30, 1919, than had the transfer of procurement functions. The consolidation of procurement rendered necessary a consolidation of financial activities under a Director of Finance, who, together with the chiefs of the previously existing Embarkation and Inland Transportation branches, also reported direct to the Director of Purchase, Storage and Traffic.

Another important change in the organization of the General Staff effected by General Orders, No. 80, was the establishment of the Military Intelligence Division, which had previously been a branch first of the War Plans Division and later of the Executive Division, as a separate and coordinate division of the General Staff. This was necessary in view of the extent and scope of the responsibilities of this division.

A subsequent and important amendment was made in General Orders, No. 80, when, by General Orders, No. 86, dated September 18, 1918, there was established, in the Operations Division, the Personnel Branch, in which there has been effected a consolidation of the handling of the appointments, assignments, and promotions of all commissioned personnel in the Army. This action became necessary as the result of the condition which arose due to the competition among bureaus and services for commissioned personnel and in order that officers might be assigned in accordance with their special qualifications to the arm in which their services could be most useful.

Other reorganizations.—In addition to the reorganization of the General Staff and the consolidation of bureau functions above referred to, it was necessary to establish certain new agencies in the War Department.

At the beginning of the war the Quartermaster Department had, in addition to its other duties, been charged with construction, motor transport, the Transport Service, and the pay of the Army. It had, early in the war, developed that these duties were of such an unrelated character and involved operations on such a scale as to render necessary a separation of these functions from the Quartermaster Corps in order that it might accomplish the tremendous task otherwise devolving upon it. The necessity for this separation of duties was emphasized when the Quartermaster Department developed into the great procuring and storage agency of the Army.

The Construction Division, which was organized as a separate agency from the Quartermaster Department in the early days of the war, was called upon to handle what was probably the greatest construction project ever undertaken, involving expenditures aggregating more than twice the cost of the Panama Canal. The rapid expansion of the Embarkation Service, which was also organized as a separate agency in August, 1917, is outlined elsewhere in this report. These agencies had already been separated from the Quartermaster Department and, following the experiences in the war, a new service, the Tank Corps, had been organized.

This reorganization was continued on my arrival. The development and procurement of material and the handling of the personnel pertaining to gas warfare, which was at that time distributed among four bureaus, was, on June 28, 1918, consolidated into a new service designated as the Chemical Warfare Service with a resulting marked increase in the efficiency of this service.

A similar consolidation of all motor transport activities and operating matters, which had previously been distributed among the various branches and departments, of which the Quartermaster Department was one, was effected in the organization of the Motor Transport Corps on August 15, 1918, which placed this important development of the war upon a sound organizational basis along the lines evolved as the result of our experience in France.

The separation from the Signal Corps of the Aviation Section of that Corps and its organization into the Bureau of Aircraft Production and the Department of Military Aeronautics, which was effected on May 29, 1918, facilitated production and served to coordinate, for the first time, the air program with the Army program as a whole. It resulted in a marked and general increase in the efficiency of that service, which was still further increased by the

consolidation on March 19, 1919, of these two agencies into the present Air Service under the Director of Air Service.

The necessity for the consolidation of finance activities, arising in part from the consolidation of procurement, and in part from the necessity of a central agency to handle disbursements, and to review and to prepare estimates for Congress, has already been referred to.

Such in general were the changes effected in the organization of the War Department by November 11, 1918, when the armistice was signed. This organization was an evolution and a development. It was a necessary outgrowth of rapidly changing conditions, and it was put into effect under the stress of war. It was based primarily upon a consolidation of functions in the bureaus and services best adapted to handle them, and upon the direct and effective control of these agencies by the General Staff in such a manner as to direct their various activities to the accomplishment of the common end—the execution of the military program.[2]

NECESSITY FOR GENERAL STAFF CONTROL.

The history of the Revolutionary War, the Civil War, and the War with Spain had shown the necessity of a War Department organization of this character; the experience of the first year of this war had demonstrated clearly that without such an organization the effective accomplishment of the tremendous military program required by a modern war was impossible.

Prior to the war, due to the legislative restrictions imposed upon its organization, no adequate General Staff organization was possible. Neither the bureaus nor the General Staff were, therefore, familiar with the best method of establishing an effective system of General Staff control. It was accordingly necessary for the details of such a system to be worked out, and for the necessary points of contact between the General Staff and the bureaus to be established, under the stress of war.

By March 4, 1918, when I became Chief of Staff, the critical military situation required action, and results, if the imperative needs of our Army overseas, and the allied cause, were to be met. The consolidation of related activities which was necessary to attain this end required a degree of actual administrative control, if results were to be secured with the expedition and effectiveness that was necessary, which, in some cases, was not essentially or fundamentally a General Staff function. Had a proper and adequate General Staff organization and supervision been in existence before the war

[2] See Chart 3, Chapter II, Vol. I.

this degree of administrative control by the General Staff would not have been necessary. Under the existing conditions, however, no other alternative existed if the military program as a whole were to be carried out, and I subordinated all other considerations to the attainment of that end.

SECTION V—PART 2.[8]

In brief the functions of the various services of the War Department, as set forth in the Army Regulations and Orders, were as follows; they were modified, however, as indicated in foot notes:

The Adjutant General's Department (A. R. 774).—The Adjutant General's Department is the department of records, orders and correspondence of the Army and the militia.

The Adjutant General is charged, under the direction of the Secretary of War, and subject to the supervision of the Chief of Staff in all matters pertaining to the command, discipline, or administration of the existing Military Establishment, with the duty of recording, authenticating, and communication to troops and individuals in the military service all orders, instructions, and regulations issued by the Secretary of War through the Chief of Staff; of preparing and distributing commissions; of compiling and issuing the Army Register and the Army List and Directory; of consolidating the general returns of the Army; of arranging and preserving the reports of officers detailed to visit encampments of militia; of preparing the annual returns of the militia required by law to be submitted to Congress; of managing the recruiting service, and of recording and issuing orders from the War Department remitting or mitigating sentences of general prisoners who have been discharged from the military service.

The Adjutant General is vested by law with the charge, under the Secretary of War, " of the military and hospital records of the volunteer armies and the pension and other business of the War Department connected therewith " ; and of the publication and distribution of the Official Records of the War of the Rebellion. He also has charge of the historical records and business of the permanent Military Establishment, including all pension, pay, bounty, and other business pertaining to or based upon the military or medical histories of former officers or enlisted men.

The archives of The Adjutant General's Office include: All military records of the Revolutionary War; the records of all organiza-

[8] Compiled in the Office of the American Member M. B. A. S., from Army Regulations 1913, General Orders and Bulletins, War Department.

tions, officers, and enlisted men that have been in the military service of the United States since the Revolutionary War; the records of the movements and operations of troops; the medical and hospital records of the Army; all reports of physical examination of recruits and all identification cards; the records of the Provost Marshal General's Bureau; the records of the Bureau of Refugees, Freedmen, and Abandoned Lands; the Confederate records, including those pertaining to the legislative, executive, and judicial branches of the Confederate Government.

The Adjutant General takes such steps as are necessary to complete or correct the records in his custody, and answers all calls or inquiries that are answerable from those records and that do not require administrative action by other bureaus of the War Department.

Inspector General's Department (A. R. 878).—The sphere of inquiry of the Inspector General's Department includes every branch of military affairs except when specially limited in these regulations or in orders. Inspectors will exercise a comprehensive and general observation within the command to which they may be respectively assigned over all that pertains to the efficiency of the Army, the conditions and state of supplies of all kinds, of arms and equipments, of the expenditure of public property and moneys, and the condition of accounts of all disbursing officers of every branch of the service, of the conduct, discipline, and efficiency of officers and troops, and report with strict impartiality in regard to all irregularities that may be discovered. From time to time they will make such suggestions as may appear to them practicable for the correction of any defect that may come under their observation.

Judge Advocate General's Department (A. R. 915).—The Judge Advocate General is the custodian of the records of all general courts-martial, courts of inquiry, and military commissions, and of all papers relating to the title of lands under the control of the War Department, except the Washington Aqueduct and the public buildings and grounds in the District of Columbia. The officers of this department render opinions upon legal questions when called upon by proper authority.

Quartermaster Corps (A. R. 1000).—The Quartermaster Corps is charged with the duty of providing means of transportation of every character,[4] either under contract or in kind, which may be needed in the movement of troops and material of war. It furnishes all public animals employed in the service of the Army, the forage

[4] This provision was modified, insofar as motor transport was concerned, when the Motor Transport Service was established. The provision of light railway equipment and matériel was a duty of the Engineers Department.

consumed by them, wagons and all articles necessary for their use, and the horse equipments for the Quartermaster Corps. It furnishes clothing, camp and garrison equipage, barracks, storehouses, and other buildings; constructs and repairs roads, railways, bridges;[5] builds and charters ships:[6] boats, docks and wharves needed for military purposes; supplies subsistence for enlisted men and others entitled thereto; supplies articles for authorized sales and issues; furnishes lists of articles authorized to be kept for sale; gives instructions for procuring, distributing, issuing, selling, and accounting for all quartermaster and subsistence supplies; has charge of the supply and distribution of and accounting for funds for the payment of the Army, and such other financial duties as are specially assigned to it; and attends to all matters connected with military operations which are not expressly assigned to some other bureau of the War Department.

Medical Department (A. R. 1386).—The Medical Department is charged with the duty of investigating the sanitary condition of the Army and making recommendations in reference thereto, of advising with reference to the location of permanent camps and posts, the adoption of systems of water supply and purification, and the disposal of wastes, with the duty of caring for the sick and wounded, making physical examinations of officers and enlisted men, the management and control of military hospitals, the recruitment, instruction, and control of the enlisted force of the Medical Department and of the Nurse Corps, and furnishing all medical and hospital supplies except for public animals.

Corps of Engineers (A. R. 1493).—The duties of the Corps of Engineers comprise reconnoitering and surveying for military purposes, including the laying out of camps; the preparation of military maps of the United States and its possessions, including cooperation with other Government and private mapping agencies, and in field operations, of maps of the theater of operations; selection of sites and formation of plans and estimates for military defenses; construction and repair of fortifications and their accessories; the supervision of the location of all buildings in or within one mile of any fortification; the installation of electric power plants and electric power cable connected with seacoast batteries, and furnishing the necessary electrical supplies connected therewith; planning and superintending of defensive or offensive works of troops in the field; examination of routes of communications for supplies and for military movements; construction and repair of military roads, railroads, and

[5] All construction passed to the Construction Division when it was established.
[6] Duty performed by the Shipping Board.

bridges; military demolitions; execution of river and harbor improvements assigned to it; and such other duties as the President or Congress may order.

In time of actual or threatened hostilities, within the theater of operations, it has charge of the location, design, and construction of wharves, piers, landings, storehouses, hospitals, and other structures of general interest; and of the construction, maintenance, and repair of roads, ferries, bridges, and incidental structures; and of the construction, maintenance, and operation of railroads under military control, including the construction and operation of armored trains.

Ordnance Department (A. R. 1511).—The Chief of Ordnance is charged with the duty of procuring, by purchase or manufacture, and distributing the necessary ordnance and ordnance stores for the Army and the Organized Militia, and establishes and maintains arsenals and depots for their manufacture and safe-keeping. All officers or other persons in the military establishment to whom ordnance and ordnance supplies or funds are intrusted, will make accounts and returns thereof to the Chief of Ordnance at the times and in the manner prescribed.

Signal Corps (A. R. 1556).—The Chief Signal Officer shall have charge, under the direction of the Secretary of War, of all military signal duties and of books, papers and devices connected therewith, including telegraph and telephone apparatus and the necessary meteorological instruments for use on target ranges and for other military uses; of the construction, repair, and operation of military telegraph lines and the duty of transmitting messages for the Army, by telegraph or otherwise, and of all other duties usually pertaining to military signaling and the operations of such corps as shall be confined to strictly military matters; of the direction of the Signal Corps of the Army and the control of the officers, enlisted men, and employees attached thereto; of the supply, installation, repair, and operation of military cables, telegraph and telephone lines, and radio apparatus and stations, except of the operation of radio apparatus when installed on military aircraft and as provided in paragraph 1505½; of the supply, repair and operation of field telegraph trains; of the preparation and revision of the War Department Telegraph Code; of the supervision of such instruction in military signaling, telephony, and telegraphy as may be prescribed in orders from the War Department, except such as is used by the Coast Artillery in fire control and fire direction and service of submarine mines; of the procurement, preservation, and distribution

of the necessary supplies for the Signal Corps, and of the procurement and issue of signal equipment required in coast defense.

Air Service (G. O. 51, W. D., May 24, 1918).—A director of Military Aeronautics, selected and designated by the Commander-in-Chief of the Army, shall hereafter have charge, under the direction of the Secretary of War, of the Aviation Section of the Signal Corps of the Army, and as such shall be, and he hereby is, charged with the duty of operating and maintaining or supervising the operation and maintenance of all military aircraft, including balloons and airplanes, all appliances pertaining to said aircraft and signaling apparatus of any kind when installed on said aircraft, and of training officers, enlisted men and candidates for aviation service to matters pertaining to military aviation, and shall hereafter perform each and every function heretofore imposed upon and performed by the Chief Signal Officer of the Army in, or in connection with, the Aviation Section of the Signal Corps, except such as pertains to the purchase, manufacture and production of aircraft and aircraft equipment and as is not hereinafter conferred, in special or general terms, upon the Bureau of Aircraft Production.

Bureau of Aircraft Production (G. O. 51, W. D., May 24, 1918).—An executive agency, to be known as the Bureau of Aircraft Production, is hereby established, and said agency shall exercise full, complete and exclusive jurisdiction and control over the production of airplanes, airplane engines and aircraft equipment for the use of the Army, it being the intent hereof to transfer from the jurisdiction of the Signal Corps to the jurisdiction of the said Bureau of Aircraft Production, every function, power and duty connected with said production, all property of every sort or nature used or procured for use in, or in connection with, said production, and the entire personnel of the Signal Corps, as at present assigned to, or engaged upon, work in, or in connection with, such production.

Such person as shall at the time be Chairman of the Aircraft Board created by the Act of Congress approved October 1, 1917, shall also be the executive officer of said Bureau of Aircraft Production, and he shall be, and he hereby is, designated as Director of Aircraft Production, and he shall, under the direction of the Secretary of War, have charge of the activities, personnel, and properties of said bureau.

Chemical Warfare Service (G. O. 62, W. D., June 28, 1918).—The President directs that the Gas Service of the Army be organized into a Chemical Warfare Service, National Army, to include: (*a*) The Chemical Service Section, National Army. (*b*) All officers and enlisted men of the Ordnance Department and Sanitary Corps of

the Medical Department as hereinafter more specifically specifies (regular officers affected being detailed and not transferred).

The head of the Chemical Warfare Service, National Army, shall be known as the Director of the Chemical Warfare Service, and, under the direction of the Secretary of War, as such, he shall be, and hereby is, charged with the duty of operating and maintaining or supervising the operation and maintenance of all plants engaged in the investigation, manufacture, or production of toxic gases, gas-defense appliances, the filling of gas shells, and proving grounds utilized in connection therewith and the necessary research connected with gas warfare, and he shall exercise full, complete, and exclusive jurisdiction and control over the manufacture and production of toxic gases, gas-defense appliances, including gas-shell filling plants and proving grounds utilized in connection therewith, and all investigation and research work in connection with gas warfare.

Motor Transport Corps (G. O. 75, W. D., August 15, 1918).—There is created during the existing emergency a Motor Transport Corps. There will be detailed a chief of the Motor Transport Corps.

In this order, unless special exceptions are made, the term "motor vehicle" will be construed to include all bicycles, motorcycles, automobiles, trailers, and trucks, by whatsoever staff corps or service they may have been originally supplied and for whatsoever purpose. All motor vehicles with cargo-carrying chassis are classed as trucks. Tractors of the caterpillar type, designed primarily for traction purposes and tanks, are excepted from the provisions of this order, the Ordnance Department being charged with the responsibility for their supply and maintenance.

The functions of the Motor Transport Corps are as follows:

(*a*) The technical supervision of all motor vehicles.

(*b*) The design, production, procurement, reception, storage, maintenance and replacement of all motor vehicles, and accounting for same.

(*c*) The design, production, procurement, storage, and supply of spare and repair parts, tools, accessories, and supplies of all motor vehicles, and accounting for same.

(*d*) The establishment and operation of all Motor Transport Corps garages, parks, depots, and repair shops.

(*e*) The procurement, organization, and technical training of Motor Transport Corps personnel.

(*f*) The salvage and evacuation of damaged motor vehicles.

(*g*) The homogeneous grouping of motor vehicles.

(*h*) The operation, in accordance with instructions from the proper commanding officer as to their employment, of groups of motor vehicles of "first class" as defined in paragraph 5, below.

(*i*) The preparation of plans for hauling cargo and personnel over military roads, or roads under military control, will be under the control of the Motor Transport Corps.

(*j*) The procurement, supply, replacement, and preliminary training before assignment to combatant organizations of personnel for operation of motor vehicles of the second class will be made by the Motor Transport Corps.

Provost Marshal General (G. O. 65, W. D., May 22, 1917).—By direction of the President, Brigadier General Enoch H. Crowder, Judge Advocate General, United States Army, is hereby detailed as Provost Marshal General, and vested with the execution under the Secretary of War, of so much of the Act of Congress entitled "An Act to authorize the President to increase temporarily the Military Establishment of the United States," approved May 18, 1917, as relates to the registration and the selective draft.

That the enlisted men required to raise and maintain the organizations of the Regular Army and to complete and maintain the organizations embodying the members of the National Guard drafted into the service of the United States, at the maximum legal strength as by this act provided, shall be raised by voluntary enlistment, or if and whenever the President decides that they can not effectually be so raised or maintained, then by selective draft; and all other forces hereby authorized, except as provided in the seventh paragraph of section one, shall be raised and maintained by selective draft exclusively; but this provision shall not prevent the transfer to any force of training cadres from other forces. Such draft as herein provided shall be based upon liability to military service of all male citizens, or male persons not alien enemies who have declared their intention to become citizens, between the ages of twenty-one and thirty years, both inclusive, and shall take place and be maintained under such regulations as the President may prescribe not inconsistent with the terms of this act. (*Bulletin 32, W. D., Sec. II.*)

Construction Division (Letters Fr. A. G. O., Oct. 5, 1917, & March 13, 1918).—The Secretary of War directs that all building and construction rendered necessary in the United States by the present emergency and provided for by existing or pending appropriations shall be executed by the Quartermaster General's Department under the direction of Colonel Littell. Under authority granted in Section 1, of the Act of Congress " to authorize the President to increase temporarily the military establishment of the United States," approved May 18, 1917, the President directs that the Cantonment Division of the Quartermaster Corps (including as a part thereof the Construc-

tion and Repair Division of the Quartermaster Corps), now operating as a part of the Office of the Chief of Staff, shall hereafter be called the Construction Division.

In view of existing orders of the Secretary of War that all building and construction rendered necessary in the United States by the present emergency shall be executed by the Construction Division unless especially excepted by the Secretary of War, all commissioned and civilian personnel of the Ordnance Department and Signal Corps heretofore employed exclusively on construction work and no longer needed in those corps and departments, will be considered available for assignment to the Construction Division as a part of the personnel herein authorized. (*Letter of Mar. 13, 1918.*)

CHAPTER III.

SECTION I—PART 1.

THE WAR CABINET (BRITISH).[1]

(Chart 1, Chapter III, Vol. I.)

The higher direction of the war, so far as British activities were concerned, remained, in 1918, as in 1917, in the hands of the War Cabinet. There were several changes in the personnel of the War Cabinet during the year under review. On January 21st, 1918, Sir Edward Carson resigned from the War Cabinet, on April 20th, Lord Milner left in order to assume office as Secretary of State for War, and on April 18th, Mr. Austen Chamberlain became a member. Thus in December 1918, the War Cabinet was composed as shown in chart.

General Smuts also continued to attend the meetings of the War Cabinet during 1918. The only exception to the principle described in the annual Report for 1917—that the members of the War Cabinet should be free from administrative duties—was in the case of Mr. Bonar Law, who continued to fill the office of the Chancellor of the Exchequer and to act as the chief representative of the Government in the House of Commons.

The War Cabinet system continued to operate on the same lines as were described in the Report for 1917, subject to such modifications as were required to meet the exigencies of the war. In the Report for 1917, it was described how a number of the less important but often highly complex questions were referred to individual members of the War Cabinet or to the Committees of Ministers or others, sometimes with power to decide and sometimes for the purpose of carrying out detailed investigation on behalf of the War Cabinet, leaving the final decision for the Cabinet itself. The principal development in 1918 was in the extension of the system of permanent Committees to deal with groups of questions which previously had tended more and more to come within the range of subjects dealt with by particular members of the War Cabinet. The more permanent Committees are shown in chart 1, Chapter III, Volume I.

[1] Extract from "The War Cabinet" (Report for the year 1918).

WAR PRIORITIES COMMITTEE

On September 20th, 1917, it was decided to set up the Aerial Operations Committee to report to the War Cabinet on the conditions prevailing with regard to manufacture of aircraft, and to make recommendations regarding the priority which should be given to this branch of manufacture, and as to the effect such priority would have upon the output of other munitions for the Army and Navy.

At their first meeting this Committee decided that they could more usefully perform their functions if they were constituted as a Standing Committee empowered to settle all questions of priority, not only of the Air program but of all other munitions programs. Their recommendations to this effect were approved by the War Cabinet and the designation of the Committee was altered to that of the War Priorities Committee.

In addition the President of the Board of Trade and the Minister of Reconstruction were empowered to attend as members on those occasions when subjects affecting their departments came up for discussion.

The method adopted by the War Priorities Committee was to set up interdepartmental boards and committees to deal with each subject or commodity where there was an excess of demand over supply. Including the Joint Priority Board, set up to secure the first stage of agreement on interdepartmental priority, there were seventeen of these sub-committees. Each board or committee reported to the War Priorities Committee, which was available as a court to decide any question or disagreement which might arise.

In addition to these sub-commttees others were set up as follows:

(*a*) The Permanent Sub-Committee, which was composed of departmental officials of high standing and acted as an intermediate court between the War Priorities Committee and the several interdepartmental sub-committees.

(*b*) The Permanent Labor Sub-Committee, set up to coordinate departmental methods of dealing with such labor matters as dilution, release of men for service with the forces, etc.

(*c*) The Works Construction Sub-Committee, which examined and decided upon the relative priority of all building and constructional schemes throughout the country. The usefulness of this committee may best be judged by the fact that during the period December 1917, to September 1918, the schemes which were refused priority or which were withdrawn after consideration by the committee amounted to a total of some £7,000,000.

(*d*) The Industries Sub-Committee, established to investigate the needs of civil and non-essential industries for those materials con-

trolled as a measure of war necessity by the War Supply Departments.

In spite of its extensive organization the War Priorities Committee was in no sense an executive body. All its efforts were directed towards bringing competing departments into close contact, thereby affording them a better opportunity for realizing the necessity for give and take if the war machine were to be kept going as a whole.

EASTERN COMMITTEE.

The "Eastern Committee" was established in March 1918, to take over the work formerly dealt with by two committees known respectively as the Persia Committee and the Middle East Committee. The Eastern Committee dealt with the multifarious problems that arose between the eastern shores of the Mediterranean and the frontiers of Asia. It co-ordinatd the military and diplomatic policy in Palestine, Syria, Mestopotamia, Persia, the Caucasus, Transcaspia, Central Asia, etc.

ECONOMIC DEFENCE AND DEVELOPMENT COMMITTEE.

The committee was given wide powers to deal within its discretion with any economic questions, and only referred to the War Cabinet such large questions of policy as required Cabinet sanction.

COMMITTEE OF HOME AFFAIRS.

In June, 1918, the War Cabinet decided to set up a Standing Cabinet Committee of Home Affairs to deal with questions of internal policy and such domestic questions as required the co-operation of more than one department, or were of such importance that they would otherwise call for the consideration of the War Cabinet.

The main subjects which engaged the attention of the committee were raised at the instance of the Local Government Board, the Board of Agriculture, the Ministries of Food, Labor, Pensions, and Reconstruction, and embraced problems of health, housing and education, wages and industrial conditions, pensions, and the supply and prices of food-stuffs.

MINISTRY OF MUNITIONS.[2]

The Ministry of Munitions was the oldest, as it was also the largest, of the temporary departments created to meet the needs of the war. The present Prime Minister was formally appointed Minister of Munitions of War on June 9th, 1915. Three years and five

[2] Extract "The War Cabinet" (Report for the year 1918)

months later the Armistice was signed and the main task of the department accomplished To that victory the Ministry had made a very substantial contribution.

The most serious single limiting factor on the output of munitions was the shortage of shipping. The actual supply of shell for the year 1918, though it marked the highest pinnacle of actual output attained during the war, was, in fact, substantially less than the maximum program for which productive capacity had been provided. For the limitation of material affected the output of muntions at every turn, and the most rigid economy became necessary when it was realized that every ton of material imported to meet the demands of one department meant the subtraction of a like amount from the supply available for some other public service.

Another shortage affecting the output of munitions in 1918 was that of coal, due to many causes, but chiefly to the loss of the coal fields of Northern France after the battle of Armentières, and to the simultaneous depletion of the British collieries to meet the increased need for men in the Army. The recruitment from the coal fields had actually a more serious effect than the recruitment of munition workers, since the latter were more easily replaced by methods of dilution.

In the face of these and many other grave obstacles the record of the Ministry of Munitions is one of proud achievement, and in an attempt to appraise the elements of that success the foremost place must be given to the enthusiastic and unremitting toil of the great civilian army of men and women munition workers.

ADMINISTRATIVE ORGANIZATION.

The Inter-Allied Munitions Council.—In the sphere of administration the outstanding feature of the period under review was the great advance made in respect to effective co-ordination of Inter-Allied effort. In the field of munitions supply this development ranks with the achievement of unity of command in the sphere of strategy to which it is in fact the inevitable corollary.

Previous to the establishment of the Inter-Allied Council there was no sure method of securing that the Ally most in need of a particular supply was in fact obtaining that supply in preference to the need, real but definitely less urgent, of another Ally. Also it was found that the Allied Governments were not kept sufficiently informed of the progress they were severally making in the invention and improvement of weapons of war.

The United States Government had suggested, shortly after its entrance into the war, that as soon as the appropriate machinery could be devised it would be necessary that purchases for the pur-

poses of the war by the several Allies should only be made after submission to a body representing them all, which would settle priority and cut down demands to what was reasonable and necessary. But the Allied Maritime Transport Council had found that in its business of allocating the available shipping tonnage of the world to the most urgent needs it was impeded by the absence of any authoritative body representing the needs of the Allies for munitions and materials. The three main classes of commodities requiring shipping tonnage were (*a*) food and feeding stuffs, (*b*) coal, and (*c*) munitions and their raw materials. In the matter of food, the Maritime Transport Council was able to deal with well organized bodies representing the whole Alliance; they were also able to obtain a comprehensive statement of the requirements of coal; but with regard to munitions they found themselves dealing with the separate Governments of the Allies, without any means of deciding the relative urgency of the demands made by those Governments for different parts of their programs.

Under the stimulus of these several needs, the Inter-Allied Munitions Council took shape and held its first meeting in June, 1918, in Paris. Among matters considered by the Council was the assistance in munitions required from the European Allies to complete the equipment of the very large forces which the United States were then sending to Europe, in response to the appeal of the Allies. A complete tonnage program for munitions and materials for 1919 was also prepared.

The Munitions Council.—When Mr. Churchill became Minister of Munitions in July 1917, the Ministry had already assumed somewhat unwieldy proportions, spreading as it did into more than three dozen buildings, including several large hotels. Corresponding with its dispersed accommodation was a certain lack of centralized organization, due to the emergency nature of its origin, the rapidity of its growth, and the fact that rapid and energetic initiative was the quality chiefly demanded of the great business men from whom its Heads of Departments were chiefly recruited. Under Mr. Churchill the fifty or sixty departments were re-organized into "Groups" under a Munitions Council, each group being presided over by a Member of Council, responsible for the superintendence and co-ordination of its departmental activities. At the time of the conclusion of hostilities these groups were ten in number, and the list of their names provides the briefest possible summary of the work of the Ministry.

I. Secretariat, including Departments of Priority, Requirements, Statistics, Demobilization and Reconstruction, etc.

II. Finance, including Contracts, Factory Audit and Costs, etc.

III. Design, including Inspection.

IV. Steel and Iron.

V. Matrial: Non-ferrous material, railway materials, optical munitions and potash, etc.

VI. Explosives, including Oils and Chemical Warfare.

VII. Ordnance.

VIII. Warfare: Mechanical warfare, trench warfare, mechanical transport, etc.

IX. Aircraft.

X. Labor.

A picture might be drawn of the movement of materials from every region and climate under the sun, beginning with rills and rivulets in remote corners of the earth, and growing in volume as the converging streams unite in a mighty river of supply, finally directed in an irresistible torrent against the resistance of the enemy's defences. Nitrates from Chile; iron ore and pyrite from Spain; steel irons from Sweden; platinum from Russia; quicksilver from Spain; copper and aluminum from America; abrasives from Greece; cryolite from Greenland—these and many more industrial constituents have been gathered together to feed the furnaces and supply the factories of this country. No less varied are the contributions which have come from within the confines of the Empire itself. From India have been drawn manganese ore; wolfram, magnesite and mica; graphite from Ceylon; from Canada steel, ferro-silicon and other ferro-alloys, nickel and asbestos, in addition to valuable contribution of spruce timbers for aeroplane construction and a great variety of other mineral products; from Australia zinc concentrates, lead and antimony; scheelite from New Zealand; chromium and other special minerals from South Africa; tin from the Straits Settlements.

SECTION I—PART 2.

NATIONAL SERVICE.[1]

The transfer of the recruiting functions of the War Office, which was a difficult and might have been a dangerous operation in time of war, had been successfully accomplished without disturbing the flow of recruits to the colors. The Ministry had established a regional organization throughout Great Britain, whereby all the branches of its administrative work had been successfully decentralized. The collapse of Russia had made it clear that increased demands would have to be made on the nation's man-power, and the recruiting program for 1918 had been settled on that basis, additional powers being given to the Ministry by the Military Service Act which became law on February 6th for the purpose of carrying it out. The German offensive on the Western front, which began shortly afterwards, profoundly modified these calculations, and the resulting crisis laid an even heavier burden on the new organization of the Ministry than had been anticipated.

The history of the Ministry of National Service during the year 1918 is dominated by the great national emergency of last spring, and is very largely an account of the steps which were successfully taken to find men to meet it.

TRANSPORT.

A. *Shipping.*—The chief characteristic of the year 1917 in relation to British merchant shipping had been the gradual development and expansion of State control and direction, so that by centralization of control British merchant tonnage could be utilized in the manner most conducive to the successful prosecution of the war. This end had been accomplished by bringing under requisition or direct control all the tonnage which previously had been trading in a free market, and by extending so far as practicable the principle of drawing supplies from the nearest source of origin. The extent to which this policy had been successful may be gathered from the fact that whereas the average amount of British tonnage available for imports into the United Kingdom was approximately 7,500,000

[1] Extract from: "The War Cabinet" (Report for the year 1918)

tons gross, the amount of imports into the United Kingdom during 1917 in British vessels was 31,000,000 tons. These figures should be compared with the corresponding figures for the year 1913, when the total amount of British tonnage available for imports had been approximately 12,000,000 tons and the imports in British vessels 35,000,000 tons.

During the year 1918 the outstanding characteristics of the administration of the Ministry of Shipping have been greater economy in the working of tonnage, and, as an important factor in this, the development of the principle of Inter-Allied co-operation.

The entry of America into the war, and the surplus merchant tonnage which it was anticipated she would be able to contribute to the needs of the European Allies, coupled with the vast potentialities of her shipbuilding output, very materially changed *prima facie* the tonnage situation as between the Allies; for whereas with the comparatively unimportant exception of Greece, Great Britain had previously been the only Allied country whose tonnage exceeded that required for her own urgent needs, the entry of America gave reason to expect that there would be two of the Associated Governments in a position to grant assistance in tonnage matters to their less fortunate Allies. The result of this fundamental change in outlook, coupled with the tendency above indicated, led to the establishment of the Allied Maritime Transport Council by resolution of the Paris Conference in December, 1917. The Council was to watch over the general conduct of Allied transport and, while leaving each nation responsible for the supervision and the management of the tonnage under its own control, was to secure the necessary exchange of information and co-ordination of policy and effort on the part of the four Governments of France, Italy, the United States of America and Great Britain, in adjusting their programs of imports to the carrying capacity of the available tonnage (having regard to Naval and Military requirements), and in making the most advantageous allocation and disposition of the tonnage under their control, in accordance with the urgency of war needs.

The Council consisted of two Ministers representing each Allied country. The United States Government did not at first formally join the Council, but was represented at its deliberations by two representatives. In the autumn, however, the United States Secretary of War, Hon. Newton D. Baker, attended a session of the Council, and pledged the United States Government to the policy of the common use of shipping for the common needs, and thus virtually put the United States Government on the same basis as the other members of the Council. In connection with the Council, a permanent Executive was created to coordinate and examine the statements of tonnage available and imports needed by the different Allies, in

order to enable the Council to determine the best allocation of the available tonnage in the general interest of the Allies as a whole. The Council was purely deliberative and advisory and had no executive powers, each Government being free to accept or reject its recommendations. Nevertheless, it represented a very important step in securing economy in the use of tonnage and the allocation of available tonnage in a way best calculated to promote the successful prosecution of the war.

In association with the Allied Maritime Transport Council, Inter-Allied bodies dealing with the purchase and distribution of the more important supplies were gradually established. These bodies were all linked up with the organization of the Allied Maritime Transport Council in such a way that the relative demands of the different Allies for the particular commodity covered by the particular allied body were presented to the Allied Maritime Transport Council as an agreed document. By this means the Allied Maritime Transport Council was spared the consideration of the relative claims of, say, France and Great Britain for cereals, and had only to consider the relative claims of, say, the allied food program as against the allied munitions program.

These bodies, in their relations to the Allied Maritime Transport Council, were known as "Program Committees". In some cases arrangements were made for bodies already in existence (e. g. the Wheat Executive) to fulfill the functions of Program Committees. In others, new organizations were specially created at the instance of the Allied Maritime Transport Council.

The Executive of the Council developed into a large organization in Lancaster House. The total staff working there prior to the Armistice numbered about 300.

Program Committees were established to cover the whole range of imported commodities, separate Committees being formed for wool, cotton, hides and leather, tobacco, paper, timber, petroleum, flax and hemp and jute, and coal and coke. In addition, a Food Council was established co-ordinating the work of Executives or Committees for cereals, oil seeds, sugar and meats and fats, and a Munitions Council, with sub-committees, for nitrates, aircraft, chemicals, explosives, non-ferrous metals, mechanical transport and steel.

It is estimated that every American soldier carried across the Atlantic shut out about 2 tons of cargo, while an additional loss was incurred owing to the fact that some ships had to sail with a portion of their remaining cargo space empty in order to join their convoys. The net effect of the transportation of American troops during the greater part of the year was that Great Britain sacrificed carrying capacity equal to nearly 300,000 tons of imports from the United States per month.

RESULTS OF INTER-ALLIED CO-OPERATION.[1]

France had the equivalent of over one million tons gross of British shipping in her service.

Forty-three per cent. of the total imports into France were carried in British ships.

Forty-five per cent. of the import of coal was carried in British ships.

One million seven hundred and twenty-five thousand tons of cereals for human consumption out of 2,732,000 tons in all, were carried in British ships in the cereal year ending August 31st, 1918, to France.

France had the benefit of coal at bunkering stations abroad which have been kept supplied by British ships.

France had in her service over 400,000 tons gross of neutral tonnage obtained by our assistance.

Italy had the equivalent of about three-quarters of a million tons gross of British shipping in her service.

About 49 per cent. of her total imports were carried in British ships.

Seventy-nine per cent. of the coal supplied to Italy was carried in British ships.

Nine hundred and sixty thousand tons of cereals for human consumption out of 2,774,000 tons in all, were carried in British ships in the cereal year ending August 31st, 1918, to Italy.

Italy had the benefit of coaling stations abroad supplied by British tonnage.

Nearly 300,000 tons gross of neutral tonnage obtained by our assistance was in her service.

The United States had the equivalent of over half a million tons of shipping in her service.

Over 1,000,000 American troops were brought from the United States in British vessels, and over 1,000,000 were carried from the United Kingdom to France in British vessels.

The American Army in France and England was supplied with large quantities of munitions, timber, etc., which were imported into the United Kingdom in British ships.

The United Kingdom co-operated with the United States to obtain neutral tonnage. By this means the United States obtained nearly 1,000,000 tons gross of neutral vessels for her own purposes.

[1] Extract from: "The War Cabinet" (Report for the year 1918).

SECTION I—PART 4.

RAILWAYS.[1]

No account of railway operations under Government control could be complete without reference to the Railway Executive Committee—the body which was, throughout the war, responsible for the management and working of the railway systems of the country. The Railway Executive Committee consisted of twelve general managers, drawn from the principal railway companies of the United Kingdom. It was constituted in 1912 as a separate Department of the Board of Trade, its Chairman being the President of the Board of Trade for the time being.

On the outbreak of the war, the Government, exercising the powers created by Act of Parliament, 1871, at once took over practically the whole of the railways of Great Britain and placed them under the general direction of the Railway Executive Committee.

The number of railways and Joint Committees taken into control was 130, the total geographical mileage being 21,331, with a capital value of £1,200 millions. The mileage controlled covers all but two per cent. of the railways of Great Britain.

On the 1st of January 1917, the Government control was extended to the Irish Railways, and a special Irish Railway Executive Committee was set up with headquarters in Dublin.

The Railway Executive Committee decided, from the commencement, on a policy of leaving the staff and the working arrangements of each railway under the control of its own management, and confined its functions to co-ordinating the work of the railways, and to dealing with those general problems which were common to all the systems and which, even in peace times, would have been solved by conference amongst railway directors and managers.

[1] Extract from: "The War Cabinet" (Report for the year 1918).

SECTION I—PART 5.

THE AIR SERVICE.[1]

ORGANIZATION OF THE AIR MINISTRY.

The Air Council was set up on January 2nd, 1918, but most careful preparation was clearly needed before it could undertake to accept the transfer from the Admiralty and War Office of full responsibility for the direction of the Royal Naval Air Service and the Royal Flying Corps, or to complete the various intricate adjustments necessary to weld the two branches into a single Force. The complexity of the task was increased by the fact that the two branches of the Air Service were based on systems of administration so widely and necessarily different as those by which the Navy and Army are respectively controlled.

It was a primary and essential consideration that the amalgamation of the two Services should be brought about without dislocation or delay in the work of the Air Service in the field or at home. To secure this it was necessary that the unified Force should be administered on a system which would be, so far as possible, in accordance with the previous experience of those who would be responsible for its direction. It almost inevitably ensued that the initial organization of the Royal Air Force should in its main features follow that of the Army, unfamiliar though that would be to the smaller portion of the new Force which had belonged to the Royal Naval Air Service, and whose members were consequently accustomed to naval and not to military systems of administration. To constitute either an entirely novel system of administration, based, as it would be, on "*a priori*" conceptions of the requirements of the new Service, or to seek to devise some form of compromise between the deep-rooted differences of naval and military methods, would have been to invite difficulties which might have had the most serious consequences.

The preliminary distribution of duties among the departments of the various members of the Air Council accordingly followed "*mutatis mutandis*" that of the distribution of duties in the War Office.

[1] Report for the year 1918, British War Cabinet.

Broadly speaking, these may be stated as making the Chief of the Air Staff responsible for all questions of Air Policy affecting the security of the Empire; for advising the Government as to the conduct of air operations and the issue of orders in regard to them; and for the organization, fighting efficiency and training policy of the Air Force. The Master-General of Personnel was responsible for the raising, training and administration of personnel (both officers and men) required to carry out the approved policy. The Controller General of Equipment was charged with supervising the provision of all aircraft, engines and armament, and with the allotment, issue and repair of all aircraft, as well as with all transport, supply and equipment services.

The responsibility of the Controller General involved the closest liaison between him and the Director General of Aircraft Production, who, under the Ministry of Munitions, had been since December 1916, responsible for the production of aircraft in accordance with the requirements of the Service. The Director General of Aircraft Production also was given a seat upon the Air Council.

The financial responsibility for the administration of the Air Force was assigned to the Department of the Under-Secretary of State, and the view was taken that the very great extensions in works (including the provision of new aerodromes) and buildings which were involved in the expansion of the flying services required that this branch of the duties of the Department should be directly represented on the Council by the Administrator of Works and Buildings. The Department of the Secretary to the Air Council was charged with the co-ordination of the work of the various executive branches (including the preparation of statistics), with the legal business of the Department, and generally with services common to the Air Ministry as a whole.

It should be added that the setting up of the Royal Air Force did not imply any immediate cessation of the performance by the Admiralty and War Office of various services connected with, for example, victualling, which continued for the time being to be carried out by these Departments as agency services for the Royal Air Force. In respect of these, acknowledgment is due to the ready assistance rendered by both the senior Services, an assistance which in important spheres continued throughout the year.

CHAPTER III.

SECTION II.

FRENCH GOVERNMENTAL ORGANIZATION OF SUPPLIES.

(Chart 3, Chapter III, Vol. I.)

In 1914, the duties of the Minister of War included the acquisition, renewal and distribution of supplies of food, forage, fuel, and of all other provisions required by the armies in the field. He also procured the munitions for the Army as well as materials of all kinds.

To satisfy these needs he proceeded to:

Exploit the resources of the national territory by purchases or requisitions; he also made purchases abroad, (in allied and neutral countries).

With reference to matériel and munitions, the raw materials which had been purchased or requisitioned were delivered to special establishments under the direct orders of the Minister of War, or to private establishments which were recognized as the best fitted for the required service. These establishments regulated their production in accordance with the instructions of the Minister.

Towards the end of 1914, it was apparent that the organization of the ministerial departments, as they had been conceived, could not furnish, within the specified time and in required amounts, that which was indispensable to enable the armies to live and fight.

It therefore became necessary to distribute the tasks among the various ministries and to create new ones.

A. *War Material.*

The Ministry of Armament and War Production (Ministère de l'Armement et des Fabrications de Guerre) was established by a decree, dated December 13th, 1916, for the purpose of handling all questions pertaining to the manufacture and purchase of artillery matériel and munitions. The efforts of the national industries relative to raw materials, means of manufacturing and labor were thus coordinated to meet the requirements not only of the war administration, but also for all the public services. This Ministry included the "Direction of Inventions" (Direction des Inventions). (April 14, 1917.)

The Ministry of War placed all necessary operating personnel at the disposal of the Ministry of Armament and War Production, as

well as that needed for administrative purposes, and it was also given the command over the troop units which were assigned to it.

The Ministry of Armament and War Production corresponded directly with the Commander in Chief and with the commanders of territorial regions to obtain the assignment of the additional personnel required for war industry purposes. Finally, the entire personnel of the State powder plants were also placed at its disposal.

The following services were placed under the direct authority of the Ministry of Armament and War Production:

The Direction for the organization and supply of (ordnance) artillery matériel (supply of artillery matériel and munitions to the armies);

The service for the manufacture and supply of motor transport matériel;

The Direction of the chemical warfare services;

The General Direction for the manufacture of powders and explosives;

The Direction for the general organization of production;

The Direction of inventions and technical research;

The Direction of mines;

The permanent inspection of the artillery manufacturing services;

The Direction of iron-works;

The service for metallurgical production;

The service for the supply of motive power;

The service for the supply of hydraulic energy;

The General wood inspectorate;

The National Coal Bureau.

B. *Wood Supply.*

With the advent of trench warfare plans were made to organize the wood supply services of the armies, as the latters' requirements were increasing rapidly.

During the latter part of 1914, and during 1915, wood producing centers were established at Paris, Rouen, Orléans, Besançon, Nantes, Grenoble, Montpellier and Bordeaux to supply the armies operating in France; while a wood supply center at Marseille supplied the needs of the Army of the Orient.

December 13, 1914, a supply center was organized at Lons-le-Saulnier for assembling the construction lumber to be used in building supports for bridges which had been destroyed.

The Direction of Engineers, at the Ministry of War, was charged with the purchase of construction and box lumber. (November 25, 1915.)

The "General Wood Committee" (Comité Général des Bois) was created by a decree of August 3, 1917 and charged with the study of all questions concerning the lumber industry, importations, etc

The "General Wood Inspection" (Inspection Générale des Bois) was created on August 17, 1917 and attached to the Ministry of Armament and War Production. Its functions included the exploitation of forests, the importation of wood from the colonies, and the granting of authorizations for the importation of wood from abroad. It made contracts and carried out technical investigations pertaining to forestry operations.

It was also charged with maintaining relations with the Allied Armies in all matters concerning forestry operations and the supplying of wood for all purposes.

Interallied organizations were created to assure the wood supply of the various Allied nations and to prevent competition between them. These were:

(*a*) The International Wood Purchasing Commission (Commission internationale d'achats de bois), created February 1916. with headquarters in London. This commission made purchases in common and distributed available lumber in accordance with the needs of the Allied nations and the amount of tonnage available.

(*b*) The Interallied Committee on Wood for war purposes (Comité Interallié des Bois de Guerre), created November 15, 1916, which regulated the distribution of wood among the Allied Armies. It made agreements with the various Allied Armies by the terms of which certain Armies furnished labor (Canadian forestry companies) in exchange for free wood cutting privileges, while others exchanged tonnage for forestry "cuts".

C. *Coal.*

The over-running of the mines in the North of France by the enemy greatly reduced the national coal resources.

The supplying of the civil population and of the armies, the fuel needed for factories and for the operation of transportation, required continuously increasing quantities of coal. It therefore became necessary to entrust the organization of this supply to a single organization.

In April 1916, the "National Coal Bureau" (Bureau National des Charbons—B. N. C.) was created and attached to the Ministry of Armament and War Production. It was charged with the purchase of coal from French and foreign mines and distributed the coal among the Chambers of Commerce, industries (iron works, spinning works, war manufactories, gas factories, etc.), and railroads. It chartered the vessels requisitioned by the State, determined their loading and unloading points according to actual needs, granted importing licenses to manufacturers and assigned the tonnage which had been granted them.

The National Coal Bureau maintained a kind of "subcommission" in the large French ports and cities. These sub-commissions were composed of a representative of the "B. N. C.," assisted by a member of the local Chamber of Commerce and by the representatives of importers, water and rail transportation companies and consumers (gas factories, electrical plants, etc.).

These sub-commissions verified bills and bills of lading, and issued vouchers entitling the importers to reimbursement by the "B. N. C." They also controlled the distribution of fuel among the public services and manufacturers of the regions.

All accounts were sent to the "B. N. C." and forwarded from there to the general accounting office of the State Railways, which handled the accounts of the "B. N. C." Furthermore, the chiefs of the State Railways depots were authorized to inspect the quality of fuel delivered to the public services.

D. *Gasoline and Liquid Fuels.*

France was absolutely dependent upon foreign countries for its supply of gasoline (essence), (Mexico, United States, Dutch Indies), and the war made it impossible for her to draw from the mines in Galicia, Roumania, or in the Caucasus.

Before the war, France imported about 400,000 tons of oil and gasoline yearly. These imports were carried on by ten companies (refineries).

Oil and gasoline being raw materials which were needed in the manufacture of explosives and also for the operation of tractor artillery, motor transportation and combat aviation, were equally as important and as indispensable in the conduct of war as powder, munitions, coal, wheat or cotton.

The French Government, because of the difficulties of this supply, planned an industrial mobilization of these products abroad, that is to say, by the organization of an autonomous oil tank fleet, the improvement of ports, the installation of reservoirs suited to the needs of such a fleet and the granting of war contracts to large foreign producing companies.

A decree of July 17, 1917, created the General Petroleum Committee. This committee was charged with examining, coordinating and controlling the needs of both the State services and the public; studying the best means of satisfying these requirements, with due consideration for the national interests; assuring the rational utilization of available resources in France and in the French colonies and protectorates; determining the priority, in France and abroad, of purchases, transportation, manufacture, importations, exportations and formation of stocks, in connection with the production and

handling of gasoline, heavy oils and liquid fuels or combustibles of all kinds.

The recommendations of the General Petroleum Committee were submitted to the Minister of Commerce, who transmitted them to the Ministries concerned for approval.

The Committee was composed of:

First, a representative of the Ministry of Commerce, Industry and of the Posts and Telegraphs—Chairman;

Second, representatives from each of the Ministries concerned, of whom three from the Ministry of War (4th Section of the General Staff, "Intendance" and General Headquarters);

Third, eight representatives from the various oil and gasoline interests.

Difficulties arose when it became necessary to increase the petroleum importation program from 400,000 tons to 1,000,000 tons per year.

The refiners warned the Minister for Supplies that the oil and gasoline reserves in France were in danger of being exhausted by March 1st, 1918, unless the United States could place a large additional amount of tonnage at the disposal of France.

As a matter of fact, the monthly requirements in 1917 were 50,000 tons per month, or, 30,000 tons for the armies and 20,000 tons for the interior, while imports barely amounted to 30,000 tons.

It became of prime importance that steps be taken to remedy these conditions, that is to say, to restrict the use and stop all waste and to increase imports and production. [1]

The General Petroleum Committee, at Paris, and the French High Commissioner in Washington then intervened decisively in the matter.

On December 15, 1917, Mr. Clemenceau, at the request of Mr. Beranger, Chairman of the General Petroleum Committee, sent a cablegram to President Wilson requesting the latter to place an additional 100,000 tons at the disposal of France. President Wilson was enabled, after strenuous efforts and by emphasizing the importance of war requirements, to obtain the assignment of a dozen large tank ships from the U. S. Shipping Board and from the American Petroleum Committee, corresponding to the 100,000 tons which France needed immediately.

But the problem of obtaining gasoline for war purposes became, not only a problem of quantity, but also one of quality. The French technical aviation services asked the General Petroleum Committee to obtain, from the American refineries, a type of aviation gasoline

[1] Algeria produced 142 tons of oil in 1914; 650 in 1915; 1,186 in 1916; 1,363 in 1917.

of a different density and distillation to that used for motor transportation and which could be treated again in France.

In view of war requirements the needs of private commercial interests were curtailed; importers were combined, under the control of the Committee, into a petroleum syndicate (March 30, 1918) for the handling and distribution of gasoline supplies which had been purchased by the State. The gasoline programs were drawn up by the General Petroleum Committee, after agreement with this syndicate as to the quantities and quality of supplies to be imported.

The American petroleum trusts were compelled to divert a large portion of their oil fleet to France. Until then, these ships had been withheld by the American oil interests and used in the Pacific.

Finally, an agreement was concluded between the Allies for the use in common of available bottoms and reservoirs.

From its creation, the General Petroleum Committee unceasingly advocated a closer and more coordinated organization. The centralization of all the services became necessary and this was accomplished through the appointment of a "General Commissioner," Mr. Henri Beranger, who, in this capacity, was delegated to act as the permanent representative of the Ministers concerned.

A decree of August 21st, 1918, provided a "General Commissariat for gasoline and fuel," at the Ministry of Agriculture and Supplies, for the purpose of assuring the supply of gasoline, petrol, heavy oils, lubricating oils, petroleum products and liquid fuels of all kinds, as well as of mineral fuels and lubricants, for France and for the French colonies and protectorates.

It was charged not only with maintaining interallied and international relations, but also with the execution of all programs, purchases, imports, new works, alterations, manufactures, constructions, etc., and with the supply of the armies and the civil population.

At the date of the Armistice, the gasoline and petroleum stocks in France amounted to 205,000 tons, which was equal to from 2 to 3 months' consumption, while in 1917, when the United States entered into the war, these stocks did not exceed 22,000 tons.

E. *Supply devolving upon the Intendance Service.*

The "Intendance" service was responsible for the supply of subsistence (food, forage, heating and lighting fuels, gasoline and automobile ingredients,[2] straw for bedding) and clothing.

[2] July 10, 1917, the Commander in Chief directed the Motor Transport Service to supply all gasoline and all ingredients for use in motor vehicles (excepting those for the Aviation) to all units.

At the beginning of hostilities, it had been provided that these supplies be obtained by combining the daily shipments from the interior with whatever was produced through the exploitation of local resources.

But, owing to the stabilization of the front and the duration of the war, the resources of regions in which the armies were stationed soon became exhausted and, as a matter of fact, the Intendance services were obliged to supply almost all of the requirements of the troops.

To obtain the large quantities of supplies required for the needs of the armies, the services of the interior had recourse to:

First, thorough exploitation of national resources;

Second, importations from abroad (allied and neutral countries).

The thorough exploitation of national resources was accomplished by means of a "national supply system," which can be summarized as follows:

Thanks to statistics prepared for each Department of France, it was possible to determine yearly what quota could be obtained from the entire country. This quota was approportioned by Departments, then by territorial subdivisions called "circonscriptions" (known as "circonscriptions de groupement"), and finally by "communes" (townships). The assembling of these supplies was entrusted to special commissions, composed entirely of civilians, which operated in each "groupement." Supplies were obtained through cash purchases at predetermined prices or, if necessary, by requisition.

At various periods of the war, imports from abroad were obtained through the following methods: contracts by French agencies; purchases by French official missions operating in the producing countries and purchases made by important interallied councils, etc.

These were the means taken to assemble the necessary resources to satisfy the requirements of the armies.

What organization was necessary to obtain complete control over these operations?

Three periods must be distinguished:—At the beginning of the war this control was in the hands of the "Direction of the Intendance," at the Ministry of War. It should be noted that the activities of the "national supply system" were directed by the General Inspection for supplies, an organization which existed in peace time. During the second period, a "General Inspection for clothing" was created which, like the General Inspection for supplies, was placed under the direct orders of the Minister of War and assisted by an Under Secretary of State for the Intendance and for Supply. These two large inspections directed the services in the army corps

districts, and, in addition to the existing peace time agencies (Intendance directions, Intendance sub-directions, administrations) these districts were also provided with new organizations, such as economic sections, administrative sections, wine supply services, centers for ordinary commodities, gasoline centers, cloth manufacturing centers, tanning centers, etc. During the third period, which dates from beginning of 1917, there was a growing tendency to entrust the task of assembling necessary resources, either for military or for civil supply, to a single civilian agency and the Army simply became a receiver.

At this time, the Service of the Intendance, which had operated until then under the sole authority of the Ministry of War, was subdivided as follows:

1st. The General Inspection for supplies was attached to the "Ministry for General Supplies and Transportation" in January 1917. This inspection was abolished in November, 1917, when the "Ministry of Agriculture and Supply" was created, as well as an Under Secretaryship for Supply.

2nd. The "Maritime Transit" service and, later, the "Gasoline and Fuel" service also became autonomous under the form of "General Commissariats," which were in effect small ministries.

The General Inspection for clothing alone remained under the direct authority of the Ministry of War.

F. *Medical Service.* (Service de Santé)

At the beginning of the war, the Medical Service was under the "Direction of the Medical Service," at the Ministry of War. But, in July 1915, this Direction was replaced by an Under Secretaryship for the Medical Service, which functioned up to and after the Armistice.

In October 1914, a General Direction of the Medical Service was attached to the "Direction of the Rear" (Direction de l'Arrière—D. A.), at General Headquarters, to coordinate and supervise the technical operation of the Army medical services in the advance zone, as well as in the zone of the rear.

Under the terms of the ministerial decree which provided his appointment (Bordeaux, October 9, 1914) the Director General of the Medical Service was charged with making all recommendations pertaining to:

1st. Hygiene and prophylaxis.

2nd. Training of medical units so as to enable them to take part in operations ordered or planned.

3rd. The organization and general operation of the evacuation services and the distribution among the armies of evacuation units at the disposal of the Direction of the Rear.

4th. Supply of medical matériel to the armies and the employment of the reserve military medical personnel.

Instruction No. 2533, dated February 12, 1917, drawn up after agreement between the Commander in Chief and the Under Secretary of State of the Medical Service, abolished the General Direction of the Medical Service and provided that matters relating to this service would be handled by the staff at General Headquarters, while most questions, particularly the more important ones, would be dealt with by the "Direction of the Rear" (D. A.). A section of the Direction of the Rear was assigned this duty, under the orders of the Assistant Chief of Staff commanding the Direction of the Rear. It was composed of three staff officers, assisted by two surgeons and an administrative officer of the Medical Service, and it was to study technical questions. Every week, one of these surgeons was detailed to act as liaison officer to the Under Secretary of State of the Medical Service.

The decree of May 11, 1917, modified this organization by placing the personnel of the Medical Service on the same footing as that of the other arms and services. This enabled the medical personnel to assume complete responsibility for the direction and execution of its functions.

The Medical Section of the Direction of the Rear was changed at this time. It was thereafter composed exclusively of medical personnel and included four surgeons, one of whom was Section Chief, while two were administrative officers.

This personnel was charged with the centralization of all matters affecting the Medical Service and with furnishing directly to the Assistant Chief of Staff (Aide-Major Général) in charge of the Direction of the Rear, all necessary information concerning existing stocks of medical supplies and estimates as to future requirements.

Furthermore, a surgeon was assigned to the Personnel Section at General Headquarters, under the orders of the chief of the Personnel Section, for the purpose of handling all matters relating to the officer personnel of the Medical Service.

A ministerial instruction dated May 24th, 1917, carrying into effect the decree of May 11th, extended the functions of the superior chiefs of army medical services, army corps medical directors and divisional surgeons, as well as those of surgeons attached to the 4th Sections of staffs and of medical regulating officers.

Two new positions were created, in conformity with the request of the Under Secretary of State of the Medical Service, to complete the general organization of this service in the armies:

1st. Order No. 89 of June 10th, 1917, provided for a Surgeon-Inspector General of the Medical Service, under the direct orders of the Commander in Chief, charged with making inspections (Missons d' Inspection) within the armies and in the areas attached to the Zone of the Armies. Reports as to the results of these inspections were forwarded to the Under Secretary of State of the Medical Service and to the Commander in Chief.

However, the prerogatives granted the Surgeon-Inspector General did not authorize him to exert direct action upon the Medical Section (D. A.), the latter remaining under the orders of the Assistant Chief of Staff commanding the Direction of the Rear.

2nd. A note (800/DA) dated September 20th, 1917, created a "Surgeon-Inspector of the Groups of Armies," who was charged: First, with coordinating the action of detachments of the Medical Service, located between the armies and the Direction of the Lines of Communication (Etapes), operating under the group of armies; second, coordinating the supply of these units and with the assignment and distribution of their personnel; third, supervising the proper operation of the regulating stations and supply establishments (stations-magasins) in matters concerning the Medical Service.

In agreement with the Under Secretary of State of the Medical Service, as confirmed by his letter of February 13, 1918, the Commander in Chief provided for an Assistant Chief of Staff (Aide-Major Général) in charge of the Medical Service, who was designated as such and whose functions were defined in the Note 59 M. G. of March 8th, 1918.

Under the terms of this note, the Surgeon-Inspector designated for these duties was charged with the centralization at General Headquarters of all matters concerning the organization and execution of the Medical Service in the armies. The Section of the Medical Service, which formerly belonged to the Direction of the Rear, was placed under him. He was charged with maintaining weekly liaison with the Under Secretary of State of the Medical Service, either in person or through the surgeons who were under his orders.

The inspection reports of the Surgeon-Inspector General of the Medical Service, who had been appointed in conformity with Order 89 of June 10th, 1917, were submitted to the Assistant Chief of Staff in charge of the Medical Service. This Surgeon-Inspector General, although retaining the prerogatives vested in him by Order

89 was, on March 26th, 1918, owing to necessities of the military situation (German advance on Montdidier), assigned the duties of Surgeon-Inspector General of a group of armies (G. A. R.).

G. *Aviation.*

In 1914 the Aviation Service was under the Direction of Engineers at the Ministry of War (Aviation Section). When war was declared an Aviation Direction had just been created but, on account of the increasing importance of this branch of the Service, it became necessary to create an Under Secretaryship of State for Aviation in 1915.

In 1914, there were three aviation groups in France, each group forming a regiment, and these were located at Reims, Dijon and Lyon. There were also technical aviation establishments and schools. The groups maintained detached squadrons at aviation centers located at Belfort, Epinal, Nancy, Toul, Verdun and Maubeuge.

There were from 20 to 25 squadrons, homogeneous in planes and rolling material, and well organized for operations.

During the war, the three aviation groups of the interior remained and functioned as depots. Schools for aviation pilots were organized throughout the territory: Avord, Pau, Chartres, Le Crotoy, etc.

In addition there were created, under the orders of the Under Secretary of State for Aviation:

A. An industrial service charged with: First, the assignment of necessary labor for the requirements of the aeronautical industries; second, the estimation of necessary raw materials required by the aviation industries and the inspection and receipt of these materials.

B. A "General Inspection" for aviation matériel.

C. A Service for aviation production: Orders, inspection of matériel at the factories and storage of same.

D. An aeronautical technical section: Studies concerning aviation, tests, research.

E. An aviation repair shop (St. Cyr) charged with repairing, or with causing the repair of, aviation matériel evacuated from the Zone of the Armies.

F. A "General Inspection" for training schools and depots.

There should also be added the Central Depot for military balloon matériel at Chalais-Meudon, which had been created long before the war, and which was in charge of orders, factory inspection, receipt and storage of balloon matériel.

H. *Transportation.*

In conformity with the law of December 28th, 1888, the railroads passed under military authority at the beginning of the war. The railroad service was then divided between the railway systems of

the armies and of the interior; the first under the authority of the Commander in Chief and the second under the orders of the Minister of War.

An officer of superior rank was appointed Director of the Railroads of the Armies and placed under the orders of the Director of the Rear (later, the Assistant Chief of Staff in charge of the Direction of the Rear).

This state of affairs remained unchanged until December, 1916.

A decree of December 27th created an Under Secretaryship of State for Transportation at the Ministry of Public Works. The decree of December 31st, completed the decree of December 27th, by specifying that the Under Secretary of State for Transportation, while exercising military authority over the railroad service, should carry out military transportation (troops, materials and evacuation of wounded) through priority orders and within time limits requested.

In the armies, the Director of the Rear was permanently delegated the duty of executing military transportation.

The decree of December 31st, 1916, was amended, however, by a decree of May 9th, 1917, under the terms of which there were created, under the direct authority of the Under Secretary of State for Transportation:

In the Zone of the Armies: a "Direction of Military Transportation of the Armies" (Direction des Transports militaires aux Armées—D. T. M. A.) with a general or superior officer at its head who was permanent representative of the Under Secretary for Transportation and responsible for the execution of troop movements and the transportation of materials, in accordance with the orders of the Commander in Chief.

In the Zone of the Interior: a "Direction of Military Transportation of the Interior" (Direction des Transports militaires à l'intérieur—D. T. M. I.) with a general or superior officer at its head who was permanent representative of the Under Secretary of State, responsible for the transportation of troops and materials, in accordance with the orders of the Chief of the General Staff of the Army.

The Commander in Chief drew the attention of the Minister of War to the disadvantages which would result from a strict application of this decree, which would have taken from the Commander in Chief the authority over railroads vested in him under the law of 1888. To give satisfaction to the Commander in Chief, the Director of the Rear was designated as Director of Military Transportation of the Armies. This measure made it possible to obtain

secrecy concerning military operations and to maintain the transportation and supply services in the armies under a single authority.

A decree of December 8th, 1917, made these instructions part of Army Regulations.

When, by a decree dated September 18th, 1918, the General Direction of Communications and Supplies (Direction générale des communications et des ravitaillements—D. G. C. R. A.) was created at the headquarters of the Commander in Chief of the Allied Armies, the Director of Military Transportation of the Armies passed under the orders of the Director General of Communications and Supplies of the Armies.

CHAPTER III.

SECTION III.

RELATIONS BETWEEN THE MINISTRY OF WAR AND THE OTHER MINISTRIES (BELGIAN).[1]

(Chart 2, Chapter III, Vol. I.)

During the war Belgium found itself in a situation much different from that of the other nations. Her territory was almost entirely in the hands of the enemy, so that the non-invaded part of the country contained but a small civilian population.

With the exception of the "Ministry of Civil and Military Intendance" (Ministère de l'Intendance Civile et Militaire), which was charged with the supply of food and clothing for the civilian population and for the Army, it was deemed unnecessary to create other special ministries during the war, (such as a Ministry of Aviation, of Armament and Munitions, etc.).

The relatively reduced strength of the Belgian Army and consequently the relative ease with which its requirements could be met, enabled the Ministry of War to undertake the direct supplying of the Army's needs, with the exception of those supplies which were furnished by the Ministry of the Civil and Military Intendance.

The only new liaison which had to be established was that between the Ministry of War and the Ministry of Civil and Military Intendance and this liaison was obtained, logically, through the Inspector-General of the Intendence services. The latter was a high military authority who was responsible for the food and clothing supply of the Army. (See Chaper II—Section III.)

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[1] Prepared for the Military Board of Allied Supply by the Direction of Transportation of the Belgian Ministry of War (Direction des Transports, Ministère de la Défense Nationale).

CHAPTER III.

SECTION IV.

RELATIONS BETWEEN THE MINISTRY OF WAR AND THE OTHER MINISTRIES (ITALIAN).

(Chart 6, Chapter III, Vol. I.)

The Ministry of War exercised supreme authority in the interior of the country. It was responsible for the administrative and technical control of the troops and services in that zone and was also responsible for the supply of men and materials for the army in the field.

The tremendous size of the Army and the consequent increase in the consumption of materials and foodstuffs, made it necessary to coordinate the supply of the Army and civilian population. It soon became evident, however, that it would be impossible to centralize these functions under a single ministry and new organizations were therefore created to take over some of the pre-war functions of the Ministry of War. These new administrative bodies were created from time to time, as necessity arose, and placed under the authority of the Ministry of War. They were:

The Ministry of Arms and Munitions.

The Air Service Commissariat.

The Ministry of Agriculture (formed by reorganizing the pre-existing Ministry of Agriculture, Industry and Commerce).

The Food Control Ministry.

The Ministry of Transportation (by land and sea).

The Ministry for War Pensions and Compensation.

The General Commissariat for National Fuel.

Under this reorganization, the only functions carried on directly by the Ministry of War were those concerning the supply of men and animals, while it only concerned itself partially in matters pertaining to the procurement of materials and foodstuffs.

The more important among the new organizations were:

The Ministry of Arms and Munitions: Procurement, administration and control of personnel and matériel; custody of magazines and depots, and charge of all matters concerning the armament and equipment of troops in the interior of the country.

The Air Service Commissariat: Had the same functions as the above mentioned ministry in all matters pertaining to the Air Service.

The Ministry of Agriculture: Supplied certain foodstuffs; obtained the services of soldiers and prisoners of war for agricultural purposes; use of military transportation for the collection of requisitioned supplies.

The Food Control Ministry: The food supply services were centralized in this ministry.

The Ministry for War Pensions and Compensation: Handled all matters pertaining to war pensions and allowances, etc., to the families of deceased or disabled soldiers.

The General Commissariat for National Fuel: Mobilization of soldiers required for the operation of coal mines; forestry operations; transportation of fuels.

The Ministry of Transportation: All matters pertaining to rail and water transport in connection with the transportation requirements of the Army.

In addition to the foregoing, the Minister of War was also in close relations with the following pre-war ministries:

The Ministry of Foreign Affairs: Mobilization of Italian subjects in foreign countries; military missions and military attachés abroad; matters pertaining to the political, economic and industrial situation abroad.

The Ministry of Justice: All matters pertaining to military judicial affairs.

The Ministry of the Treasury: War expenditures and administration of the financial affairs of the State.

The Ministry of the Navy: Questions concerning coast defenses, as well as all questions pertaining to sea transportation for military purposes.

The Ministry of Posts and Telegraphs: Control and administration of the postal and telegraph services between the Army and the interior; supply of postal materials.

The Ministry of Public Works: Assignment of necessary personnel for the operation of the Civil Engineer services.

The Ministry of War was subdivided into General Directions, Autonomous Divisions, and Offices and Inspectorates. The activities of these various sections was coordinated by the General Staff Division.

CHAPTER III.

SECTION V.

RELATIONS EXISTING BETWEEN WAR DEPARTMENT AND CIVILIAN AGENCIES (AMERICAN).[1]

(Chart 4, Chapter III, Vol. I.)

Although no ministries exist in the United States their places are taken in large part by the President's Cabinet under whose direction are the various "Departments" of the Government.

Council of National Defense: (Chart 5, Chapter III, Vol. I.) The War Department was the one charged by the President with the duty of carrying on the war in so far as the Army was concerned, but its Secretary was directly assisted by the Council of National Defense. The Council of National Defense was created by Act of Congress, approved August 29, 1916, but was not fully organized until March 3, 1917. Under the terms of the act, the council was among other things charged with the "coordination of industries and resources for the national security and welfare" and with the "creation of relations which render possible in time of need the immediate concentration and utilization of the resources of the Nation". The council under the act was composed of the Secretaries of War, Navy, Interior, Agriculture, Commerce, and Labor, and functioned under the advice and counsel of its Advisory Commission, composed of "not more than seven persons, each of whom shall have special knowledge of some industry, public utilities, or the development of some natural resource, or be otherwise specially qualified", and functioned through a director who had authority to employ such expert and other help as might be required. In a broad sense it was the council's duty to make available to the United States the best thought and effort of American industrial and professional life for the successful prosecution of the war. It was also its duty to put behind the war machine the coordinated individual effort of the Nation's industrial system, its transportation, communication, and production facilities, and to transmit from Washington to the Nation the information so that the individual industries could carry on that work successfully. The council was an administrative laboratory where needs were studied and the necessary machinery set up to supply those needs. It was through such study that the

[1] Compiled for the M. B. A. S. by Col. Harry L. Hodges, General Staff, U. S. Army from Economic Agencies, Monograph 8, Historical Branch, War Plans Div., War Dept.

General Munitions Board was created and the War Industries Board built. These boards and other similar organizations were created around the nuclei of the committee of the council. As new organizations were set up, the subcommittees of the council were dissolved by council action and were immediately reappointed under the new agency or were made cooperative war service committees for the various industries themselves. For this reason a great number of committees under the council seem to have had but short life, but in reality they were governmental creations in process of integration.

War Industries Board: As a result of study by this council, the General Munitions Board and then the War Industries Board were established. The War Industries Board was created July 28, 1917, by the Council of National Defense to act as a clearing house for Government war industry needs. The Board combined the functions of the General Munitions Board and of the Advisory Commission of the Council of National Defense. It was made a separate executive agency by the President on May 28, 1918. "The War Industries Board, broadly speaking, was to be the general eye of all supply departments in the field of industry." Its function was to obtain materials for military purposes with the minimum dislocation of industry; to restrict non-war production, and to fix minimum prices; and more explicitly, according to the President's letter, the functions of the board were to be: (1) Creation of facilities and opening of sources of supply: (2) conversion of existing facilities, where necessary, to new uses: (3) conservation of resources and facilities: (4) advice to Government purchasing agencies as to prices: (5) determination of priorities of production and delivery, and of proportions when supplies were insufficient; (6) purchases for allies. Most important was the stipulation that "the ultimate decision of all questions, except the determination of prices, should rest always with the chairman." The board threw itself upon the country as a "public agency, which wished public confidence and cooperation," and its great service was shown positively by results and by general commendation, and negatively by an almost entire absence of public criticism. The board performed its joint function on prices through the affiliated Price Fixing Committee, centralized its activities by weekly meetings of commodity chiefs, and decentralized its work through subordinate agencies, termed divisions and sections, and the Purchasing Commission for the allies. The names of the divisions changed from time to time, but on September 1, 1918, were: Labor, Requirements, Finished Products, Priorities, Conservation, Planning and Statistics, Chemical, Explosives, Steel, Textile, and Facilities. The President, in a letter of November 30, 1918, accepted the resigna-

tion of Chairman Baruch, and the War Industries Board ceased to exist January 1, 1919. Many divisions and sections had completed their work and were disbanded by that date, but the permanent activities were turned over to other Government departments, in the main to the War Trade Board."

While the War Industries Board was the civilian agency upon which the War Department depended for the production of supplies, it depended upon other agencies to secure tonnage for the hauling of these supplies to the seaboard and overseas. The United States Railroad Administration secured the former, while the Shipping Board, the Shipping Control Committee and the Shipping Board Emergency Fleet Corporation secured the latter. Their respective functions follow:

UNITED STATES RAILROAD ADMINISTRATION

"In order to carry out the provisions contained in the President's proclamation, Congress passed the Federal Control Act, which was approved March 21, 1918. By way of compensation the act provided that each road under Federal control should receive an annual sum equivalent to its average annual railway operating income for the three years ended June 30, 1917; and it was also provided that the properties taken over were to be maintained in as good repair and with as complete equipment as when placed under Federal control. In order to carry out these provisions the President was authorized to enter into contract with carriers. The act expressly stated that it was a piece of emergency legislation, and provided the period of control should not continue longer than one year and 9 months after the conclusion of peace. By proclamation of April 11, 1918, certain coastwise steamship lines were taken over and placed under the Director General of Railroads, and, in like manner on November 16, 1918, the President took possession of the American Railway Express Company. In order to exercise effective control over the operation of the railroads under Federal control, the country was on January 18, 1918, divided into three regions for administration purposes, as Eastern, Western, and Southern regions, each in charge of a regional director responsible to the Director General. Further subdivision becoming necessary, the Allegheny and Pocahontas regions were created on June 1, 1918, while on June 11, 1918, the Western region was divided into the Northwestern, Central Western and Southwestern regions. Owing to the elimination of competition and the introduction of more efficient operating methods, the congestion which prevailed when the roads were taken over was cleared up and by May 1, 1918, the railroads were functioning normally again. In handling the enormous traffic involved in the movement of troops

and supplies, the Railroad Administration accomplished results which would have been impossible under private control. The closest liaison existed between the Department Inland Transportation of the Division of Purchase, Storage and Traffic, General Staff and the U. S. Railroad Administration."

SHIPPING BOARD

"To acquire vessels already constructed, and to operate, manage, and dispose of all vessels theretofore and thereafter acquired by the United States, there was granted to the United States Shipping Board Emergency Fleet Corporation all power and authority vested in the President relating to the construction of vessels. The United States Shipping Board Emergency Fleet Corporation, whose trustees included all the members of the Shipping Board, was formed by the board under the authority of the Shipping Act and incorporated under the laws of the District of Columbia, April 16, 1917. It was the most important of the agencies through which the Shipping Board performed its war activities, and was charged with the purchase, construction, equipment, lease, charter, maintenance, and operation of ships for the United States during the war. It acted in some respects as a corporation, but at the same time benefited from its character as a Government agency. Besides the operation and construction of ships the Shipping Board was concerned with every other phase of the shipping problem which confronted the United States during the war, e. g., the allocation of ships to cargoes and trade routes, recruiting and training men for the merchant marine, questions of just compensation, insurance claims, regulation of rates, port and harbor development and utilization, etc."

SHIPPING CONTROL COMMITTEE

"For the United States Shipping Board it allocated vessels under the control of the board to cargoes and routes, and for the War Department it controlled the operation of the fleet of cargo carriers transporting material to the American Army abroad. The necessity for the creation of this committee arose from a serious shortage of tonnage for war purposes and the lack of scientific direction and control of existing tonnage. Its main purposes were to centralize control of shipping, to unify the shipping resources of the allied nations and the United States, and to make existing shipping as liquid as possible. Through the centralized control of shipping, the employment of the "marine skip-stop system", (which involved di-

rect routing, unification of cargoes, full loading, reduction of time in port, and the use of progress charts and tabulations of vessel movements,) the committee was enabled to double the efficiency of the available shipping."

There were other civilian agencies which functioned from time to time with the War Department but which were not so closely allied as those heretofore mentioned.

In this latter class are the United States Food Administration, the United States Fuel Administration and the National War Labor Board whose activities touched the nation as a whole.

GEN. A. A. McHARDY

British Section Military Board of Allied Supply; British Member of the Editing Committee

CHAPTER IV.

SECTION I.

WAR OFFICE (RELATIONS WITH FORCES IN THE FIELD) (BRITISH).

(Chart 1, Chapter IV, Vol. I.)

Generally speaking, as regards stores, a program was drawn up and approved by the Quartermaster General of each expeditionary force showing the allotment of dock tonnage required for the ensuing month. This program showed under categories of stores, not only the tonnage, but also the ports at which it was required, and shipments were made accordingly within the tonnage allotment.

All questions of policy were taken up through the General Officers Commanding in Chief and the Army Council, but it will be realized that in addition a close liaison was maintained between Directors of Departments concerned at the War Office in London and the corresponding Directors in overseas theatres of war, and by this means a great mass of detail was arranged expeditiously.

In addition to the methods followed in the case of movements, food supplies, ordnance stores and remounts, the procedure regarding personnel, and the evacuation of sick and wounded, will now be described.

Movements.—The direct influence of the War Department on movement extended over the whole of the movement in the United Kingdom and on the sea. In theatres of war, and in all overseas countries where a local military administration was in existence, internal movement was regulated by the military headquarters subject only to the general control of the War Department.

The basis of the whole of the store movement controlled by the War Department was the Docks Tonnage Program. This was a monthly statement prepared by General Headquarters of the forces in the field in each theatre of war, and forwarded for agreement to the War Department. The program showed in detail the requirements for the armies in each theatre by categories of stores at each port of entry to the theatre for the ensuing month, and varied month by month in accordance with the varying requirements of operations or administration, and the varying capacities of the rail-

ways, canals, etc., to effect clearance of the different ports before congestion could arise.

The program, prepared by the Director of Docks in each theatre and approved by the Quartermaster General, was submitted after receipt by the War Department to detailed examination in order that the heads of provision departments might take steps to meet the demands in the different categories of material, and then forwarded to the Ministry of Shipping as the authentic War Department demands for tonnage over the period covered by the program.

Upon this demand the Ministry of Shipping allocated available tonnage in accordance with the distribution to overseas ports recommended in the program. If available tonnage did not meet the requirements of the full program the Ministry of Shipping made the best allocation possible under the circumstances and amended the program accordingly. The program so amended was then returned to the War Office where any modifications were noted and their effect examined. If the modifications were not satisfactory for military reasons, the matter was adjusted on a basis of compromise by discussion with the Ministry of Shipping, and the program as finally agreed sent to the various theatres of war to form the basis of the administration of internal movement.

The movement of personnel was more simple in character and little difficulty was experienced in its execution. Certain ports, or portion of ports, both in the United Kingdom and in overseas theatres were set aside for the movement of personnel and these were kept entirely distinct from ports or port areas used for the movement of material.

Personnel were despatched either as units, or as drafts, except in the case of leave when personnel were dealt with as individuals. Drafts prepared in the training depots in the United Kingdom were formed and despatched on the demand of the Adjutant General in the field formulated by the Deputy Adjutant General's Office at the base overseas. Demands for units were formulated by the General Staff, or in the case of administrative units by the Adjutant-General's or Quartermaster General's Staff at General Headquarters and transmitted direct to the War Department whence orders for movement emanated.

The movement was controlled by the War Department acting through the Railway Transport staffs and Embarkation staffs both in the United Kingdom and overseas. In the war the great bulk of such movement was that of British personnel to France and Belgium, and in this case the flow was regulated by the War Office by telegraphic orders to the various commands at home. A

certain number of cross-channel steamers were kept in reserve ready to be sent to meet abnormal demands for movement. The leave service was also managed in the same way, the flow being regulated by the allocation to General Headquarters in France of a certain number of vacancies per diem, the number being kept within the limits of accommodation of the steamers available at the time for the leave service.

In the case of theatres of war other than France and Belgium, a long sea passage was involved. The methods of dealing with this traffic was similar to that described above for the movement of material, except that the basis was a Drafting and Leave Program prepared by the Adjutant General's Branch at the War Office on the basis of the co-ordinated demands for personnel received from overseas theatres of war.

Close relationship involving almost personal touch between the officials at the War Office and the Ministry of Shipping, and officers charged with the control of movement overseas, was essential to secure the smooth operation of continuous movement on so large a scale. In this respect the necessary relationship was secured by two means:

(*a*) All questions involving policy or matters of general principle having large application were dealt with by means of letters or telegrams passed between the Secretary, War Office, on the one hand, and the Commander in Chief or his principal staff officers in the overseas theatre on the other hand. Such matters were dealt with by the Army Council in the normal manner, being submitted to the Council by the Director General of Movements and Railways who was the executive head of the Movements Branch at the War Office.

(*b*) All questions involving the adjustment of details necessary to the execution of an accepted policy were dealt with by letter, telegram, or even by telephone between the staff of the Director General of Movements and Railways at the War Office, and the staff of the Quartermaster General in the field. Minor questions involving everyday details affecting the working of the system were dealt with directly between the executive staffs, such as embarkation staffs, or officers of the Directorate of Docks, and the staffs of similar duties overseas.

One of the clearest deductions which can be drawn from experience gained during the war is that whenever a continuous operation is in progress part of which is controlled by a different headquarters to that which is controlling the whole, it is essential that the closest possible touch should be maintained behind the two controlling authorities. This is especially true of movements, and it was thoroughly understood and put into practice as an accepted principle that free communication on matters of detail between sub-

ordinate controlling authorities under the one headquarters, and their opposite numbers under the other headquarters, was desirable and to be encouraged.

Supplies.—So far as supplies were concerned the procedure was as follows:

In accordance with arrangements for mobilization steps had been taken to meet first of all requirements of the Expeditionary Force and to establish certain reserves to maintain these requirements, and in addition to feed the troops remaining in the United Kingdom.

When war broke out these arrangements were put into force. supply depots were established at various places in the United Kingdom, selected with a view to shipment for the forces abroad, for supplying troops quartered at home and for supplying troops engaged in active operations. Supplies to fill these depots were obtained through the Director of Contracts at the War Office, so that there should be no question of competition between the Commands. A fixed reserve was decided upon for each depot and these reserves were completed within about one month of the outbreak of war.

The supply organization was devised so as to be sufficiently elastic to meet altered circumstances and to admit of immediate expansion should such be necessary.

A test of efficiency of this system was provided almost at once, in that as soon as the depots in Northern France were evacuated it was possible by drawing upon certain home depots to establish reserve depots elsewhere in France without any delay whatever.

Again at later periods as expeditions in other theatres of war were undertaken, there was never the slightest check in allotting one or other of our home ports to maintain supply. The number of days' reserve of supplies to be maintained in each theatre of war was fixed according to distance from home and local resources available, by the Commander in Chief of the various Expeditionary Forces in consultation with the War Office.

When this reserve had been fixed it became the duty of the Deputy Quartermaster General of each Expeditionary Force to demand by cable through the agency of his Director of Supplies, on the Quartermaster General at the War Office for his requirements item by item in specific quantities. The time in advance of making these demands varied with the distance from home of the various Expeditionary Forces, other allowances being made for the transportation by sea of the supplies required.

In practice it was found that, for the Forces in Gallipoli, Salonika and Egypt, a month's notice was sufficient, and demands were made for one month's supplies at a time.

Further, from the very beginning, it became the practice for each Director of Supplies overseas to correspond daily in the case of France and weekly in every other case, directly with the Director of Supplies at the War Office. This procedure was found to be of inestimable value and was continued throughout the war.

Later, as the armies grew in numbers, it was found expedient to make direct shipments of supplies from their various sources to the Expeditionary Forces; the principle, however, always remained the same, that is to say, the demand for supplies was made by each Expeditionary Force direct on the War Office and the War Office arranged the provision of the supplies.

Ammunition and Stores.—For some years before the Great War, the Army Council maintained a reserve of all natures of stores and clothing for the initial requirements of our army in the field. These reserves were maintained for all articles forming the equipment of the Army and were in addition to the war equipment of units. When war was declared these reserves of ammunition, guns, carriages, stores of all kinds and clothing were sent to the ordnance base depots and were utilized to meet replacements during the first few weeks.

In the meantime, the Army Council (The Master General of the Ordnance for guns and ammunition, and the Quartermaster General for other stores and clothing) placed orders for future requirements on the Government factories, and on the trade. These orders were at first based on reasonable anticipation of requirements, but as the situation overseas was consolidated, the demands from the theatres of war were taken as the basis for provision.

These " demands " on home were prepared, in the first instance, by " Officers in charge Provision " at the base depots and were generally framed to allow of from three to six months stock being available on the lines of communication. After preparation at the bases the demands were sent to the Director of Ordnance Services at General Headquarters, who criticized and amended them according to the situation and sent them by messenger or cablegram to the Director of Equipment and Ordnance Stores at the War Office, London. The Director of Ordnance Services in the field was in close touch with the Quartermaster General and received his orders in connection with all the requirements of the Army in ammunition and stores. The Director of Ordnance Services in France was also connected by telephone with the Director of Equipment and Ordnance Stores at the War Office.

In cases of special urgency the Assistant Director of Ordnance Services (Provision) at the base was empowered to communicate direct with the Director of Equipment and Ordnance Stores, War Office, by cablegram, letter, or if possible, by telephone.

The demands received by the Director of Equipment and Ordnance Stores at the War Office were sorted and distributed to the several branches at the War Office responsible for ordering the stores. Thus demands for guns, ammunition vehicles and ammunition were passed to the Director of Artillery, and demands for certain Engineer stores to the Director of Fortifications and Works, both Directors being under the orders of the Master General of the Ordnance.

Demands for general stores and clothing were dealt with by the Director of Equipment and Ordnance Stores under the Quartermaster General at the War Office.

While the Master General of the Ordnance remained responsible for providing or ordering guns, ammunition and other technical stores, once the stores had been obtained from the Government factories or the trade they came into the care of the Royal Army Ordnance Corps under the Quartermaster General. The Director of Artillery and the Director of Fortifications and Works placed their orders for their stores with the Ministry of Munitions. The Ministry of Munitions actually obtained and inspected the finished articles and these were either handed over when ready to the Royal Army Ordnance Corps in England or were sent direct to the Chief Ordnance Office (R. A. O. C.) at the overseas base from the contractors' premises.

The Deputy Director of Ordnance Stores at Woolwich Arsenal received instructions direct from the Director of Artillery and Director of Fortifications and Works in regard to issues on those overseas demands for which these Directors were responsible.

The despatch of stores from ordnance depots at home and from contractors' premises to overseas bases was arranged between the Deputy Director of Ordnance Services, Royal Arsenal, and the Director of Equipment and Ordnance Stores. The former officer reported the tonnage for rail or shipment and the Director of Equipment and Ordnance Stores formulated transport requirements to the Director General of Transportation at the War Office. The Director General of Transportation being in touch with the Ministry of Shipping.

The Director of Equipment and Ordnance Stores placed his orders for general stores and clothing through the Surveyor General of Supply at the War Office, and, as in the case of ammunition and technical stores, these were sent when ready to ordnance depots in England or direct from contractors' premises to the Chief Ordnance Officer of the overseas base. The Director of Equipment and Ordnance Stores had his own inspectors of general stores and clothing and these officers carried out inspection at the home ordnance depots

or at contractors' premises according to circumstances. The Director of Equipment and Ordnance Stores sent the overseas demands for *stores* to the Deputy Director Ordnance Services, Royal Arsenal, and for clothing to the Chief Ordnance Officer of the Royal Army Clothing Depot, Pimlico. These officers were responsible for reporting tonnage to the Director of Equipment and Ordnance Stores and for meeting the demands.

Orders for stores and clothing were prepared by the Deputy Director Ordnance Services, Royal Arsenal, and the Chief Ordnance Officer, Royal Army Clothing Depot, respectively, on forms termed "contract demands", under instructions from the responsible Directors at the War Office, and these contract demands, after approval of the several Directors, were passed to the Ministry of Munitions and the Surveyor General of Supply respectively as explained above.

The system naturally improved as the campaign proceeded, but it was founded on a sound basis and the further development was smooth and businesslike and enabled the Army to be kept well supplied with all natures of ammunition and stores.

Remounts.—The arrangements for the provision of all animals necessary on mobilization were completed in peace time, and on the outbreak of war the following additional measures were necessary.

To form an embarkation remount squadron at the port of embarkation to insure that any casualties occuring during the mobilization period were replaced.

To send remount units (a base depot and two advanced depots) to France. The base remount depot holding a general reserve of animals and in addition the regimental reserve of cavalry units, which were taken to France by the units themselves.

To obtain animals for reserve units established at home. These units trained animals in readiness for despatch overseas.

To make arrangements for the provision of animals to replace the normal and battle casualties.

The Remount formations in the theatre of war were organized on similar lines to those of other administrative services. A Director of Remounts was appointed who at first had his headquarters with the Inspector General of Communications. He was responsible for the supply in the theatre of operations and for keeping in closest touch with the War Office.

The Director of Remounts in France periodically estimated the requirements for coming months and made demands on the War Office accordingly. The demand was based on the wastage likely to occur during, say, the ensuing five months.

The War Office made its arrangements for the provision of animals in accordance with this demand and in conjunction with the

branches concerned drew up a regular shipping program for the transport of these animals overseas.

Although it became necessary at times to ship as many as 7,000 animals a week the demands of Commanders in Chief in the various theatres were generally met in full.

Personnel—Co-ordination of drafting.—As regards personnel a co-ordinating centre for drafts was established in the Adjutant General's Department of the War Office. Its functions mainly were:

(*a*) To determine whether drafts forecasted for each theatre were in accordance with policy and establishments.

(*b*) To consolidate forecasts of drafts proceeding; of drafts placed under orders; in order that those concerned with shipping might arrange vessels; and to notify alterations in drafts found necessary before sailing.

(*c*) To record drafts despatched so that strength of each arm in each theatre might be determined at any time.

Re-inforcements.—Stock was taken monthly of assets in man power, and formulae evolved by which numbers of men of each arm for each theatre could be ascertained. This not only systematized drafting, but also enabled training to be regulated and recruits called up or held back as necessary.

Branches at the War Office dealing with personnel were required to submit to the co-ordinating branch monthly estimates of their requirements for respective theatres overseas.

The necessary data was ascertained by maintaining statistical records both at home and in each theatre. The co-ordinating section of the Adjutant General's Department included a small statistical office, and its counterpart existed in the 3rd echelon of General Headquarters overseas.

All drafts despatched went in the first instance into the base depots overseas maintained for their respective arms, and their subsequent disposal was arranged by the Commander in Chief, within his regulated establishment. Proposals for alteration of existing establishments were submitted by Commanders in Chief to the War Office but the new establishments were not worked upon until War Office sanction was given.

Evacuation of sick and wounded.—The arrangements for the evacuation of the sick and wounded were as follows:

Prior to the war nearly all invalids arriving from overseas were conveyed by ordinary transports and disembarked at Southampton and sent to the Royal Victoria Hospital, Netley, and all necessary details were carried out by the Embarkation Medical Officer, Southampton, under the orders of the War Office. In the few instances when sick arrived at other ports in the United Kingdom the dis-

embarkation arrangements were carried out by the Deputy Director Medical Services of the command.

On the outbreak of war all arrangements in connection with the evacuation of sick and wounded from overseas and their distribution to hospitals in the United Kingdom were placed under the control of a senior medical officer holding the rank of major general who was appointed Director of Medical Services, Embarkation, with headquarters at Southampton, which port remained the chief centre of disembarkation. His headquarters were subsequently removed to London in order that he could be in closer touch with the War Office and other ports of disembarkation.

All hospital ships, with the exception of those working east of Suez and on the East African Coast, were placed under the administration of the Director Medical Services, Embarkation, who was in intimate touch with the War Office and with the medical and embarkation authorities overseas. He was also in close touch with all hospitals in the United Kingdom from which he received weekly or daily notification of available hospital accommodation.

The accommodation and movement of sick within the forces overseas was controlled by the Director of Medical Services of the force concerned.

In the case of forces operating in the Mediterranean considerable use was made of Malta as a hospital base and arrangements for transporting invalids thereto were made directly between the authorities at Malta and Egypt.

Hospital trains were provided overseas according to the requirements of each force. In England, a pre-war arrangement existed whereby various railway companies undertook to provide 12 ambulance trains within a certain period after mobilization. All hospital trains in the United Kingdom were placed under the control of the Director Medical Services, Embarkation.

The provision of hospital accommodation within the United Kingdom was controlled by the War Office. The total number of patients disembarked and distributed to hospitals between August 1914 and July 1919 was 132,431 officers and 2,508,219 other ranks.

CHAPTER IV.

SECTION II.

RELATIONS BETWEEN THE GOVERNMENT AND THE FORCES IN THE FIELD (FRENCH).

If one pictured only the relations between the Minister of War and the Commander in Chief, he would consider only a small part of the questions involved.

As a matter of fact the Commander in Chief of the French Armies was, necessarily, in constant and direct relations not only with the Minister of War (Ministre de la Guerre), but also with the Minister of Armament and War Production (Ministre de l'Armement et des Fabrications de Guerre), the Minister of Public Works and Transportation (Ministre des Travaux Publics et des Transports), the Minister of Agriculture and Supply (Ministre de l'Agriculture et du Ravitaillement), the Under Secretary of State of the Council (Sous-Secrétaire d'Etat à la Présidence du Conseil), the Under Secretary of State of the War Administration (Sous-Secrétaire d'Etat à l'Administration de la Guerre), the Under Secretary of State of the Medical Service (Sous-Secrétaire d'Etat du Service de Santé), the Under Secretary of State for Aviation (Sous-Secrétaire d'Etat de l'Aviation) and the Under Secretary of State for Claims and Military Justice (Sous-Secrétaire d'Etat du Contentieux et de la Justice Militaire), etc.

For the purpose of obtaining the necessary coordination for the proper execution of supply and transportation and, at the same time, to enable the Minister of War to keep in touch with all developments affecting the armies, an endeavor was made to reduce the number of persons who could communicate direct with the Commander in Chief to the minimum.

Through a decree of August 28, 1918, the Director General of Military Transportation (Directeur Général des Transports Militaires) was named Assistant Chief of Staff of the Army (Sous-Chef d'Etat-Major de l'Armée), at the Ministry of War, and the 4th Section of the General Staff (Etat Major Général) was placed under his orders.

From thence on the General Staff of the Army (4th Section) was charged with studying, in conjunction with the Marshal, Commander

in Chief of the Allied Armies (D. G. C. R. A.), and the Ministries concerned, the organization of the lines of communication in the Zone of the Interior, as well as the establishment, location, and assignment of intermediate depots (stations-magasins), reserve depots (entrepôts), etc., in that zone for either the French or the Allied Armies. The 4th Section of the General Staff at the Ministry of War, henceforth collaborated in the preparation of the transportation plans pertaining to the general supply organization of the Army.

As a result of these measures, the Commander in Chief of the French Armies corresponded directly, insofar as transportation and supply were concerned, only with the Marshal, Commander in Chief of the Allied Armies (D. G. C. R. A.) and the 4th Section of the General Staff (Ministry of War). Materials, foods, and supplies of all kinds coming from the national territory (Zone of the Interior) or obtained from abroad, were acquired, classified and stored by the Ministries concerned. Supplies forming part of the current requirements of the Army were placed at the disposal of the Commander in Chief and he could draw them direct from the classification depots (entrepôts de réserve générale) or from the intermediate depots (stations-magasins), where they were stored and cared for by the Ministry concerned until their withdrawal. In addition, the Ministry was responsible for keeping these stores up to required amounts and seeing to it that the supplies were maintained in good condition.

For material which was not in current use, the Commander in Chief made special requests upon the Minister responsible for the supply of the particular material required and it was therefore most important that the various Ministries be prepared, at all times, to immediately satisfy such requests.

To accomplish this, the Ministries had to obtain close cooperation on the part of the national industries; moreover, they supplied not only the French Army and the French civilian population, but they were also obliged to furnish an enormous quantity of munitions and artillery matériel to the Allied Armies. This was a heavy burden on France, but France did her best and this spirit of cooperation was one of the essential factors in obtaining the victory.

For all classes of supplies, the Commander in Chief advised the Ministers concerned as to estimated needs of the armies and the Ministers made the necessary contracts to enable them to satisfy these requirements. The Commander in Chief never had to occupy himself with questions of purchase or procurement pertaining to the acquisition of supplies in the interior of the country or from abroad. He was concerned solely with the exploitation of the resources in the Zone of the Armies.

With reference to transportation. In the Zone of the Interior, the Minister of Transportation (Ministre des Transports) was responsible for the movement of supplies to the regulating stations; beyond this point, transports were forwarded by the Commander in Chief.

In this connection, special "transportation schedules" (marches) were reserved for military transports in the Zone of the Interior for the purpose of assuring the regular movement of supplies from the intermediate depots (stations-magasins), or from the general reserve depots (réserves générales), to the regulating stations.

CHAPTER IV.

SECTION III.[1]

RELATIONS BETWEEN THE MINISTRY OF WAR AND THE FORCES IN THE FIELD (BELGIAN).

As in France and Italy, the Belgian Ministry of War served as the procurement and storage agency for the field army. These relations are well set forth in Chapter II, Section III, and in the chapters dealing with the various services. It will only be necessary here to explain the functions of one or two of the agencies of the Ministry of War.

The "First General Direction" (Première Direction Générale), in agreement with the General Headquarters, provided for the appointment of all officers. The "General Direction of the Armament and of the Technical Services of the Army" (D. G. A. S. T. A.), whose main office was at Paris, procured practically all of the supplies needed for the Army, with the exception of food and clothing.

Requests from the units or services of the Army were forwarded through the appropriate administrative section of the General Staff, at General Headquarters, to the D. G. A. S. T. A. The latter provided for the manufacture or purchase of the required supplies and forwarded them to the Belgian establishments in the region of Calais from whence, at the request of the Army and under the control of G. H. Q., these supplies were issued to the army in the field.

The organization and operation of this service is recorded in Chapter VIII, the operation of the "D. B. M." in Chapter XX, and that of the Intendance service in Chapter X, of this volume.

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CHAPTER IV.

SECTION IV.

RELATIONS BETWEEN THE MINISTRY OF WAR AND THE FORCES IN THE FIELD (ITALIAN).

(Chart 3, Chapter IV, Volume I.)

In the matter of supplies, the intermediate organ between the Army and the interior was the "Intendenza Generale" (Quartermaster Department).

"Field Service Regulations" in defining the powers of the "Intendente Generale" (Quartermaster General) prescribed that: "The Intendente Generale shall be in constant communication with the Ministry of War for the supplies obtained in the interior for the use of the Army and, in an inverse sense, for the evacuation of men and stores. He is to act, principally, as intermediary between the Army Intendant's Office and the Ministry of War, particularly with regard to the supplies from the central depots."

The creation of the new administrative organizations mentioned in the preceding chapter, amplified and amended the existing regulations. Under the reorganization, the Intendente Generale was in direct contact with the Ministry of War, as well as with many of the new central administrations.

Except for munitions, arms, aviation matériel, etc., which were under the Supreme Command (G. H. Q.), the Intendenza Generale remained entirely responsible for the supply of the armies in the field. For the supply of the special matériel and stores mentioned above, the Supreme Command established direct relations with the particular central organizations charged with providing same.

The regulations concerning the flow of supplies remained unchanged, to wit: The central authorities were charged with the mobilization and transportation of materials, etc., to the central depots (Depositi Centrali), while the Intendenza Generale, in conjunction with the "Intendenze d'Armata" (Army Intendenza), assured their distribution to the troops through the depots at the front.

As a rule, during the last phases of the war, the flow of supplies was assured in the following manner:

(A) *Through the Ministry of War:*

So far as foodstuffs, forage, clothing and equipment were concerned, the Intendente Generale prepared estimates, calculated on

the average strength of the Army, and determined the quantities to be allotted to the various central depots. These credits were maintained by the Ministry of War through the "General Direction of the Supply (Logistici) and Administrative services," upon the basis of the periodical inventories transmitted to the Ministry by the commanders of the central depots.

From time to time, extraordinary requirements were brought to the attention of the Ministry of War by the Intendente Generale. The Ministry of War provided for these urgent requirements through the organizations under its control and directed that the necessary supplies be sent to the Reserve Zone. In the event of a deficiency the Ministry of War applied to the other Ministries for assistance and these, in turn, forwarded the quantities of supplies needed in accordance with the requests which had been received.

The Intendenza Generale made direct request upon the Ministry of War (General Administration of Military Hygiene), for medical and veterinary supplies.

(B) *Through the Ministry of Arms and Munitions:*

The Supreme Command (G.H.Q.) prepared production programs for the manufacture of arms and munitions for the purpose of equipping the new units which were being organized, replace expended matériel or losses incurred at the front and create reserves in view of future operations. These programs, after having been approved, were carried into effect by the Ministry of Arms and Munitions.

The assignment of these supplies and matériel to the depots of the various army corps at the front, or to those of the Intendenza Generale, was made by the Supreme Command and communicated directly to the Ministry of Arms and Munitions. The latter took the necessary steps to provide the materials required.

The supply of various materials for the Ordnance and Engineer services was carried out through the Intendente Generale, who forwarded the requests to the Ministry of Arms and Munitions. These supplies were sent to the central depots, or to the special depots of the Intendenza Generale, in accordance with the instructions of the Ministry.

The Intendenza Generale, in conjunction with the Supreme Command, prepared programs of motor transportation requirements and these were then carried into effect by the Ministry of Arms and Munitions. Motor vehicles and motor transport supplies were sent to the motor transport reserve parks under the control of the Intendenza Generale and from there distributed to the various army corps. Tires, spare parts and repair material were provided directly by the Intendenza Generale.

The Intendenza Generale made direct requisition upon the Ministry of Arms and Munitions for the supply of benzine and lubricants.

(C) *Through the General Aviation Commissariat:*

The Supreme Command, in conjunction with the General Aviation Commissariat, prepared aviation production programs. In the preparation of these programs the contemplated development of aerial operations, as well as the relative proportion of the losses that had been incurred, were taken into consideration.

The supply of the Air Service establishments in the field was assured by the Headquarters of the Air Service (Superior Command), through demands on the General Aviation Commissariat.

CHAPTER IV.

SECTION V.

SUPPLY IN THE UNITED STATES AS IT FUNCTIONED AT THE DATE OF THE ARMISTICE.

(Compiled from the Report of the Chief of Staff, U. S. Army 1919 by Col. Harry L. Hodges, General Staff.)

To appreciate the enormity of the supply[1] difficulties of the American Army, it is well to consider the successive programs for the overseas shipment of the American Army.

Early in the spring of 1917, it was decided to send over one complete division to form the nucleus for the training of other troops and for the moral effect.

In July, 1917, it was decided, upon General Pershing's request, to send 30 divisions during 1917 and 1918. To this force was to be added service of the rear troops and other special units. This program provided for the placing in France by December 31, 1918, of 1,372,399 men. On July 18, 1918, it was decided to send to Europe by June 30, 1919, 80 divisions, 3,360,000 men, maintaining at home 18 divisions or a total strength of 4,850,000 men. Should the war continue beyond 1919 and in order to have a basis for the production of supplies, it was provided to have 100 divisions in France and 12 in the United States or a total of 5,500,000 men by June 30, 1920. We were still functioning under the program of July 18, 1918, when the war ended.

To meet this formidable program of troop shipment, ship tonnage was necessary.

Through the aid of the British, who in the early months of 1918 assigned large liners to our use, by the efforts of the Shipping Control Committee which was charged with allocation and distribution of available tonnage and through the cooperation of the Shipping Board, by June 30, 1918, over a million men had been embarked for France, 306,000 sailing in one month.

The organization which accomplished these results was that indicated in the second chapter of this study, the War Department, which was, in effect, the General Staff and the administrative bureaus as organized on November 11, 1918. This organization was in process of development but it is believed that in its then exist-

[1] Supply and supplies as herein used are employed in their broadest sense and not as referring alone to food and forage.

ing form, November 11, 1918, it would have met without hitch or delay all the difficulties of a continued war.

The foregoing organization was rendered possible only by the passage of the Overman Act which gave the President a free hand in the organization or reorganization of the governmental agencies necessary to the successful conduct of the war. By so doing Congress showed a keen appreciation of the necessity of an absolute central control in the prosecution of war, which understanding had never been reached by a preceding Congress in the history of the United States.

Under the final development of the organization, all requests for supplies went to the Director of Purchase and Storage, and he filled from stock whenever possible. When the supplies desired were found to be *not on hand*, the requests were forwarded for procurement to the Director of Purchase, unless ordnance, aircraft, or other highly specialized material were required. In the cases of such supplies requests were sent to the proper bureau for procurement. Once obtained, the requests were filled as "Engineer equipment," "Signal Corps supplies," etc., and were consigned to the Corps of Engineers, Signal Corps, etc., for issue to the troops. (Chart 2, Chapter IV, Vol. I.)

PURCHASE STORAGE AND TRAFFIC DIVISION, GENERAL STAFF.

Supervising Units.	*Operating Departments.*
Statistics and Requirements Branch.	Embarkation Service.
External Relations Branch.	Inland Traffic Service.
Purchase Branch.	Director of Purchase and Storage.
Production Branch.	Facilities Department.
Executive Branch.	Finance Department.
Inspection Branch.	Primary Ports of Embarkation.
Research Branch.	

Requirements.—The first step in the procurement of supplies was the calculation of requirements. The fundamental data required in this task were: (1) The Army Program, in terms of estimates of the total number of men to be in the service at given dates; (2) Tables of Organization showing the exact composition of the different existing units, or those to be organized, (3) tables showing the type and number of articles of equipment required by each unit. In the case of certain classes of supplies, such as aircraft, the amounts required were the maximum output to which the manufacturing capacity of the country could be developed rather than the exact strength of the Army at any given time, and special projects were necessary. For the larger part of the work of determining requirements, however, the starting point was the Army Program itself. Many articles of equipment, especially ordnance,

required months or years to complete. Many large orders, such as for articles of clothing in amounts reaching into the millions, could not be delivered until long after the orders had been placed. Consequently procurement schedules covering future as well as present needs and based directly on the mobilization, organization and shipping schedules constituting the Army Program, were necessary.

After the establishment of Staff control under the Purchase, Storage and Traffic Division, a Requirement Branch was organized in which requirements for the entire Army, with the exception of highly technical articles and special projects, were drawn up. This was based on the programs furnished and revised by the Operations Division, General Staff. The intention was eventually to absorb in this branch the special requirements section of all the bureaus, so that each aspect of the Army demands might be prepared by those best informed.

Contracts.—Once the requirements for any article had been drawn up, whether in the bureaus or in supervisory or controlling agencies, it became necessary to translate these into terms of purchase. This was accomplished in the contracts prepared by the purchasing departments for the business organizations to work on. A Board of Contract Adjustment was accordingly created in the Purchase, Storage and Traffic Division on November 6, 1918. This was to hear and determine all claims, doubts and disputes, including all claims of performance or non-performance, which might arise under any contract made by the War Department.

In the early months of the war, many disagreements had developed between the departments and bureaus in regard to particular purchases.

Clearance.—One of the results which the Purchase, Storage and Traffic Division undertook to bring about was the unifying, for the Army, of requests for clearance. An Army Clearance Committee composed of the liaison officers or other representatives from the various supply bureaus was organized. From this committee there issued the final requests for clearance which were consolidated and transmitted to the clearance committee of the War Industries Board—whose industrial organization was thus further paralleled by the new military organization. This Board was allowed forty-eight hours in which to act upon requests for clearance, after which time the bureaus were free to proceed with their own purchase negotiations. By familiarity with the War Industries Board's practice, the Army clearance office found that a great many requests for clearance were unnecessary; and an arrangement was made whereby that office undertook to discriminate between the requests which should or should not be submitted.

Priority.—The word "priority" was originally applied largely to a preference given between two conflicting requests for immediate purchase. This became known as "clearance"; and "priority" came to be connected rather with preferential consideration given a government contractor in the matter of fuel, raw materials, labor or transportation facilities to which he became entitled ahead of other contractors whose work was considered less important to the military program. In the earlier months of the war all bureaus and Government departments strove for priority. Each procuring agency was responsible for its own individual task. In March, 1918, a Priorities Board was established which consisted, in addition to the Priorities Commissioner and the Chairman of the War Industries Board, either of members of or important officials in the Railroad Administration, Navy, Army, Department of Labor, Allied Purchasing Commission, Food Administration, Fuel Administration, Shipping Board and War Trade Board.

Within the Army, a priority system was developed under the Purchase, Storage and Traffic Division. This included both the settlement of priority questions between the various supply bureaus, and the single representation of the War Department on priority matters in the War Industries Board. Conflicts within a bureau were settled by the bureau committee; the requests were then to be transmitted to an Army priorities officer, and after adjustment had been made between bureaus, the requests were put through the regular procedure of the priorities of the War Industries Board. This system worked with great efficiency. At the end of active hostilities practically all the industries of the country were operating under priority schedules which kept their entire activities in pace with the progress of the Army Program as a whole.

Purchase by Commodity and Zones.—The original basis of the Army Supply system had been that of military functions. The War Industries Board had been based on the stratifications of the market in commodities such as leather, steel, wool, cotton, etc. In this board an elaborate set of "commodity sections" was created, each under an expert in the particular thing concerned. The responsibility for planning supply on a large scale and in advance of developing facilities, and for the proper distribution of orders throughout any single industry, rested with these commodity sections.

Under the Purchase, Storage and Traffic Division, however, it became possible to systematize the contracts of the various Army departments with the commodity sections. A series of Army Commodity Committees were created to parallel and operate with the Commodity Section of the War Industries Board. Each Army Committee was made up of representatives from the supply bureaus in-

terested in a particular commodity. The chairman of each committee was appointed from the representatives of the bureau whose interest in the commodity happened to be largest and these chairmen also served as members of the respective War Industries Board Commodity Sections. This system greatly simplified the problem of the War Industries Board in dealing with Army needs.

Thus a real centralization over former contracting and purchase methods was established. At the same time, a more clear definition of functions was developed in the actual supply operations outside of Washington. This was supplied by the transition from the highly decentralized depot system of the Quartermaster Corps to a system of supply zones, under the control of the Director of Purchase and Storage. The zone offices were established in the old Quartermaster depots, but were given direct responsibility for actually procuring and distributing supplies throughout the district of which the offices formed the centers. The zones, thirteen in number, were established during a period commencing in the early summer of 1918, although final organization was not attained until January, 1919. Direct cooperation and communication between the Zone Supply Officers themselves was encouraged, especially in the adjustment of shortages, overages, etc. Finally, as nearly every district was especially adapted to the procurement of one or more particular articles, each zone came naturally to assume responsibility for and to be able to furnish accurate information on special aspects of procurement. Thus a real service of supply was effected, from the zones through the camp or port supply officers to the troops—all under the contracting and purchasing control of the single central agency.

Relations with the Allies.—All the factors described above were primarily concerned with supply activities in this country. It was also necessary, however, to systematize certain supply relations of the United States with other countries. Purchase of war supplies were being made from England and France, and in many of the agreements the United States pledged itself to "replace" the amounts of raw material used in making the articles bought. A Replacement Section was therefore established in the Purchase, Storage and Traffic Division to supervise the various replacements involved. This task brought into the section a considerable volume of business relating to purchase from and sale to the allied nations which were not necessarily of a replacement character. In consequence, this section was reorganized September 5, 1918, as the Allied Relations Section, and its duties defined as "to maintain relations and conduct negotiations with representatives of Allied Governments in matters pertaining to supplies, and to supervise and direct the compilation and maintenance of records and accounts pertain-

ing thereto". The centralization of supply control made it possible to standardize many processes and articles which had previously been designed independently by the bureaus; and thus to reduce multiplicity of types, to further interchangeability of parts, to save much waste and in general to simplify purchase and storage problems. The final organization of the Office of the Director of Purchase provided the eight commodity divisions of Clothing and Equipage, Subsistence, Motors and Vehicles, Machinery and Engineering materials, Raw Materials, Medical and Hospital Supplies,[1] General Supplies, and Remounts. This office in turn, was brought into direct relation with Storage and through the office of the Director of Purchase, Storage and Traffic, into close relation with the requirements, facilities and general supply needs and policies of the Army as a whole.

Distribution, Storage and Traffic.—The procurement of supplies having been effected, the next questions to arise were those of methods of distribution. The eventual end of distribution, in turn, was issue to the various units of the forces. This fact brought distribution into immediate and direct relation to the troops themselves. With procurement, the strictly military aspect came largely in the start of the process. The first task of procurement was to translate the Army Program and the Tables of Organization and Equipment, into detailed requirements for each of the various procuring units and services—that is, it resolved questions of supply from military into business and civilian terms, and built up an organization based on business methods. Once the supplies had been procured, however, it became necessary to reverse the process, and retranslate the lists of finished products into the military terms of distribution and issue. The General Staff prepared the pattern, or plan, for the results it needed; and directed the general activities of the organization by which the pattern was fulfilled.

Distribution included the proper handling of supplies procured and carrying them to their eventual destinations, whether to the camps in this country or the firing line in France. These two functions were represented by Storage and by Traffic. Of these, storage occupied an intermediate position between procurement and issue. The fluctuations of procurement and transportation, together with the necessity of accumulating reserves, were indeed the reasons for the existence of a storage problem. Traffic was more of a special problem in itself, though it played a very direct part in all the other supply functions. In its task of moving men and supplies overseas it represented the final step of the distribution, while in moving new materials to the factories it affected the first steps of

[1] Munitions—Artillery were procured through the Ordnance Department.

procurement. In spite of these interrelations, however, it constituted a unitary function which could be and was worked out largely apart from the progress of the supply situation in general. Furthermore, it early came in close touch with the General Staff officers who were directing all Army movements, both of men and munitions. The appointment of a Director of Storage and Traffic brought under one jurisdiction the whole problem of the movement and handling of Army supplies from the factories to the troops.

The establishment of a perfect storage program was dependent upon a knowledge of the needs of the troops for supplies over long periods, and upon a definite policy for relating procurement to issue in the matter of time, that is, how great a reserve stock should be provided for by the enunciation of the Army Program. The second formed the direct basis of storage requirements. The aim of storage was to distribute in such a way that there would always be a sufficient quantity on hand to permit of an adequate supply for the troops, and to allow freedom of military movement. It was also important that an unnecessary quantity of supplies should not be accumulated at any point. In January, 1918, the General Staff established a *basis for reserve supplies.* For the overseas force this was to be an eight months' supply; three months' supply for the troops in France, one month's for the troops en route to France, two months' at or near the Atlantic seaboard in this country, based on the number of troops abroad and the remaining two months' supply in interior depots in this country. For troops in training in the United States, provision was to be made for a six months' reserve, of which one month's supply was to be held at camps and cantonments and the balance at interior depots. Upon recommendation of the Director of Storage this last provision was arranged to provide for sixty days' supply at the camps in order to effect more economical use of freight cars by avoiding small shipments.

Between January 1st and July 1st, 1918, construction was commenced on practically all the important storage projects undertaken. At the seaboard these included Army Supply Bases at Boston, South Brooklyn, Philadelphia, Charleston, and New Orleans. Among the more important projects at interior points were:

Permanent warehouses at Chicago;

Completion of a permanent warehouse at St. Louis;

Army Reserve depots at Columbus, O., South Schenectady, N. Y., and New Cumberland, Pa.;

Additional warehouses at Jeffersonville, Ind.;

Additional warehouses on Governors Island;

Philadelphia Interior Depot;

Additional facilities at Pittsburgh;

An increase in warehouse capacity in all camps and cantonments, amounting to practically 100 per cent;

Cold storage facilities at camps and cantonments;

Engineer sub-depots at camps and cantonments;

Powder magazines at a large number of camps and cantonments.

In addition, a large number of buildings were leased to afford necessary storage space in connection with existing depots.

In accordance with the plan for accumulating reserves, three Army reserve depots were authorized, an inland depot at Columbus, Ohio; and depots adjacent to the seaboard at New Cumberland, Pa., and South Schnectady, N. Y. In general, the construction of storage facilities was constantly limited by the prospective production of supplies.

It was early perceived that the most important function of the Director of Storage was control of distribution, of which storage was but one feature.

In the system finally developed the greater part of storage activities for the Army were thus performed by clearly defined field services, under the direct and single control of the central office in Washington. The field services consisted in the general and special depots and distribution facilities under the Zone Storage Officers, the Army Reserve Depots, and the primary and secondary Ports of Embarkation—of which the former, moving men and supplies, were operated by a Port Storage Officer under the Commanding General; and the latter, moving supplies alone, were directly under the Port Storage Officer. In the central office of the Director of Purchase, six divisions were created. These were the Storage and Administration Division; Domestic Distribution and Domestic Operations Divisions, with general control over the depots, stocks and distribution of supplies in the United States; Distribution Division controlling the distribution and movement of supplies destined for shipment abroad, a Port Operations Division controlling the Port Storage Officers, and allotting tonnage for the supplies moved by the latter Division, and a Salvage Division, in charge of a highly important, though subsidiary, aspect of the storage problems.

Once supplies are produced they must be assembled and carried to their final point of issue. In addition, the very production of the *Traffic* supplies is dependent on the movement of raw materials, fuel, etc., to the factories. Furthermore, men had to be moved from their homes to the camps, from camps to ports, and from the ports to Europe. This entire process of movement and transportation was eventually grouped under the name of "Traffic" in the final supply organization of the Army.

In December, 1917, with freight congestion becoming daily a more serious problem, it was realized that a more comprehensive scheme for unified control of the movement of Army supplies was needed than the above organization could provide. The limitations of transportation in this country consisted in the capacity of the shipping tonnage available, the loading facilities at the ports, storage and terminal facilities at the ports, and the inland transportation facilities. Congestion at any one of these points must effectually block the final end of the entire supply system—the continuous flow of supplies to the troops. The need for a central agency to direct, coordinate and control Army Transportation by rail was apparent. This agency was provided by the appointment on January 10, 1918, under the Director of Storage and Traffic, of a Director of Inland Transportation, with jurisdiction over all matters pertaining to the routing and transportation of all troops and property by all means of inland transport. The organization of this division fell under two main heads, property movement and troop movement. The Property Movement Branch was subdivided to correspond with the various supply bureaus of the Army (with the exception of making the transportation contract) and its functions were to take all the necessary steps in regard to rail movement of property for the Army. It cared for the transportation orders, arranged for the imposing and lifting of temporary embargoes, the furnishing of cars and equipment, the tracing and expediting of shipments, etc., etc. A complete Car Record Office was set up for the Railroad Administration, which served not only the Army, but the Navy and the Shipping Board, and kept records of the movements by rail of all government property.

The Troop Movement Branch served as a connecting link between the Railroad Administration and the various parts of the Army in the matter of arrangements for the movements of troops. On April 22, 1918, its functions were considerably enlarged by the abolishment of the separate transportation units in the various bureaus and the transfer to it of their functions. A set of branch offices in important cities was provided for, as well as numerous district offices throughout the country. The result was that all Army transportation matters came to be practically completely centralized in this Service, with a direct responsibility and control through this service to the Director of Purchase, Storage and Traffic, who brought its functions into relation with the needs of the entire Army.

The Movement of Freight.—The great task which immediately confronted the Director of Inland Transportation was the remedying of freight congestion. To handle this problem a method was devised which, though far-reaching in its application, was simple in

principle and effective in the accomplishment of its purpose. The principle was that shipments to ports of embarkation, as well as to other congested points, should not be accepted by the carriers at points of origin except with the express approval of this division. This approval was to take the form, in certain cases, of a transportation order, which not only showed the shipments to be made but operated as an order to the carrier to furnish the necessary transportation. No shipment could move from the place of origin without a transportation order issued by the Inland Transportation Division, which, in turn, did not issue such an order until the supply bureau concerned had first obtained a release from the Embarkation Service.

The Director of Inland Transportation, and certain others serving under him, were officials of the Railroad Administration as well as of the War Department—an interlocking arrangement similar to the connection of the Acting Quartermaster General with the Director of Storage and Traffic. It was therefore possible, through the Railroad Administration, to issue orders mandatory upon the carriers. The transportation orders were ordinarily confined to shipments to particular ports and congested points; but in all cases when a Government agent or contractor was unable to get necessary transportation with sufficient promptness, a transportation order would be issued calling for immediate shipment by the carriers. Under these circumstances the Inland Transportation Division not only issued the order but took all necessary steps to see that it was complied with. Finally a system was established of allotting to the bureaus or supply services the exact amount of cargo space to which they were entitled. The Inland Traffic Service was kept informed of these allotments, and made arrangements for confining rail shipments for all bureaus and branches within these limits.

In spite of the very serious conditions existing when the Inland Traffic Service began its work, freight congestion was eliminated within a few weeks after its system of control was put into effect. From that time on, movement by rail of men and supplies was always well under control.

Embarkation.—The first troops sent abroad, in the early spring of 1917, were hospital units. These were shipped on commercial liners under the control of the Water Transportation Branch of the Quartermaster Corps, acting through the General Superintendent of the Army Transport Service at New York. This branch also made arrangements for the first convoy and, all told, shipped some 25,000 troops to France. The first step in the evolution of an embarkation service independent of the Quartermaster Corps consisted in the formation of the Port of Embarkation at New York, in August, 1917. This was operated directly under the Secretary of War, by

a commanding general with control over representatives of all bureaus. This example was followed in the case of Newport News and, in a more or less modified form, in all ports from which men and supplies were shipped during the war. The Commanding Generals of the primary ports, i. e., those for men and supplies, reported directly to the Purchase, Storage and Traffic Division; the secondary ports or those for supplies, and (in a few isolated cases for a relatively few men) were directed by the Zone Supply Officer of the supply zone in which the ports were located, and through him, by the Director of Purchase and Storage. Thus from August 1917, throughout the war, the system of ports maintained an existence apart from the exclusive joint control of the system of independent bureaus.

The Port of Embarkation at New York was the principal point for the shipment of troops, 88 per cent of all troops being there embarked. It included the terminals at Newark, Hoboken and Brooklyn and three embarkation cantonments created to facilitate shipment of troops from the port—Camp Merritt, with a capacity of 38,000; Camp Mills, 40,000; and part of Camp Upton, sufficient to accommodate 18,000 men. The Port of Embarkation at Newport News, including Norfolk, Virginia, shipped much freight, a small proportion of troops, and was the point of shipment for animals. This port included Camp Stewart, with a capacity of 25,000 men; Camp Hill, with 18,000; a Quartermaster terminal, an Ordnance depot, a Signal Corps station, extensive Engineer terminals and general warehouses. Overseas expeditionary depots were established at Boston, Philadelphia and Baltimore, and some shipments were made from time to time at Savannah, Jacksonville, Mobile, Gulfport, New Orleans and Galveston.

The establishment of the Port of Embarkation at New York as an independent unit was accompanied by the establishment there of an independent service to operate it, as well as at such new ports as later came into use. This service, known as the Embarkation Service, was formed August 4, 1917. Its functions were to coordinate all shipments of munitions and supplies of every kind and all movements of troops whose ultimate destination was Europe. Its specific duties were to supervise all movements of supplies from points of origin to the ports of embarkation, to supervise the operation of those ports, to control the employment of all Army transports engaged in the trans-Atlantic service and such commercial shipping as might be used to supplement this service, to arrange with the Navy for convoys, and to arrange that supplies for the forces abroad should be forwarded in the most expeditious and convenient manner. Through this service the General Staff exercised

principle and effective in the accomplishment of its purpose. The principle was that shipments to ports of embarkation, as well as to other congested points, should not be accepted by the carriers at points of origin except with the express approval of this division. This approval was to take the form, in certain cases, of a transportation order, which not only showed the shipments to be made but operated as an order to the carrier to furnish the necessary transportation. No shipment could move from the place of origin without a transportation order issued by the Inland Transportation Division, which, in turn, did not issue such an order until the supply bureau concerned had first obtained a release from the Embarkation Service.

The Director of Inland Transportation, and certain others serving under him, were officials of the Railroad Administration as well as of the War Department—an interlocking arrangement similar to the connection of the Acting Quartermaster General with the Director of Storage and Traffic. It was therefore possible, through the Railroad Administration, to issue orders mandatory upon the carriers. The transportation orders were ordinarily confined to shipments to particular ports and congested points; but in all cases when a Government agent or contractor was unable to get necessary transportation with sufficient promptness, a transportation order would be issued calling for immediate shipment by the carriers. Under these circumstances the Inland Transportation Division not only issued the order but took all necessary steps to see that it was complied with. Finally a system was established of allotting to the bureaus or supply services the exact amount of cargo space to which they were entitled. The Inland Traffic Service was kept informed of these allotments, and made arrangements for confining rail shipments for all bureaus and branches within these limits.

In spite of the very serious conditions existing when the Inland Traffic Service began its work, freight congestion was eliminated within a few weeks after its system of control was put into effect. From that time on, movement by rail of men and supplies was always well under control.

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its control over the ports of embarkation, and other agencies of the Army in so far as they were directly concerned with embarkation.

Finally with the organization of the Purchase, Storage and Traffic Division in April, the Embarkation Service became one of the four main sub-divisions and continued as a main operating department through the reorganization of the Staff in August. The internal organization developed for this service consisted of three sections, supervised by a fourth known as the Administrative Section. The Passenger Section maintained records of all troop movements overseas and returning, including a log of each unit from the date it was reported ready by the Operations Division until it had landed in Europe. A Ship Section maintained liaison with the United States Shipping Board and the Shipping Control Committee, keeping the Chief of Embarkation advised at all times of ships available for troops and cargo service, and made recommendations as to equipment, repair, and maintenance of ships. A Cargo Section exercised control over the movement of supplies to the seaboard and over the assignment of these supplies to ships in accordance with the approved schedules. This section maintained close relationship with the supply bureaus and kept records of their shipments. It also cooperated with the Inland Transportation Branch in following up shipments towards the seaboard to prevent congestion and to secure the stores most needed for shipment. The functions of financing, chartering, constructing and altering vessels continued to be performed, during the greater part of the war, by the Water Transportation Branch acting independently. In November, 1918, however, this branch too was assimilated into the Embarkation Service.

The greatest concern of the Embarkation Service, and of the entire War Department, was to secure the ships necessary to carry out the constantly increasing Army Program. In the spring of 1917, the Army Transport Service had consisted of fifteen vessels. Of these, five were engaged in the Trans-Pacific service, two in the Trans-Atlantic service, two in the New York-Canal Zone service, and three were stationed in Philippine waters. Two were out of commission, one was a cable ship, one was in the service of the Interior Department, and one was a tug in service at San Francisco. The number of troopships had been increased, largely by the addition of the interned German boats, to 27; the cargo fleet numbered 53, and there were 18 animal transports. On these had been embarked by the end of January, 1918, for Europe 243,298 troops, 18,908 animals and 594,360 short tons of cargo. By February the situation had become very acute, and it was recognized that it would be impossible to carry out the Army Program and maintain the forces already abroad, without tremendous increases in the amount of ton-

nage at the disposal of the Army. The securing of this increase was a task performed by all agencies of the Government. The Shipping Control Committee, in the Spring of 1918, stripped bare our import and export trades of their ships and turned over for the Army nearly 1½ million tons of ships. Twelve other nations also furnished ships, Great Britain taking the lead, with Holland, furnishing 374,817 tons, the two Scandinavian countries 175,063 tons and Japan 173,041. Every ship that could possibly be spared in this country and abroad was negotiated for, and as a result ships came from nearly all nations and all parts of the world. These were obtained upon numerous conditions of charter and hire, but all were pressed into service in the least possible time. In particular, the tonnage furnished by the British in May, and that supplied by other allies enabled the monthly shipment of our troops to be increased from 84,889 in March to 118,642 in April, and to a record of 306,352 in July. From the fifteen old Army transports, the fleet operated by the Embarkation Service grew to a total of over 500 ships, with a tonnage of more than 3,560,000 dead-weight tons.

The Shipment of Supplies.—The shipment of freight overseas fell into three main phases, (1) the shipment of the initial material and miscellaneous technical supplies necessary to build up the ports, railroads and other facilities for the operation of the future armies, (2) the shipment of the personal and combat equipment of the forces from which the armies were created, (3) the shipment of supplies and equipment of all kinds to replace that already sent, to maintain the forces, to meet special calls from time to time and to make up for shortages of previous shipments. A later development of this policy was to save tonnage and railroad transportation by sending only new equipment abroad, not that which had been used by the troops in training, but equipment as crated direct from the factories. Thus when a division was ordered from its camp for overseas duty, it left the equipment it had used for the new organizations to be formed in that camp, and received a complete outfit of new or salvaged equipment. In this way the equipment lasted longer after reaching France and did not require replenishing so frequently, the amount of railroad shipments in the United States was reduced and every ship's ton was utilized to its full capacity.

In general, the dispatch of equipment of all kinds abroad had to be carefully related to the Priority Schedule which governed the shipment of men. It was necessary indeed to prepare priority schedules for equipment as well as for men, especially after the policy of sending unit equipment with the units themselves was abandoned. These schedules were adjusted between the needs of

the troops in the field, the ability of the supply system in the United States to procure the supplies needed, and tonnage available from month to month. The latter again proved the decisive factor. No matter what elaborate systems of automatic supply to replace wastage, or whatever careful adjustment was made between needs and supplies in storage, an adequate flow of supplies could not be maintained without the tonnage necessary to move them. Each additional soldier sent abroad increased the demand for tonnage space. The result of the enormous shipments of men during the summer of 1918 was to upset all preestablished balances and schedules. Supply requirements were calculated and recalculated each month by the A.E.F. and sent to the United States in the form of cables. The final basis of the requirements came to be the minimum needs of the different organizations in France, calculated for a month in the future. Even then, it remained impossible completely to fill the requests urgently presented, and the shipment of supplies partook of an emergency character through all the last months of the war. In spite of the lack of shipping facilities needed for complete maintenance, the Embarkation Service had developed a machinery of freight shipment capable of expansion as new tonnage might be secured, and adequate to insure the prompt and efficient handling of all supplies which could be loaded. The system of transportation releases, by which the railroads carried to the ports shipments only in the amounts proportionate to the capacity of the ports to care for them, checked port congestion at its source. In spite of all difficulties, the early confusion at the ports and the limitations of shipping the Embarkation Service, up to November 11, 1918, had transported 5,148,086 short tons of cargo for use abroad, while from November 11th to June 30, 1919, 2,209,862 additional short tons had been sent overseas for the use of the rapidly decreasing Expeditionary Force.

CONTROL EXERCISED BY THE NAVY.[2]

The Navy began to take over the vessels heretofore handled by the Army the latter part of 1917, handling them through the Navy Overseas Transportation Service. They had from the very start supplied the gun crews for the protection of the vessels, and as soon as they got the men, they supplied the entire crew. When an Army vessel was taken over by the Navy as to crew, they also took over all matters pertaining to her supply and controlled her, from the time she left the dock, until she was tied up at dock or other safe anchorage at the port of debarkation. When a convoy was ready to start from the United States, a "consist" was pre-

[2] Prepared by Lieut. Col. D. W. MacCormack, T. C., General Inspector, A. T. S., A. E. F.

pared, giving the name or code number of the vessel, the anticipated date of arrival at destination, the quantity and nature of her cargo, special reference being made to particular items. This "consist" was transmitted from the Navy to the Naval Force Commander at Brest who, in turn, notified the Director of the Army Transport Service at Tours.

On receipt of the "consist," the Director of the Army Transport Service notified the various supply departments of the anticipated arrival of certain vessels, with the character of supplies, but did not give the name of the vessel or the exact date of arrival. The supply departments notified the Director at which port they preferred to have the vessel forwarded. The assignment of vessels to ports was, however, decided by the tonnage of the vessel, the class of cargo carried, and berths available. The Director then determined to which port the vessel should be sent and notified the Navy accordingly, through the Force Commander at Brest. He then, by wireless direct, or through the office of Admiral Sims in London, notified the Commanding Officer of the convoy to which ports the vessels should be sent. Due to shortage of convoy accommodations, it was not always possible to put vessels in at the ports requested by the Director of the Army Transport Service, A. E. F.

However, after it had been determined to which port the vessels were to be sent, the Director of the Army Transport Service notified the Superintendent, Army Transport Service, at the ports in question (immediately upon receipt of the cable "consist" he furnished a copy to the C. G., S. O. S., and the C. in C., at G. H. Q.). The Superintendent, Army Transport Service, held these communications as secret until a few hours before the vessel was due to arrive.

The unloading of cargo was discharged at Ports of Debarkation by the Army Transport Service in one of three ways: (1) into dock warehouses for classification; (2) into cars for transshipment to large classification warehouses, such as Montoir, St. Sulpice, etc., (3) into trains or trucks for shipment direct to warehouses controlled by supply depots at the ports, or similar warehouses in the interior, or to regulating stations. Such shipments were controlled through G-4, S. O. S., which in many instances gave orders necessitating direct shipment from shipside to destination.

The operations at the ports were conducted as follows:—The General Superintendent, Army Transport Service, was in charge of the operation of the docks, handling all vessels as to unloading, the operation of dock warehouses not assigned to supply depots, and the operation of railroad yards at the ports. The supply depots maintained small warehouses at the ports which were controlled by their representatives. The Army Transport Service discharged all

troops on arrival, they being taken over at the dock by the Base Commander and handled by him thereafter. The Railroad Transportation Department of the Transportation Service took charge of the loading of cars and the troops were sent either to the nearest classification depot, or, for main line service, to interior points.

When the return movement started, G–1, Hq., S. O. S., and the Commanding Generals at the base ports assumed practically entire charge of the assignment of troops to vessels and supervised their embarkation, although a check was made by the force of the Superintendent, Army Transport Service. The procurement of tonnage for the return movement was handled by the Chief of Embarkation in Washington, by the Shipping Board through its representatives in London and Paris, and by the Army Transport Service through its Embarkation Branch. The Embarkation Branch of the Army Transport Service, however, operated mainly as an agency of the Embarkation Service in Washington, and of the Shipping Board.

TONNAGE AND ALLOTMENT. AMERICAN E. F.[a]

The supplies for the American E. F. that were obtained from the United States may be separated generally into two classes. The first class comprised supplies of more or less uniform consumption, such as rations, forage, clothing, equipment, ammunition, etc. The second class included exceptional articles, such as technical machinery and tools, special instruments, etc.

The original plan (as laid down in cable No. 145–S, Par. 5, Sept. 7–17, from the C. in C. to the Adjutant General, W. D.) contemplated that each Supply Service would prepare tables of articles of the first class based upon probable consumption, for units of 25,000 men. Based upon these tables there would be automatic shipment of these supplies from the U. S. Each 25,000 men shipped from the United States would be accompanied by an "initial" shipment for a four (4) months' period. This initial shipment would comprise the three (3) months' reserve required, plus one month for consumption. The United States would thereafter continue to ship these supplies automatically to France at regular periods.

Articles of the second class mentioned above, would be requisitioned from time to time, as necessary.

The following factors, however, developed which seriously affected the carrying out of this system.

(*a*) A shortage of tonnage.

(*b*) A shortage and delay in production in the U. S.

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[a] Prepared for the M. B. A. S. by Colonel J. W. Wright, General Staff, Chief Historical Officer, G–4, S. O. S.

(*c*) A delay in delivery at seaboard in U. S. due to railroad congestion.

(*d*) Sinking of vessels at sea.

(*e*) Revision of tables of consumption as originally prepared.

(*f*) Change in troop-shipping program.

(*g*) Change due to military situation.

To surmount these obstacles two classes of estimates were sent to the United States. First tentative estimates were prepared by the services and checked by G–1, S. O. S., to cover the second and third months, following transmission. These tentative estimates were the basis for shipment of supplies to the seaboard in the United States. The second class consisted of "Priority Cables" which called for supplies for all services for the month following transmission and these cables governed flotations at ports in the United States. In the meanwhile, monthly cables were received from the United States containing statements as to tonnage available for the following month. These cables were received by G–1, S. O. S., who assigned to each service its share of tonnage space.

The working of the system may be stated briefly as follows:

(1) The War Department received monthly "tentative estimates" for the second and third month following transmission. Based upon these estimates, stores were directed by rail to the seaboard.

(2) The War Department notified Headquarters S. O. S. (G–1) by monthly cable the amount of tonnage available for the A. E. F. during the following month.

(3) G–1, S. O. S. assigned portions of this tonnage to the services, who prepared lists of their necessities, arranged in order of urgency. These lists went to G–1.

(4) G–1, transmitted to War Department the "Priority Cable" for the following month.

(5) Upon the receipt by the War Department of the "Priority Cable" for the following month, so much of the "tentative estimates" previously received as related to that month was automatically cancelled and the priority of shipment indicated in the "Priority Cable" governed, as far as practicable, this flotation.

(6) When services found it necessary to call for exceptional articles they were usually required to cancel an equivalent tonnage of other supplies.

When August 1918 arrived, a very grave situation arose, caused by a shortage of tonnage on one hand and the vastly increased number of troops transported to France during June, July and August. To meet this situation the system of allotment of a specified amount of tonnage to each service was abandoned and each service was called upon to prepare requisitions for their minimum needs. These requisi-

tions were carefully studied by G–1, S. O. S., and articles procurable in Europe were cancelled. Every effort was made to meet the requirements of the situation. Of the minimum amount considered necessary for one month by all the services, namely, 1,022,135 tons, there was tonnage only for 722,222.

The armistice of November 11, however, terminated this problem.

TRANSPORTATION AND STORAGE (A. E. F.).[4]

At each port in France used by the American E. F., there were representatives of each supply service, who designated the disposition of the supplies arriving or pertaining to their service.

The disposition of these arriving supplies was a matter to be decided by the services. They were, however, subject in their decision to the following conditions:

(*a*) 15 days' supply were required for storage in advance storage; 30 days' supply were required for storage in intermediate storage; 45 days' supply were required for storage in base storage.

(*b*) The amount of rail transportation available at the time at the port of arrival had to be considered.

Questions of priority of shipment of supplies from base ports (or storage) constantly arose. Many of these were settled by the Commanding Officer of the Base Section, but others of these questions were referred to Headquarters S. O. S., where a decision was given (G–4, S. O. S.).

The question of the location of storage depots was settled by G. H. Q. (In Report of G–4, G. H. Q.). The policy was to create "General Storage depots" under one commanding officer, where each service would have an allotted section. It was planned to have one General Storage Depot in each Base Section to care for the necessary base storage and to free the local storage immediately at ports. It created two large intermediate storage depots, one to hold supplies from Base Section No. 1 &c, and the other Base Section No. 3. Two large advance storage depots were built, Is-sur-Tille and Liffol-le-Grand.

In other words the frame work of our storage was as follows:

B. S. No. 1	Montoir.
B. S. No. 7	Aigrefeuille.
B. S. No. 2	St. Sulpice.
B. S. No. 6	Gièvres.
	Montierchaume.
Advance	Is-sur-Tille.
	Liffol-le-Grand.

[4] Prepared by Colonel J. W. Wright, General Staff, G–4, S. O. S.

CHAPTER V.

SECTION I.[1]

GENERAL HEADQUARTERS (BRITISH).

The British General Headquarters was organized into three major subdivisions: the General Staff (G. S.), the Quartermaster General's Branch ("Q"), and the Adjutant General's Branch ("A"). Each of the three had direct access to the C. in C. (Chart 1, Chapter V, Vol. I.)

Under the General Staff Branch were various sections, one charged with operations, the order of battle, concentration of troops, distribution and movement of troops, etc. (O); one charged with Staff duties, which also was responsible for censorship and publicity, machine guns, anti-aircraft and training; ("S. D.") and a third with Intelligence, which was also charged with the provision, distribution and revision of maps ("I"). Directly under the General Staff operated the Director of Signals. (Chart 1a, Chapter V, Vol. I.)

The Quartermaster General's Branch was, in general, charged with the movement of supplies and means of transport both of men and materials from their arrival and with the storage of supplies of all sorts and quartering of troops. Its specific duties will be treated more in detail in the chapters following.

The third subdivision of the British G.H.Q. was the "A" Branch, which was charged with all matters relating to personnel, its supply, its discipline, its legal administration, the records of officers and men, rewards, its mobilization, its spiritual welfare, graves registration, etc. This branch functioned through various subdivisions, one concerned with personnel services, law, discipline, morale and prisoners of war (P.S.) and one with labor and welfare organization ("M") all of these functioned under one Deputy, while under another Deputy and in the 3rd echelon at the bases was a subdivision charged with records, personal services, pay, promotions, discharges, releases, etc. (Chart 1b., Chapter V, Vol. I.)

Having control of personnel, the Provost Marshal and Traffic Control problems were handled in the "A" Branch. The Judge Advocate General and Chaplains' Department were also under this branch. Differing from the other Allied armies, the Director of

[1] Prepared for the M. B. A. S. by Colonel Harry L. Hodges, Gen. Staff, U. S. Army, Chief of Staff American Section, revised and corrected by Major G. E. Pitt, Deputy Assistant Quartermaster General.

Medical Services operated here also, but in close cooperation with the Quartermaster General's Branch which transported medical supplies to the troops and evacuated the wounded.

Attached to all headquarters were representatives of the Administrative Services or Departments—the Directorates—either the Director, a Deputy Director or an Assistant Director was with each echelon of G. H. Q. The appointment of each had to receive the Q. M. G.'s sanction. These Directorates were concerned at G. H. Q. with the provision of stores and supplies and, in the armies with their care and distribution, subject to the policies established by the "G. S.," Quartermaster General or Adjutant General branches of the G. H. Q. Routine matters and technical matters were taken up directly by the service representatives with their directors, but questions of strategy and tactics, i. e. operations, were referred to the staff (G. S.) of each formation.

There was also a technical staff such as the senior artillery, engineer, signal officers and the other combatant arms of the services who were found at each of the headquarters. They were attached to the Staff in order to provide efficient advice in matters which could not be expected to be within the ordinary knowledge of the staff officers. These officers were at headquarters as technical advisers, and were also the medium through which technical instructions were transmitted to the technical units. They received at first hand the instructions of the Commander and then put them into the required technical form.

Duties of the Principal Chaplain.—Was responsible for the spiritual administration and welfare of the Army.

Duties of the Deputy Judge Advocate General.—Was the representative of the Judge Advocate General and advised the Commander on matters of military, martial and international law.

CHAPTER V.

SECTION II.

GENERAL HEADQUARTERS (FRENCH).

(Chart 4, Chapter V, Vol. I.)

At the beginning of the war, the organization of the French General Headquarters was that of a general headquarters for offensive operations and able to move rapidly and frequently.

It comprised:

1. The Commander in Chief and his personal staff.
2. A Chief of Staff.
3. A *General Staff* composed of:
   - Two Assistant Chiefs of Staff.
   - First Section (1er Bureau)—Personnel and matériel.
   - Second Section (2e Bureau)—Intelligence and political affairs.
   - Third Section (3e Bureau)—Operations and movements; telegraph (signal) service of the first line.
   - Direction of the Air Service.
   - "Chancery" office and for the transmission of orders (message center).
   - Headquarters command of the G. H. Q.
4. A *Direction of the Rear* composed of:
   - A Major General (Général de Division), Director of the Rear.
   - A Brigadier General, Chief of Staff.
   - Staff and Section of the lines of communication (Etapes).
   - Direction of the motor transport services.
   - Telegraph (signal) services of the second line.
   - Intelligence service.
   - Railroad section (Bureau).
   - Navigable waterways commission (navigation de campagne).
5. The G. H. Q. services for the interior operation of the General Headquarters and which consisted of the following:
   - The Intendance (Supply) service.
   - The Medical service.
   - The Finance and Postal service (Trésorerie et Postes).
   - The Telegraph (signal) service.
   - The Motor Transport Service.
   - The Headquarters train (détachement du train).

A total of 92 officers, 580 men, 162 horses and 95 automobiles. The railroad section and the navigable waterways commission personnel

are not included in these figures and there should also be added the headquarters troops which consisted of the following:

One company of cyclists (chasseurs cyclistes).

One company of forestry guards (chasseurs forestiers).

One squadron of cavalry and a number of "gendarmes."

A total of 22 officers, 1,056 men and 195 horses additional.

The first modification in the organization of the General Headquarters took place in November 1914, when the "General Director of the Rear" was suppressed. He was replaced, first, by a colonel, Chief of Staff of the Direction of the Rear, and later by an Assistant Chief of Staff in charge of the Direction of the Rear. The "Direction of the Rear" (D. A.) remained unchanged, but its officer personnel increased in proportion with the growing importance of the supply question and on account of the development assumed by certain supply services (roads, water supply, remounts, motor transport, etc.) so that, in November 1917, it had more than 100 officers assigned to it.

During 1918, General Headquarters, after undergoing a few minor changes, was composed as follows:

The Commander in chief and his personal staff (cabinet).

A Major General, Chief of Staff.

Five Assistant Chiefs of Staff.

The functions of these Assistant Chiefs of Staff were:

1. The Assistant Chief of Staff for organization and matériel, in charge of:
   - *a*) Personnel (transfers, decorations, etc.)
   - *b*) The First Section (1er Bureau)—organization of units in personnel and matériel.
   - *c*) Headquarters command, G. H. Q. guard, police and discipline.
   - *d*) Courier service.
2. The Assistant Chief of Staff for operations, in charge of:
   - *a*) The Second Section (2e Bureau)—Map making, information concerning Allied and hostile armies.
   - *b*) The Third Section (3e Bureau)—Operations, training, anti-aircraft defense.
   - *c*) Telegraph (signal) services of the first line.
   - *d*) Liaisons of all kinds, including by carrier pigeons.
   - *e*) Code.
   - *f*) Relations with Allied officers.
3. The Assistant Chief of Staff for aviation, who handled all questions concerning the employment, organization and matériel of the Air service. He treated these questions after agreement with the

Assistant Chief of Staff in charge of operations and the Assistant Chief of Staff in charge of organization and matériel.

4. The Assistant Chief of Staff for the direction of the rear and transportation, in charge of:

a) The Direction of the rear (Direction de l'arrière).
b) The Direction of the Motor Transport service.
c) The Field Railway (60 centimeter) Direction.
d) The telegraph (signal) services of the second line.
e) The Postal service.
f) The Intendance (supply) service.
g) The Roads service.
h) The Inland Waterways service.
i) The Forestry service.
j) The Direction of Transportation.

5. The Assistant Chief of Staff for the Medical Service (Service de Santé).

There was also at General Headquarters: a special service in charge of the relations with the civil authorities, a military secret service, a postal control (censorship) service and a service for the circulation of propaganda in leaflet form.

All questions relating to the Intelligence service and to the press were handled by the staff of the Commander in Chief.

In addition to the above, a certain number of Inspectors-General and Inspectors of Services, were attached to the General Headquarters. These were:

a) The Inspector General of the Artillery, charged with technical questions concerning his branch of the service (matériel, munitions, inspection of munitions, gas service.)

b) The Inspector General of the Engineers, in charge of technical questions interesting his branch of the service.

c) The Inspector General of the Services, charged with the inspection of the "Directions of the lines of communication" (Directions d'Etapes) and of the special organizations created for the welfare of the troops (leave camps), railway station canteens (foyer du soldat), sales commissaries (coopératives).

d) The Inspector of the Veterinary service.

e) The Inspector of the Remount service.

A new modification was brought about in the organization of the General Headquarters in October 1918, with the creation of the General Direction of Communications and Supplies (Direction Générale des communications et des ravitaillements—D. G. C. R. A.) in the staff of the Marshal, Commander in Chief of the Allied Armies. (Chart 6, Chapter VII, Volume I).

A "Note" dated October 15, 1918, from the Commander in Chief of the French Armies, placed the Direction of the Rear under the orders of the Assistant Chief of Staff for organization and matériel.

The Direction of Railroads (Direction des Chemins de fer) was withdrawn from the Commander in Chief of the Army and attached to the staff of Marshal Foch, under the orders of the Director General of Communications and Supplies to the Armies. (D. G. C. R. A.) Chart 7, Chapter XV, Volume I.)

CHAPTER V.

SECTION III.

ORGANIZATION OF G. H. Q. OF THE BELGIAN ARMY.[1]

(Chart 2, Chapter V, Vol. I.)

In peace time there existed in the Belgian Army an organization called: The Staff of the Army (Etat-Major de l'Armée) composed as follows:

A Lieutenant General, Chief of Staff of the Army;

A Major General, Deputy Chief of Staff of the Army;

Four superior officers, Chiefs of the Staff Sections;

Sixteen captains, belonging to or temporarily assigned to the Staff, assistants to the Chiefs of the Sections;

Subaltern officers detailed to the Staff and varying in number according to circumstances;

Enlisted personnel.

The peace time functions of the Staff of the Army are indicated below:

I. Chief of Staff of the Army.

1. He was responsible for the organization and preparation of the Army and fortresses for war.

He was Chief of the Staff Corps.

He was a member of the Superior Council of National Defense and of the Council of the Minister of War.

Upon instructions from the Minister and whenever the Chief of Staff, himself, deemed it necessary, he inspected the mobilization centers, the artillery parks, and the various parks and depots of matériel in the fortified places, in order to personally determine whether the measures undertaken by authorities in charge had been carried out in accordance with the general mobilization plan for the Army and the fortresses.

He studied the recommendations submitted by the various authorities for the improvement of the mobilization and concentration plans of the Army. He supervised and directed the work of the Staff and of the Headquarters. He assured himself that the officers of the Staff Corps were conversant with their duties and that they were properly qualified for Staff duty. The Staff's functions are defined as follows:

[1] Prepared for the M. B. A. S. by G. H. Q. Belgian Army. (Chart 2, Chapter V. Vol. I.)

A. *Employment of the Army and the Fortresses.*

A study of the probable operations of the Army and the use to be made of the fortified places under different circumstances.

B. *The Organization of the Army upon both a War and a Peace footing.*

Study and preservation of documents relating to the military history of Belgium and of the Belgian Army.

Preparation of tables of organizations (men, animals, wagons and automobiles) for the units and services of the Army as well as for the fortified positions. Information concerning foreign armies and fortresses.

C. *Mobilization of the Army and the Fortresses.*

Preparation of plans for mobilization.

Study of transportation to the mobilization centers of peace time garrison troops, men reporting at the depots in response to the mobilization call, and of mounted services organized throughout the country.

D. *Matériel and Supplies.*

Determination of ways and means for the purchase of supplies (artillery matériel, small arms, wagons, automobiles, powder, harness, balloon and aviation matériel, tools) for the field army and for the fortified positions.

Determination of methods for the procurement of supplies of matériel and food stuffs.

Periodical reports on the supply situation.

Determination of money, matériel, and munitions to be allotted to the Corps and Services for technical and tactical training and for mobilization tests.

E. *Military Training.*

War College (Ecole de Guerre). Study of the rules, regulations and general policies of the War College, as well as the selection of its staff of instructors.

Military School (Ecole Militaire). General training programs.

Schools for the training and improvement of the Infantry, Cavalry and Artillery. General programs for technical and tactical, as well as practical and experimental, work.

F. *Regulations.*

Revision of the general regulations for the Field Service, the Service of the Rear, the Medical Service, Veterinary Service, the Staff Services, the Supply Service and the Legal Department of the Army.

Regulations for the drills, maneuvers and target practice of the different arms.

Determination of the fundamental principles governing combat, its principal exigencies and general phases, the tactical employment of the different arms, the method of employment of each, means of insuring liaison between them and G. H. Q.

The coordination and study of all regulations applicable in war-time to the interior administration of hospitals, supply depots etc.

G. *Practical Exercises.*

Determination of and plans for target practice by the different arms and maneuvers by the large units. Practice marches and transports of troops. Summoning of reservists to the colors for periodical participation in maneuvers and target practice.

Instructions for maneuvers by the combined arms. Documents relative to maneuvers.

3. *The Chief of Staff of the Army* submitted recommendations, upon all matters that came under his jurisdiction, for approval by the Minister of War.

At the mobilization of the Army, the Staff of the Army constituted the General Headquarters and formed, in fact, the Staff of the Commander in Chief, H. M. the King. It was through the Staff that all orders and instructions were transmitted to the Commandants of units and services of the army in the field and in the fortresses.

At the end of the war, the Staff was constituted as follows:

A Lieutenant General, Chief of the General Staff, who had under his immediate command: Two Major Generals, Deputy Chiefs of the General Staff; a General, Commander of the Artillery of the Army; a General, Commander of the Engineers of the Army; a Surgeon, Chief of the Medical Service of the Field Army.

The two Deputy Chiefs of the General Staff divided the work of the General Staff among themselves and the Chiefs of the Staff Sections and Chiefs of Services were under their orders.

One Deputy Chief of the General Staff directed the 1st Section A, 1st Section B, 2nd Section and the Historical Section, Aviation Service, Balloon Service, Military Telegraph Service and the Wireless Telegraph Service.

The other Deputy Chief of the General Staff directed the 3rd Section, the 4th Section, the Railroad Services, the Services of the Rear, and the Provost Marshal Services.

Briefly:

The 1st Section A, was concerned with the preparation of orders and instructions concerning the employment of divisions at the front and in reserve, as well as the preparation of orders carrying out the war policies enunciated by the High Command of the Army.

The 1st Section B, was concerned with all questions relating to the training of the Army, (schools, training centers, etc.).

The 2nd Section: Intelligence, the study and utilization of information. Rights of the civil populace. Relations with the Allied Armies, press, censorship, reports and contra-espionage.

The Historical Section compiled reports and data on the campaign, collected notes, plans, maps, etc., and prepared a detailed history of the campaign.

The 3rd Section handled all questions relating to the organization of units and to the higher organization of the Army, the study of tables of organization, commissioned and enlisted personnel, Remount Service, matériel and equipment of all branches except the Artillery, motor and animal-drawn transportation, food and clothing.

Relations with the following Chiefs: Supply Service (Inspecteur Général du Service de l'Intendance), Veterinary Service (Vétérinaire en Chef), and Department of Military Justice (Auditeur Militaire Général) etc.

The 4th Section was charged with the Service of the Rear, insuring communications between the Army and the base, directing and coordinating the services and establishments responsible for the supply of the Army.

Railroad Service; Inland Water Transport Service (by canals); "Service des Etapes" (L. of C. Service); Establishments and Services of the Base, Railway Parks, the Evacuation Hospital of the Army; The Veterinary Evacuation Hospital.

The General Commanding the Artillery of the Army.

1. He was the Chief of Artillery at G. H. Q. He was under the direct orders of the Chief of Staff and was the technical advisor of the latter in all Artillery matters. During the war, he was a member of the Army Commission (Commission d'Armée).

2. The heavy artillery of the Army and artillery not assigned to divisions, were under his direct orders. He exercised the prerogatives of a division commander over these troops.

The Commander of the Artillery of the Army exercised administrative and technical control over artillery units including the detachments of heavy artillery, even when the latter were temporarily attached to large units of the Army, in the same manner that division commanders exercised their authority over detachments temporarily separated from their commands and attached to other large units for tactical purposes.

3. The Chief of the General Staff delegated the Commander of the Artillery of the Army as the technical inspector of all Artillery units and services of the Field Army. In the course of his inspections, he observed the technical efficiency, as well as the tactical use, of the

artillery under combat conditions. He reported to the Chief of Staff on these points and made such recommendations as he deemed necessary.

4. The Commander of Artillery of the Army exercised command over the Artillery units designated to constitute the Army Artillery, as well as over Artillery units detailed to take part in a particular operation. In the latter case, he became the Artillery Commander for the General in command during the operation. He could ask, at any time, that the Commander of the Heavy Artillery Brigade of the Army take over temporary command of the Army Artillery for short periods of time.

5. In his capacity as technical advisor to the Chief of the General Staff, he made all recommendations as to the technique of the Artillery arm. He was generally charged with the preparation of all studies conerning the part which the Army Artillery was to fulfill in the operations.

6. He made recommendations to the Chief of Staff concerning the supply of Artillery ammunition in the Zone of the Army and concerning the establishment of divisional munition depots in this zone. Through orders from the Chief of Staff, he informed the division commanders of the decisions made on these points and saw to it that these were carried out.

7. He kept the Chief of Staff advised as to the situation of the Artillery material, and made all necessary recommendations for its upkeep, conservation and replacement.

8. He determined the methods to be used by the Artillery for indirect firing (flash and sound).

9. He directed ranging stations of the Artillery anti-aircraft defense.

10. He was charged with the study of questions concerning the technical use of Artillery, as well as those concerning artillery matériel and munitions.

He obtained information as to Artillery progress in foreign armies, carried out such practical experiments as he deemed necessary, prepared notes, orders and technical regulations and submitted the latter to the Chief of the General Staff.

The General Commanding the Engineer Troops of the Army.

1. He was under the direct orders of the Chief of the General Staff and was the technical advisor of the latter in engineering matters (excepting telegraph (Signal) troops, ballooning, aviation and the Railway Battalion). During the war he was a member of the Army Commission.

2. He had technical, but not administrative, authority over the battalion of Pioneers, the Searchlight Company, the animal and

motor-drawn bridge material and the Engineer troops who tested the water supply. He exercised technical control over detachments of Army Engineer troops temporarily attached to large units, in the same manner that division commanders retained control over small detachments of their divisions temporarily attached to other divisions or large units.

3. He was permanently designated by the Chief of Staff as technical inspector of all engineering works and Engineer troops and services, (except the telegraph (Signal) troops, ballooning, aviation and the battalion of Railway Engineers).

During these inspections he noted the methods employed in the execution of engineering works, and reported his observations to the Chief of Staff.

He gathered information concerning Engineer progress in foreign armies, made such practical experiments as he deemed necessary, and prepared notes and instructions for submission to the Chief of Staff.

4. The role of the Chief of Engineers, in attack and defense works of all echelons, was regulated as follows:

The plan of attack and defense was always determined by the headquarters which specified, on the ground, the general position of the organization, the location of guns, etc., and the part which the latter were to play. Based upon this information the Chief of Engineers determined the exact location of the engineering works. He supplied the headquarters with the necessary technical information for the execution of the work, and divided the troops detailed for such construction work into reliefs; he also indicated what quantities of engineer material and tools would be required for the purpose.

Pursuant to this, the Commander of the Engineers of the Army informed the Chief of Staff of the apportionment of work between the large Army units and such Engineer troops as were assigned to the Army, although the latter were not normally attached to Army units.

He also informed the Chief of Staff as to which of the Engineer troops belonging to a large unit or division, he desired for the execution of special engineer work devolving upon him.

5. The Chief of Staff could delegate him to construct certain works which were of interest to the entire Army (organization of positions, construction of shelters, communications, roads, arrangements for inundations, drainage, construction of ditches and canals, etc.). For these purposes the Chief of Engineers used the personnel and material of the Engineer and Bridges and Highways services of the Army. Additional personnel for the work was furnished by

the Army Engineers, the auxiliary Engineer troops and, if necessary, by troops from the Army Divisions.

The Commander of Engineers had charge of the "Technical Direction of the Water Supply Service" (Direction Technique du Service des Eaux—D. T. S. E.) which supplied drinking water to the Army.

6. He was charged with the supply of Engineer material and tools. He kept himself informed as to the requirements of the different organizations and took the necessary measures to satisfy them.

He compared the stocks of supplies in the different depots, and arranged for equalizing them; this comparison enabled him to coordinate requests and to supply the army divisions to the best advantage.

He verified the inventories of the officers in charge of the Engineer depots.

The Chief of the Medical Service of the Field Army.

1. He was under the direct orders of the Chief of the General Staff and was his technical advisor. From this point of view, he took the place of the "Inspector General of the Medical Service" (Inspecteur Général du Service de Santé—I. G. S. S.).

He corresponded with the I. G. S. S., through the Chief of Staff concerning technical matters or matters pertaining to military medical personnel.

All technical correspondence between the Divisional Surgeons and the I. G. S. S. passed through the Chief of the Medical Service of the Field Army for his consideration.

2. He was delegated by the Chief of Staff and by the I. G. S. S. to exercise permanent technical and administrative (except concerning financial matters) control over all the medical organizations and services of the Field Army.

His correspondence with the divisional surgeons passed through the division commanders.

His technical inspections covered the hygiene and sanitary condition of cantonments, messes, clothing, quarters and sleeping arrangements of the troops.

He had to be prepared, at all times, to advise the Chief of Staff as to the sanitary situation in the Field Army. He issued the necessary orders on this subject and was kept informed as to the situation by the divisional surgeons.

3. He assured himself that the Army Regulations for the medical service in the field were being followed and gave the necessary orders on the subject.

He acted on his own initiative in urgent cases and reported action taken.

He controlled the assignment of the medical officers, medical administrative officers and of the officer personnel for the pharmacies.

He kept a " Field Journal " in which he recorded, day by day, important medical events and noted action taken, together with the reasons therefor.

He received, through the Chief of Staff, the orders issued by division commanders concerning medical officers and personnel, he added his remarks thereon, as well as notations concerning any disciplinary action taken and forwarded them to the I. G. S. S.

He reported the sanitary condition of the army in the field, as well as any technical information of interest, to the I. G. S. S. every fifteen days, or oftener if necessary. He also forwarded all returns and reports for the information of the Statistical Section of the Army.

4. When active military operations seemed imminent, he issued orders to the divisional surgeons to evacuate the patients from their hospitals and to make the necessary preparations for receiving new casualties. He informed the I. G. S. S. and the Chief of Staff concerning the measures taken in this respect.

5. He was a member of the Technical Commission of the Medical Service.

6. He had two assistants.

CHAPTER V.

SECTION IV.

ORGANIZATION OF THE "SUPREME COMMAND" (COMANDO SUPREMO). (ITALIAN.)

The Supreme Command (Comando Supremo) was charged with the entire conduct of operations and its authority extended over all the territory declared to be in a state of war.

It was essentially an organ of command and operated through the headquarters or commands of the large units (Armies, Army Corps, Divisions). The supply of the Army as a whole was provided by the Intendenza Generale (Q. M.) which, under the authority of the Supreme Command, directed the activities of the various services of the Army.

Subordinate to the Chief of the General Staff was the Assistant Chief of Staff, who controlled the General Commands of the Cavalry, Artillery and Engineers, the Superior Commands of the Corps of Royal Carbineers and of the Air Service, the General Section (Secretariat) for Civilian Affairs and the Office of the General Assistant (Addetto).[1]

The latter, through the Secretarial Office, directed the work of the various sections of the Supreme Command (operations, organization, mobilization, general and technical matters, intelligence, officer personnel, printing and propaganda, naval affairs, allied missions to foreign countries and military justice). An additional section, alongside the Secretarial Office, was charged with the training of the troops.

The composition of the Supreme Command is shown in Chart 5, Chapter V, Volume I.

The General Commands were the consulting and, eventually, the inspecting organs of the Supreme Command, insofar as the employment of the different branches of the Army was concerned. They were at the disposal of the Chief of the General Staff as technical advisors for their respective services and corresponded directly, in technical matters, with the commanders of the various

[1] Corresponded, practically, to the "Secretary of the General Staff" of the U. S. War Department.

branches at Army headquarters. Subsequently, they commanded the sections at the disposal of the Supreme Command.

These General Commands, in agreement with the Personnel Section, were also responsible for the assignment, etc., of the officer personnel of the various branches.

The Superior Command of the Aviation performed the following duties:

Acted as technical advisor of the Supreme Command in all matters concerning Aviation.

Had technical control over the employment and distribution of the Aviation with the mobilized Army in the zone of the Supreme Command and coordinated all matters, including supply, pertaining to this branch of the service.

Directed the anti-aircraft defences in the zone of operations, controlled the technical employment and distribution and coordinated aviation resources in that zone.

Directed the photographic and aerological services of the Aviation.

Had direct command over all Aviation and anti-aircraft defense resources belonging to the Supreme Command.

Controlled the promotion and assignment of the Aviation and anti-aircraft defense personnel.

Acted as the representative of the Supreme Command at the General Aviation Commissariat, in connection with the preparation of plans for the formation of new units, the supplying of matériel, recruiting, training, as well as increase in personnel, for the Aviation services.

The Superior Command of the Corps of Royal Carbineers was charged with advisory functions and inspections in connection with the employment of the troops belonging to the Corps of Royal Carbineers. It coordinated the employment of Royal Carbineer troops and territorial units in the "War zone" (Zona di Guerra). It also distributed passes and safe-conducts to and from, as well as within, that zone.

The General Secretarial Section for Civilian Affairs, as delegate of the Supreme Command, exercised political and administrative powers throughout the war zone.

This Section controlled and supervised the civil administration in the occupied territories by means of Civil Commissioners; guarded private property and works of art in the war zone; recruited labor for employment in the war zone; provided insurance against accidents; supplied the civilian population and supervised cultivation. It was also responsible for keeping records of all civilians in the war zone and controlled the evacuation of civilians from areas threatened by the enemy.

The principal duties of the various Sections of the Supreme Command were:

Secretarial Section: Received and coordinated the documents which were to be submitted to the Chief and Assistant Chief of Staff for examination and transmitted the decisions of the latter to the authorities concerned.

Operations Section: Planned and organized operations and movements of the large units and sections. Formulated defensive plans. Prepared situation reports on the war and kept a record of all communications, bulletins and data issued by the enemy. Obtained all available information concerning foreign exchequers and maintained relations with the Italian military missions abroad.

Intelligence Section: Charged with collecting information concerning the military, economic and political situation of foreign countries. Responsible for the military police, morale of the troops, mail censorship, counter-propaganda and coordination of Italian propaganda activities, counter-espionage and border control; employment of disabled war veterans. The foregoing was effected in liaison with the Intelligence services of the Allied Armies.

Officer Personnel Section: Dealt with all matters pertaining to the officer personnel, including promotions, assignments, transfers, organization (inquadramento) of new units; issued general bulletins and special instructions; compiled lists of officers, efficiency reports, intelligence reports. It was also responsible for the detail of officers to the Supreme Command and for the recruiting and employment of officer personnel.

Printing and Propaganda Section: Printing, war correspondence, communications, censorship of the press and of war photographs. Propaganda at home and abroad. Issued various publications. Had charge of photographic, cinematographic and artistic services. Furnished escorts for non-military missions.

Naval Section: Promoted cooperation between the Supreme Command and the Chief of Staff of the Navy and between the Intelligence Departments of the Army and Navy.

Section for Allied Military Missions: Promoted cooperation between the Allied Missions and the officers and headquarters of the Army. Provided escorts for special military missions.

Military Justice Section: The establishment or abolition of military courts or tribunals. Designation of officers to act on the military courts. Supervision of military tribunals. Determination of policies concerning the application of military laws and jurisdiction of military courts, etc. Examination of requests for clemency in sentences of capital punishment, as well as of serious charges preferred against officer personnel.

Section for General Affairs: Treated all matters of a general character. Training of units (quadri) and troops. General measures for supply. Investigation of the discipline of the troops. Courts martial. Rewards and decorations. Typographical, photographic and cartographic (map making) services. It also controlled channels of correspondence between the subordinate sections and the Auditing Service at the Supreme Command.

The following sections or offices were particularly important in matters pertaining to supply:

The Organization and Mobilization Section: Charged with the supply of men, animals and means of transportation, whether animal-drawn or motor transport. The organization of new units and replacements.

For purposes of supply, the Intendenza Generale received the necessary estimates of requirements and, in accordance with this information, supplied the materials, etc., (except armament and munitions), to the units concerned through the services of the Army Intendenze (Army supply services). Armament and munitions were supplied by the office specially created for that purpose, in agreement with the Technical Office.

The Technical Office was particularly charged with the study and preparation of plans for the manufacture of artillery, mortars, trench weapons and ammunition. It investigated new patents, inventions, etc. It directed the chemical warfare service (gas and flame-projectors), and the carrier pigeon and telephotography services.

A General Headquarters (Quartier Generale) also formed part of the Supreme Command. It was charged with:

Coordinating the sections of the Supreme Command. Billeting the personnel. Administration and discipline of troop personnel and various services.

CHAPTER V.

SECTION V—PART I.

GENERAL HEADQUARTERS (AMERICAN).

The General Staff of the General Headquarters of the American Expeditionary Forces was divided into five main divisions, as shown in Chart 3, Chapter V, Vol. I.

In addition to these general staff sections there was a bureau known as the Adjutant General's Department, which in large part handled questions of personnel, subject to general policies prescribed by the Personnel Section of the General Staff. The Office of the Adjutant General was the office of record, all correspondence being received there and distributed. All administrative orders were issued over the signature of the Adjutant General, who was charged with the distribution and printing as well as with all other printing. The Central Records Office, in which track was kept of every enlisted man in service overseas operated under its supervision. The Operations Division of the General Staff issued and recorded all orders concerning operations. Each chief of General Staff Section sent out instructions in the name of the C. in C., but as a general rule these were recorded by the A. G. O.

There was also at G. H. Q., a technical staff consisting of the Chief of Artillery, the Chief of the Tank Corps, The Judge Advocate General, The Inspector General, and the Chief of the Aviation Service, whose duties were to act in an advisory capacity to the Commander-in-Chief and to the Chiefs of the General Staff Sections. Other technical advisors, operating in large measure under the direction of G–4, were also stationed at General Headquarters. These comprised a deputy from each of the following chiefs:

The Chief of Engineers,
The Chief of Motor Transport,
The Chief of Ordnance,
The Chief Surgeon,
The Chief Quartermaster,
The Chief Signal Officer and
The Director General of Transportation.

All of the chiefs of the supply services were originally at G. H. Q., which exercised War Department functions as well as those normally belonging to General Headquarters of Field Forces, but[1]

[1] From the "Final Report of General John J. Pershing, Commander in Chief, American Expeditionary Forces."

"as the American Expeditionary Forces grew, it was considered advisable that, in matters of procurement, transportation and supply, the chiefs of the several supply services, who had hitherto been under the General Staff at my headquarters, should be placed directly under the supervision of the Commanding General, Services of Supply. At General Headquarters, a Deputy Chief of Staff to assist the Chief of Staff was provided, and the heads of the five General Staff sections became Assistant Chiefs of Staff. The General Staff at my headquarters thereafter concerned itself with the broader phase of control. Under my general supervision and pursuant to clearly determined policies, the Assistant Chiefs of Staff, coordinated by the Chief of Staff, issued instructions and gave general direction to the great combat units and to the Services of Supply, keeping always in close touch with the manner and promptness of their fulfillment. Thus a system of direct responsibility was put into operation which contemplated secrecy in preparation, prompt decision in emergency, and coordinate action in execution." It will thus be seen that these Chiefs of Service, who were essentially engaged in War Department duties were assigned to the S. O. S., instead of being stationed at G. H. Q. The organization of the S. O. S. will be treated in another chapter.

The duties of the General Headquarters of the American Forces at first included many of the functions which belonged to Army Staffs; this of course was a necessity during the period of the formation of our corps and larger units for even then our troops were operating in smaller units with the French and English.

For this reason, even before the organization of our armies, the supply of these detached units had to be coordinated and army supply organizations were put into effect by G–4. As our larger units were organized many of the corps and army functions passed to the army commanders and G. H. Q. was thereby relieved of this necessary, but extraneous labor.

The organization of the American G. H. Q. was, therefore, a progressive one, brought about by special conditions; first, the necessity for exercising War Department functions, and second, the necessity for exercising the functions of armies and smaller units. In a completely organized army its duties could have been very materially reduced.

The organization of the General Staff Sections was followed in the smaller units, in the divisions and corps the duties of G–1 and G–4 being combined into one section known as that of G–1.

The duties of the various "G's" are shown in G. O. 31, G. H. Q., A. E. F., February 16, 1918, an extract of which follows.

SECTION V—PART 2.

GENERAL STAFF

(Direction)

Chief of Staff

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Deputy Chief of Staff

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The Deputy Chief of Staff will assist the Chief of Staff and act as such during his absence.

Secretary General Staff

Office of temporary record for the Chief of Staff and his deputy.
Forwards to destination in Headquarters all papers emanating from or returning from consideration by the General Staff.
Is responsible for prompt action on papers referred to the General Staff and runs a call-list and follow-up system for them.
Supervises historical sub-section, which collects data as to our official history of the war, and keeps a War Diary.
Maintains active liaison with the A. G.

GENERAL STAFF

Assistant Chief of Staff

First Section (G. 1)

Supervises: Ocean tonnage and requisitions on War Department.
Priority of overseas shipments (Troop shipments in consultation with G. 3).
Disposal of captured men and material.
Replacements of losses in men and animals.
Organization and equipment of troops (in consultation with G. 3).
Ratio of combat troops to S. O. S. troops.
Billets and billeting.
Provost Marshal Service.
Red Cross, Y. M. C. A., War Risk Bureau, Auditors and other similar agencies.
Remount service.
Prepares: Strength reports and graphics.
Order of battle.

GENERAL STAFF

Assistant Chief of Staff

Second Section (G. 2)

(*a*) INFORMATION.

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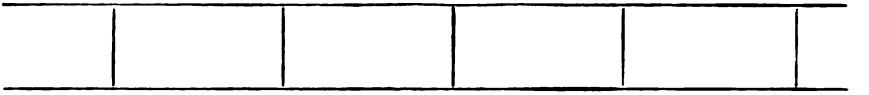
1. Enemy's order of battle; enemy's organization.
Preparation of diagrams and statements showing distribution of enemy's forces.
War trade and enemy's economic resources.

2. German recruiting and classes; man power.
   Examination of prisoners and documents.
   Information on German armament and equipment.
   Translations.



3. Situation maps, except special maps made by G.3. Information of theatre of war behind enemy's front.
   German lines of defense.
   Strategical movements of enemy and plans.
   Air reconnaissances and photographs.
4. Preparation and issue of periodical summary. Information concerning railroads, roads, bridges, canals and rivers.
   Road and bridge maps and area books. Summary of foreign communiques and wireless press.
5. Collation of information regarding enemy's artillery.
   Preparation of daily and weekly summaries of enemy's artillery activity.
   Preparation of periodical diagrams showing enemy's artillery grouping.
6. Enemy's wireless and ciphers.
   Enemy's signal communications.
   Policy regarding preparation and issue of ciphers and trench codes.
   Listening sets.
   Policy as regards carrier pigeons.
   Training of listening set of interpreters.
7. Dissemination of information.
   Custody and issue of intelligence publications. Information of theatre of war (except portion immediately in rear of enemy's front).
   Intelligence diary.

(*b*) SECRET SERVICE.

1. Secret service in tactical zone and co-ordination with War Department and with French, English and Belgian systems.
   Atrocities and breaches of international law.
   Counter-espionage; direction and policy.
   Secret service personnel.
2. Dissemination of intelligence from secret service sources.
   Ciphers, selection and changing of.
   Examining of enemy's ciphers.
   Intelligence and secret service accounts.
3. Counter-espionage; index of suspects; invisible inks and codes.
   Dissemination of information from English, French and Belgian counter-espionage systems.
   Control of civil population as affecting espionage and all correspondence with the missions on the subject.
   Censorship as affecting counter-espionage.
   Counter-espionage personnel.
   Regulations regarding passes in the Zone of the Armies.

(*c*) TOPOGRAPHY.

1 Preparation and issue of maps and charts; all lithograph and photography in connection with map reproduction.
Survey and topographical work.
Supervision of topographical work and topographical instruction of engineer troops.
Topographical organizations—Attached from engineers.
Experimental sound and flash ranging section—Liaison with engineer troops.

(*d*) CENSORSHIP.

1. Press correspondents.
Press censorship.
Examination of U. S., British, French and other foreign newspapers.
2. Compilations and revision of censorship regulations.
Issue of censor stamps.
Postal and telegraph censorship.
Breaches of postal and telegraphic censorship rules.
Control of censor personnel, under A. C. of S. (G–2).
3. Official photographs and moving pictures.
Military attaches.
Press matters.
Visitors.

(*e*) INTELLIGENCE CORPS.

1. Policy in regard to the establishment of the intelligence corps.
Record, appointments and production of intelligence corps officers.
Intelligence police.
Intelligence corps, motor cars.
Administration of intelligence corps.

GENERAL STAFF

Assistant Chief of Staff

Third Section (G. 3)

1. Strategic studies and plans.
Operation and combat plans.
Operation and instructions and orders.
Receipt and dispatch of messages, etc., relating to operations and combat.
Operation codes.
Supervision of the execution of operations and combats.
Security.
Reconnaissance.
Designation of lines of information.
Location and employment of strategical, combat and reconnoitering units of the air service.
Journal of operations.

2. Movements of troops.
   Location of camps, billets and training sites for combat and replacement troops.
   Location, composition and strength of our own and Allied combat units.
   Special daily situation maps of our own and Allied forces.
   Schedule of troop shipments from the United States.
3. Artillery concentrations.
   Movements of heavy guns.
   Artillery ammunition.
   Allotments of guns and ammunition.
4. Strategical and tactical liaison with Allied G. H. Q.'s through A. E. F. missions.
   Liaison between G. H. Q. and subordinate commands of the several armies.
   Inter-communication between all forces.
   Co-operation between the different arms.
   An officer of this sub-section will be assigned to each army under G. H. Q., who keeps in touch with the local operations, the conditions and raids and spends much time with the army to which attached. Officers of this sub-section under-study the chief of the sub-section.
5. General changes in organization and equipment.

GENERAL STAFF

Assistant Chief of Staff

Fourth Section (G. 4)

Supervises: Supply, construction and transportation in France including location of railway and supply establishments.

Analyzes: Statistics concerning the above.

Guarantees: Supply and transportation arrangements for combat.

Supervises: Hospitalization and evacuation of the sick and wounded.
All operations of the Services of Supply not assigned to other sections of the General Staff.

Makes Assignment: Of all new units arriving in France.
Of all labor and labor troops.

GENERAL STAFF

Assistant Chief of Staff

Fifth Section (G. 5)

General direction and enunciation of the doctrine of instruction and training throughout the command.

Supervision of centers of instruction and staff schools. Preparation of courses of training.

Coordination of school training and that imparted to troops.

Preparation of training manuals, with incorporation of changes suggested by actual experience.

Translation of training manuals and similar literature.

Methods of tactical inspections.

Training bulletins.

Sits with Third Section, General Staff, in matters affecting organization and equipment.
Inspection of schools and methods of instruction.
Inspection to insure efficiency and thoroughness in training throughout the command.

HEADQUARTERS COMMANDANT

Hq. Bn	Hq. Guard	Hq. Messes	Hq. Property and Transportation
Orderlies Messengers Mounts Details	Provost and other guards	Officers' Mess Clerks' Mess	Motor transporation Field transportation Hq. property Field equipment

ADMINISTRATIVE SERVICES

(Adjutant General Department)

Routine administration.
Records.
Administrative orders.
Commissioned personnel.
Enlisted Personnel.
Reserve Corps examinations and appointments.
Returns, muster rolls, strength reports and statistical reports.
Office supplies and blanks.
Printing.
Circulation permits and identification cards for individuals.
Returns of prisoners.
Prisoners' Inquiry Office.
Recruiting.
Correspondence.

(Inspector General Department)

Investigations of all classes and establishments, including efficiency, organizations, camps, quarters, interior economy, transportations, morals, messing.
Inspection of property.
Verification of money accounts.

(Judge Advocate Department)

General supervision of courts-martial.
Examination and tentative review of court-martial cases requiring action of commander.
Court-martial orders.
Supervision and administration of military law.
Submissions of legal opinions on request.
Regulations for military police in consultation with General Staff.

CHAPTER VI.

SECTION I.

SUPPLY DIVISIONS OF THE GENERAL HEADQUARTERS (BRITISH).[1]

(Chart 1, Chapter VII, Vol. I.)

In one organization of the British General Headquarters the "Q" Branch was charged, as has been stated, with the general coordination of supplies from the bases to the troops. It operated under two deputies, but there was one directorate which more than other directorates controlled by the Quartermaster General had direct access to him, the Director General of Transportation.

One of the aforementioned deputies established policies on movements by sea and railway, matters concerning mechanical transport, ordnance stores, salvage, signal and telephone equipment, trench stores, the coordination of administrative arrangements of British troops with other Allies, horse transport, artillery, machine gun and trench mortar material, and ammunition of all nature. The other deputy was concerned chiefly with matters relating to the base ports, installations, financial accommodations, food, forage, quartering, billeting, embarkation, engineer stores, forestry and labor. It will be seen that the duties of the first of the deputies referred to were largely, if not entirely, in the advance zone, while the duties of the other deputy were in the zones of the lines of communication.

As has been stated in the preceding chapter, there were attached to each of the branches of the G. H. Q. certain administrative directorates, the directors had direct access to the Quartermaster General and full control in technical matters, but they functioned in large measure through the deputies referred to above. (Chart 2, Chapt. VII, Vol. I.)

The directors who were controlled by the Quartermaster General in addition to the Director General of Transportation, were the Director of Works, the Director of Transport, the Director of Supplies, the Director of Remounts, the Director of Ordnance Services, the Director of Engineer Stores, the Director of Agricultural Pro-

[1] Prepared for the M. B. A. S. by Col. H. L. Hodges, G. S., U. S. Army; revised by Major G. E. Pitt, Chief Historical Officer, Office of the Quartermaster General to the Forces, British Army.

duction, the Director of Forestry, the Director of Veterinary Services, the Paymaster-in-Chief, the Controller of Salvage, the Controller of Labor, the Director of Army Postal Services, the Director of Hirings, Requisitions and Claims, and the Deputy Controller of Expeditionary Force Canteens.

Functioning under the Quartermaster General were the following inspectors: Inspector of Messing and Economies, Inspector of Horse Feeding and Economies, and the Inspector of Laundries. Working in connection with the Quartermaster General were the offices of the Chairman of the Imperial War Graves Commission, the Fire Expert, and War Trophies.

The Director General of Transportation, himself, controlled certain directorates which are indicative of the duties which were performed by this directorate of the Quartermaster General's Branch: The Director of Construction, the Director of Docks, the Director of Inland Water Transport, the Director of Light Railways, the Director of Railway Traffic, and the Director of Roads.

In brief the duties of these directorates were, as stated in the British "Field Service Regulations," the following:

"*Director of Works*—Provision, construction, and maintenance of buildings, offices, stores, camping grounds, roads, etc., on the lines of communication. Provision of water supply, gas, electric lighting, or other technical plant required for military purposes on the lines of communication, and not provided by other services.

"*Director of transport*—Provision and distribution of all transport, excluding railway and sea transport. Administration of transport personnel. If inland water transport is used on a large scale, a separate director for this service may be appointed.

"*Director of Supplies*—Provision of all food, forage, fuel, light, and disinfectants; administration of personnel engaged in this service.

"*Director of Remounts*—Provision, training, and distribution of all animals. Administration of remount personnel.

"*Director of Ordnance Services*—Provision of ammunition, equipment, clothing, and stores of all kinds other than medical or veterinary stores. Provision of technical vehicles of Artillery and Engineer units, and of workshops on lines of communication for repair of damaged material of all kinds. Administration of personnel engaged in these services.

"*Paymaster-in-Chief*—Is charged with the general supervision of the pay and cash accounting services. Supervises and controls the personnel and organization of all Paymasters' Offices, and sees that all moneys are properly accounted for.

"*Director of Army Postal Services*—Provision and administration of all postal communications. (The directions of the Postmaster General in matters of a technical postal nature are observed)."

The duties more in detail of the various directorates are covered in the chapters of this work devoted to each particular subject.

DUTIES OF ADMINISTRATIVE SERVICES AND DEPARTMENTS.[1]

"The Administrative Services and Departments are responsible for the provision of all material requirements of the forces in the field, their care, and care of their equipment. They are essential to the fighting force, since its efficiency depends upon the proper working of the administrative units.

"There are three departments—namely, the Law, Chaplain's and the Pay Department—the others all being referred to as "services".

"At the head of each service there is a Director, who has a number of assistants scattered through the various commands to look after the details affecting the particular service within that command. As has already been stated, the Directors are attached to the Staff of the Commander in Chief, Deputies being appointed to the other formations in each case. The Directors of Army Signals, Supply, Transportation, and Medical Services, are usually attached to General Headquarters, the remainder being attached to the Staff of the I. G. C. This was changed when the I. G. C. was abolished. The distribution is fixed by the Commander in Chief, who will fix the positions of the various offices of the Administrative Directors.

"The duties of the representatives on the smaller formations only differ in degree from those of the Directors attached to General Headquarters, whilst those attached to administrative commands on the lines of communication are similarly affected.

"Administrative Officers are responsible for advising their Commanders in all technical matters relating to their particular branches, and subject to the instructions they receive, they direct the operations of all units of that branch within that command. In matters of a distinctly technical and routine nature, they deal through their own departmental chiefs, but all questions affecting the tactical operations of the force to which they are attached must be submitted to the Commander of the formation or base. In this respect, the routine operation of their services or departments is not interfered with by the Commander, but where variations are necessary his instructions are paramount. The Commander of the forces purposely leaves the routine to the Administrative Services, and

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[1] From Chapter V, "Military Organization and Administration" by Major G. R. N. Collins, 4th Batt. Canadians, 1918.

will rarely interfere with their working, but his power to do so is undisputed.

"The various services deal through the Staff of a command, receiving their instructions through the branches with which their duties are allied, as has already been explained in discussing the Staff. In the absence of a representative of the Staff, the Commander of the units in the command is the responsible Officer for that particular service.

"Every Officer of the administrative services or departments is held responsible that all moneys, supplies, etc., handled through his command are properly applied. He must be certain that only authorized issues are made, and, where departures from regulations are ordered, he must get the required authority for issue. Where public moneys are to be handled, the limitations of expenditure will be fixed by the Director of the Service or Department, together with such regulations as may be necessary regarding quality, use, etc. Each Officer administering public money is personally responsible for all expenditure, and is liable for any mal-administration.

"The direction of the Staff over Administrative Services is only intended to govern the movements of their transport, their location, and orders as to possible and immediate requirements. Beyond this, the responsible Officers operate their own departments in accordance with the instructions received from the Director."

NOTE.—Supply duties in connection with a Cavalry Division are carried out under the direction of a Cavalry A. S. C., H. Q., which is commanded by a Lieut. Colonel assisted by an Adjutant and two A. S. C. Officers, one of whom looks after requisitions and the other distribution and supply.

CHAPTER VI.

SECTION II.

ORGANIZATION OF THE DIRECTION OF THE REAR (DIRECTION DE L'ARRIERE) OF THE FRENCH ARMY.[1]

I. Functions of the Direction of the Rear.

The Direction of the Rear (Direction de l'Arrière—D. A.) was the organ of the General Staff of the Army (Etat-Major Général) which, under the authority of the Commander in Chief, was charged with the regulation and coordination of all services for the purposes of:

1. Organizing the communications of the Army.
2. Organizing transports of all kinds on the Army transportation system (Réseau de l'Armée).
3. Assuring the supply and carrying out the evacuations of the Army.

The functions of the Direction of the Rear were somewhat modified by the creation, on October 15, 1918, of the "General Direction of Communications and Supplies of the Armies" (Direction Générale des Communications et des Ravitaillements aux Armées—D. G. C. R. A.) which was directly under the orders of the Marshal, Commander in Chief of the Allied Armies.

The Direction of the Rear, while remaining under the orders of the Commander in Chief of the French Armies was obliged, as regards the organization of the communications and transportation of the Army, to conform to the regulations prescribed by the Director General of Communications and Supplies concerning:

a) The general organization of the lines of communication with reference to movements of troops and supplies.

b) The creation of new installations of all kinds (regulating stations, supply depots, reserve depots, etc.) to handle the supplies at the disposal of the Army.

[1] Prepared for the M. B. A. S. by Commandant Poupinel, Chief of Staff, D. G. C. R. A., French Army, by direction of General Charles J. M. Payot.

II. Organization of the Direction of the Rear.

(Charts 5 and 6, Chapter VII, Volume I.)

The Direction of the Rear, at the head of which was the "Assistant Chief of Staff in charge of the Direction of the Rear", assisted by the "Chief of Staff of the Direction of the Rear," consisted of:

a) A General Staff.

b) Services.

The attached table shows the organization in detail of the D. A.

(*a*) The Staff consisted of the various sections which were charged with the study and preparation of plans pertaining to communications, supplies and evacuations.

These sections were grouped under two Assistant Chiefs of Staff: the Assistant Chief of Staff for organization and the Assistant Chief of Staff for supply.

a. Assistant Chief of Staff for organization:

Organization section.
Labor section.
Allied Armies section.

b. Assistant Chief of Staff for supply:

Supply Section.
Artillery section.
Engineer section.

The "General Organization and Communications section" dealt with questions of policy, the coordination of the various sections of the Staff and services in the preparation of general studies, and evolved plans with reference to communications and supplies.

The "Allied Armies section" studied questions concerning the organization of the communications of the Allied Armies. This section was withdrawn from the Direction of the Rear when the D. G. C. R. A. was created, as its functions overlapped those of the D. G. C. R. A.

(*b*) The Directions and services attached to the various sections, viz:

Delegation of the Direction of Military Transportation of the Armies;
Direction of the Motor Transport services;
Direction of the Light (60 cm) Railways;
Telegraph service;
Postal service;
Intendance (supply) service;
Roads service;
Water Transportation services;
Forestry service;

which studied and prepared the various questions pertaining to their respective branches.

III. Operation of the Direction of the Rear.

The Commander in Chief furnished the Direction of the Rear instructions and outlines as to planned or proposed military operations, as well as information as to probable consequent requirements of the armies.

Based upon this information (and, after October 15, 1918, in accordance with the instructions of the D. G. C. R. A.), the Direction of the Rear prepared a general plan for communications and supplies.

It had a dual role: Estimation and distribution. Estimation as to the probable requirements of the Army; distribution of resources from the interior or obtainable in the Zone of the Armies.

A. *Communications.*

The Direction of the Rear studied communications of all kinds: Standard gauge railways; waterways; light railways; motor transport; highways; telegraph services of the second line.

The various means of communication served to assure:

1. *Standard Gauge Railways.*—Transports from the interior to the regulating stations and to the railheads. Troop movements for the purposes of bringing large numbers of men to certain portions of the front; relieve tired units or bring up reinforcements.

2. *Waterways.*—Transport of heavy, bulky, materials and evacuation of seriously wounded over short distances.

3. *Light Railways.*—Transport to the units at the railheads or at the supply depots of supplies of all kinds.

4. *Motor Transport.*—Transport of troops and material by road to supplement railway transportation, when the latter was insufficient, or to take its place if the railroad lines were disrupted.

5. *Highways.*—Intensive circulation (traffic), requiring a large amount of labor and material for the upkeep of existing highways or for the construction of new roads.

6. *Telegraph services of the second line.*—Liaison between the General Headquarters and the interior, the groups of armies and the armies and inter communications within the armies.

B. *Supplies and Evacuations.*

a) *Supplies.*—The requirements in foods and materials necessitated:

1. The organization in the Zone of the Interior of large supply stores of all kinds. The size of these depots was determined by the Minister in accordance with the data furnished by the D. A.

2. The establishment in the Zone of the Armies of large supply stores, planned in accordance with projected operations, for the purpose of having supplies on the spot and available for immediate use in case of emergency.

The Direction of the Rear was responsible for the distribution of the supplies to the depots of the interior which had been placed at the disposal of the Commander in Chief by the Minister. The armies received these supplies in proportion to the strength of the commands and according to circumstances.

The supplies of food and clothing, and of Artillery, Engineer and Motor Transport material have been made the subject of special studies which are attached hereto in the form of "annexes":

Annex I: Supply of food (subsistence) and clothing.

Annex II: Supply of Artillery material.

Annex III: Supply of Engineer material.

Annex IV: Supply of Motor Transport material.

b) *Evacuations.*—The large number of troops involved and the necessity for classifying and treating the wounded, before assigning them to a definite destination, led the Direction of the Rear to adopt the following organization:

(*a*) Large evacuation hospitals were established near the front, charged with the triple role of classifying, treating or caring for the seriously wounded and evacuating all others.

(*b*) The establishment of an evacuation service (courants d'évacuation) charged with the transportation of the movable wounded, either to hospitals in the interior of the country or in the Zone of the Armies, according to the probable length of time required for their recovery.

(*c*) The establishment of "Medical regulating stations" (Régulatrices sanitaires) along the lines of evacuation, to inspect the hospital trains within three or four hours after their departure from the Army evacuation hospitals (H. O. E.), in order to remove the wounded unable to continue the journey, those who had been incorrectly routed, or those requiring further and immediate treatment.

ANNEX I.

SUPPLY OF FOOD AND CLOTHING.

1. FOOD.

The food supply requirements of the various units were coordinated by the 4th Section of the General Staff of the Army; whether for rations, the supply of which was automatic (bread, groceries,

oats, etc.), or for occasional issues such as tobacco, spirits, live stock, canned meat, gasoline, etc.

The necessary requisitions were transmitted by the 4th Section to the Regulating Officer (Commissaire Régulateur) and the latter was directed to satisfy the demands with the stocks at his disposal.

The Regulating Officer received his supplies from the intermediate depots (stations-magasins), where a daily "credit" was established for him by the Direction of the Rear (D. A.). In connection therewith, the expression "base strength" (effectif de base) was used. To inform a Regulating Officer that the intermediate depot at his disposal had a "base strength" of 200,000 men and 40,000 horses, meant that he could draw daily, from that particular intermediate depot, the necessary rations for 200,000 men and 40,000 animals.

Frozen meat was stored in refrigerator depots in the interior (preferably at the ports) and a "credit" was established there for the Regulating Officer. Fresh vegetables were also stored in the depots of the interior (entrepôts de l'intérieur) and credits established in favor of the Regulating Officer.

A) *Function of the Regulating Officer.*

The Regulating Officer sent the requisitions for supplies to the intermediate depot or depots assigned to him, in proportion with the amount of "credit" which had been established in his favor and within the limits of the "base strength." The requisitions were then filled by the daily dispatch of supply trains to the regulating station.

He assured the proper distribution of the food among the units which he supplied by basing himself upon the requisitions which had been transmitted to him by the 4th section of the General Staff. He made up the supply trains destined for the large units and directed these trains to specified railheads.

It should be noted, however, that the above system of supply was only possible during calm periods. During active periods, only trains of a certain type (Army corps supply trains, divisional supply trains, etc.) were made up at the regulating stations and the composition of these trains was determined by agreement between the 4th Section of the army concerned and the Regulating Officer.

B) *Functions of the intermediate depots (stations-magasins).*

The food supplies of the armies were stored in intermediate depots which had been organized during peace time or created since the beginning of hostilities. These depots were organized by the Minister and their contents (with the exception of personnel, offices, organization, etc.) placed at the disposal of the Commander in Chief. Besides, similar depots could also be organized in the Zone of the Armies by order of the Commander in Chief.

The intermediate depots were vast storehouses which were constantly replenished by the Minister and from which the armies drew their supplies through the Regulating Officer. These depots contained: ordinary food supplies, wines, and various fuels, such as gasoline, wood, coal, solidified alcohol.

2. CLOTHING.

The requirements of the various units were transmitted to the "Intendant" (Q. M.) of the Army (Intendant de l'Armée) who, after examining the requests, furnished the necessary supplies either through the Army depot, if the need was urgent, or, through the depots under his jurisdiction when small quantities were involved.

The shipments from these depots were sent to the regulating stations, which forwarded them to the railheads of the units concerned.

ANNEX II.

SUPPLY OF MATERIAL FOR THE ARTILLERY SERVICE.

1. *Resources—System of supply.*

a) Munitions: The armies supplied the large units assigned to them by means of their own stocks of ammunition. These stocks were replenished by the "Ammunition sub-parks" (Parc annexes de munitions), which were organs of the Direction of the Rear, and, in exceptional cases, by the general reserve depots (entrepôts de réserve générale), which were establishments of the Interior (Etablissements de l'Intérieur). The "Parc annexes" were replenished by the general reserve depots.[2]

b) Artillery matériel: (Military equipment, artillery matériel proper, armament, automatic arms, horseshoes, harness and saddlery.)

The armies supplied their large units through the following establishments:

Main Artillery Park (Grand Parc d'Artillerie)—Military equipment, harness and saddlery, horseshoes.

Artillery Repair Park (Parc de réparations d'Artillerie)—Guns.

Automatic Arms Center (Centre des Armes Automatiques)—Automatic arms.

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[2] The ammunition sub-parks (Parcs annexes de munitions) were large depots which contained complete rounds (charges, shells, fuzes, primers). Furthermore, a great deal of the ammunition was loaded on railway cars, ready for immediate shipment. The sub-parks were sufficiently close to the armies so that ammunition could reach the latter within a few hours. The general reserve depot (entrepôt de réserve générale) received the ammunition from the manufacturing establishments. It did not always contain complete rounds, moreover, it did not maintain ammunition loaded on railway cars and was often located at quite a distance from the front.

The armies were supplied by the G. H. Q. establishments: Sub-parks for equipment material (Parcs annexes de matériel des équipages); sub-parks for automatic arms (Parcs annexes d'armes automatiques); park-depots for artillery matériel (Parcs entrepôts de matériel d'Artillerie).

For each army main artillery park, there was a corresponding "Matériel Park" (Parc de matériel).

For each of the Artillery repair parks, there was a corresponding "Park-depot" (Parc entrepôt).

These were known as "connecting parks or depots" (Parcs de rattachement).

The sub-parks and the park-depots were supplied from the resources in the Zone of the Interior.

2. *Method of filling requisitions.*

a) Munitions: The army (4th Section, after agreement with the 3rd Section and the Artillery) forwarded all requisitions for ammunition to the Group of Armies (4th Section).

The 4th Section of the Group of Armies (after agreement with the 3rd Section) forwarded the requests to the 1st Section of General Headquarters which, after agreement with its 3rd Section, approved the requests, whether periodical (every 5 or 10 days) or special, and issued orders to the Direction of the Rear (D. A.) for the delivery of the ammunition.

Whenever necessary, the Group of Armies determined distribution of ammunition allowances among the various armies and notified the D. A of its decisions; the latter then directed the movement of the ammunition to the proper railheads.

b) Matériel: The requests of the units were transmitted directly to the following organizations:

Artillery Repair Park (Parc de réparation d'Artillerie—P. R. A.), for artillery matériel.

Automatic Arms Center (Centre des Armes Automatiques—C. A. A.), for automatic arms.

Main Artillery Park (Grand Parc d'Artillerie—G. P. A.), for equipment, horseshoes, harness and saddlery.

These establishments supplied all material for replacement or upkeep purposes.

The Main Artillery Park and the Artillery Repair Park were replenished through direct requisitions upon the "connecting parks or depots," (D. A. organs) charged with supplying them.

Automatic arms for the armies were obtained through requests addressed to the 1st Section of General Headquarters, which controlled the shipments thereof.

The Direction of the Rear requested necessary supplies from the Minister for maintaining the stocks of the sub-parcs (Parcs annexes) at a normal level, while the General Inspection of the Artillery (Inspection Générale de l'Artillerie) did likewise with reference to the park-depots (parcs entrepôts).

Whenever requisitions for initial equipment were concerned, these were sent to the 1st Section of General Headquarters. The Direction of the Rear was charged with filling such requisitions pertaining to headquarters equipment, harness, saddlery and horseshoes; while the General Inspection of the Artillery was responsible for the filling of similar requisitions pertaining to artillery matériel.

ANNEX III.

ORGANIZATION FOR THE SUPPLY OF ENGINEER MATERIAL.

A. SUPPLY OF THE ARMY ENGINEER PARKS.

In order to supply the various requirements of their units, the armies had Army Engineer Parks (Parcs du Génie d'Armée) at their disposal.

At the beginning of the war these Army Engineer Parks were automatically restocked by the Engineer "First and Second Reserves." These were supply establishments containing various materials as prescribed in Army Regulations and which were in current use previous to 1914: tools, sandbags, explosives, Engineer carts, etc.

During the war, however, the kinds and quantities of Engineer materials used by the Army increased considerably and new systems of supply had to be instituted.

The supply of Engineer material was effected through three methods:

1. Through the 1st and 2nd Engineer reserves.
2. Through the Direction of the Rear, by means of its general reserve depots and " parcs annexes."
3. Through requests addressed to the Direction of the Rear and transmitted to the Minister.

I. *First and second Engineer reserves.*

The first Engineer reserve was located at the regulating station.

The second Engineer reserve was in the interior.

Both of these reserves belonged to the Army.

The Army Engineer Park called upon the 1st Engineer reserve only for such supplies as were absolutely necessary. The 1st reserve

replenished its stocks by drawing upon the 2nd Engineer reserve and the latter, in turn, was supplied by the Minister.

II. *General reserve depots and "Parcs annexes."*

From the foregoing, it will be seen that an army could exhaust its "1st Engineer reserve" as often as it wished. This system could only be applied to materials obtainable in practically unlimited quantities; for materials which were not readily available, this system could not be used, because an army might use up available supplies to the detriment of the other armies.

Therefore, certain supplies were placed under the Direction of the Rear (D. A.) and the latter was responsible for their distribution.

These materials, as soon as produced by the manufacturing establishments, or upon arrival in France from abroad, were immediately deposited by the Minister in the general reserve depots (Entrepôts de réserve générale) located in the interior of the country and placed at the disposal of the Direction of the Rear. These supplies generally consisted of: barbed wire, iron wire, iron beams, corrugated iron, stakes, etc.

In addition, in order to have some of these supplies readily at hand, the Direction of the Rear stored certain quantities of this material in what were known as "Engineer sub-parks" (Parcs annexes du Génie), which were located in the Zone of the Armies.

The supply functioned as follows:

The Direction of the Rear received periodical requests from the 4th Sections of the Groups of Armies and, according to amounts on hand, the D. A. supplied the requirements, entirely or partially, from the stocks available in the "Parcs Annexes" and general reserve depots.

The D. A. replenished the "Parcs annexes" by drawing upon the general reserve depots and the latter, in turn, were restocked by the Minister as indicated above.

III. *Special Engineer materials obtained by direct requests from the Armies upon the Direction of the Rear and by demands from the latter upon the Minister.*

Finally, certain materials which, on account of their varied nature could not be easily handled, were obtained by requisition upon the Direction of the Rear, which transmitted the requisitions to the Minister for compliance.

This class of supplies included building material, barracks, gunshields, shelters for observers, drilling machines, etc.

B) SPECIAL MEASURES PERTAINING TO THE SUPPLY OF WOOD (LUMBER).

The armies obtained their necessary wood or lumber requirements, shoring timber, construction lumber, poles, etc., by exploiting the

resources in their zones and by requests upon the D. A., which transmitted same to the Minister for compliance.

In addition, in order to effect more rapid delivery and to facilitate the supply of armies whose zones were poor in wood resources, the Direction of the Rear organized and operated a number of forestry exploitations (exploitations forestières).

ANNEX IV.

SUPPLY OF MOTOR TRANSPORT MATERIAL.

The object aimed at was:

1. On one hand, to assure and maintain the organic equipment of the motor transport units.

2. On the other, to repair or salvage the greatest possible number of unserviceable motor vehicles.

I. *Resources.*

The three basic organizations of the system were:

a) The Motor Transport Organization Parks (Parcs automobiles d'organisation—P. A. O.)

b) The Central Motor Transport Depot (Magasin Central automobile—M. C. A.)

c) The Motor Transport Evacuation and Sorting Centers (Centres d'évacuation et de triage—C. E. T. S. A.)

All three were under the orders of the Minister.

(*a*) The P. A. O. (Motor Transport Organization Parks) were charged with supplying the armies with the necessary motor vehicles.

These parks were supplied either by vehicles purchased from the manufacturers through the "Commission for the purchase of motor transport matériel" (Commission d'Achat du Matériel Automobile), or, by vehicles overhauled by the Motor Transport Evacuation and Sorting Centers (C. E. T. S. A.).

(*b*) The M. C. A. (Central Motor Transport Depot) was charged with the supply to all of the motor transport units, i. e. work and repair shops, of spare parts for the repairs that these various units were authorized to make, according to their means and object. These units included:

The shops of the T. M. motor transport services.
The shops of the motor transport groups.
The shops of the motor transport groupings (groupements).
The shops of the army motor transport parks.
The shops of the motor transport repair parks.

The Central Motor Transport Depot was also responsible for the supply of bicycles and motorcycles to the armies.

The M. C. A. was supplied partly by spare parts purchased from the manufacturers, and partly by spare parts obtained from dismantled machines at the various overhaul parks.

(*c*). The C. E. T. S. A. (Motor Transport Evacuation and Sorting Centers) were charged with receiving motor vehicles which could not be repaired by the other motor transport establishments, with the repair or utilization of all serviceable parts and the sale of all motor transport matériel which was absolutely unserviceable.

Two other motor transport organizations with the armies were charged with the distribution of motor transportation, spare parts and the overhauling of motor vehicles, viz:

1. The Army Motor Transport Parks (Parcs d' Armées), which were army organs.

2. The Motor Transport Repair Parks (Parcs de réparations), which were under the Direction of the Rear (Direction of the Motor Transport Services).

The difference between these two organizations was that the Repair Parks completely overhauled the motor vehicles, while the Army Parks only carried out general repair work.

II. Method of Filling Requisitions.

From the statements contained in the preceding paragraph it will be seen that:

1. For the replacement of motor vehicles, the Direction of the Rear (Direction of the Motor Transport Services) satisfied all requirements, either by using motor vehicles which had been overhauled or which were held in the Motor Transport Repair Parks, or, by using motor vehicles which were available in the Motor Transport Organization Parks.

2. All spare parts were furnished by the Central Motor Transport Depot.

Supply of Gasoline and Motor Ingredients.

A number of main and secondary depots were established in the Zone of the Armies, where motor transport units could obtain their supplies of gasoline and motor ingredients in exchange for "supply coupons" (bons). These depots either supplied designated units or were designated to supply all motor transport units. They were supplied, themselves, through the intermediate depots (stations-magasins).

A special service to control the consumption of gasoline operated under the orders of the Direction of the Rear (Direction of the Motor Transport Services).

CHAPTER VI.

SECTION III.

SUPPLY DIVISIONS OF THE GENERAL HEADQUARTERS (BELGIAN).

I. The 3rd. Section of the General Staff treated all questions relating to the organization of units and the higher organization of the Army, discipline, strength, personnel, remounts, matériel and armament for all branches, except artillery, motor transport and animal transportation, food supply (determination of the ration) and clothing.

II. The 4th. Section of the General Staff was charged, during the war, with handling all questions pertaining to supply, evacuations and transportation for the entire Army.

(Chart 3, Chapter VII, Volume I.)

A. Supply and Evacuations.

At the beginning of the campaign 1914–1918, the supplies for the field army were assembled in the fortress of Antwerp. Each day, in accordance with the orders received from the Command of the Army (4th Section), issues were made from the existing stocks and forwarded by means of the daily supply trains to the Army divisions and to the Cavalry division.

Inversely, all evacuations from the field army were sent to Antwerp; (however, a few hospitals which were located in the western portion of the country continued to function).

At the time when the evacuation of the fortress of Antwerp (Position Fortifiée d'Anvers—P. F. A.) was being considered, the Army Command ordered the establishment of a secondary base in the region of Bruges-Ostende-Zeebrugge and a portion of the supplies from the fortress of Antwerp was evacuated there. As soon as the evacuation became a reality, the remaining supplies in Antwerp were also transferred to the above named places (perhaps it would be more correct to state that the supplies which it was possible to save before the surrender of the place were removed there).

The region Bruges-Ostende-Zeebrugge then became the only base of the Belgian field army.

Developments, from the fall of Antwerp until the Battle of the Yser, caused the Army Command to order the removal of the supplies which had been stored along the Belgian coast to the region of Calais. It was from this region that the Belgian Army obtained its supplies during the Battle of the Yser and to this region also were evacuated the Belgian sick and wounded.

Then began the period of what is known as the " war of stabilization " (stationary trench warfare) and, at the same time, a more complete organization of the Belgian service of the rear.

The latter was created progressively. As a matter of fact, the Belgians were obliged to reorganize in a foreign country in which numerous French and British services were already established. As the French and British, as well as the Belgian services, were increasing in size from day to day the choice of locations remained, naturally, very limited.

The various chapters of this work dealing with the " Intendance " (supply) service, the Artillery and Engineer services and the Medical service, etc., give a detailed account of their expansion during the course of the campaign 1914–1918.

Although the territory in the rear of the Belgian front could not be subdivided into a Zone of the Army and into a Zone of the Interior due to the fact that, for the most part, the Belgians were obliged to establish themselves outside of their own national territory, the Belgian supply establishments and Army depots can, nevertheless, be classed in depth.

In the region of Calais, supplies were at the disposal of the Command of the Army and served to fulfill all requirements of the Army. It was, properly speaking, an advanced base and contained all the supplies (food, munitions, spares, etc.) for the field army.

The authorities charged with the direction of these establishments received orders direct from the Command of the Army (4th. Section).

Further towards the rear there were purchasing agencies, manufacturing plants and repair establishments which normally would have constituted, in the zone of the interior, the Army's supply services and establishments.

These establishments received orders from the Minister of War or from delegates who were authorized to act in his name.

In this chapter will be examined only those services which were under the Command of the Army. Those under the Ministry are treated in the section of this study dealing with the D. G. A. S. T. A., Medical service, etc.

A. SUPPLIES.

I. SERVICE OF THE INTENDANCE.—In the region of Calais, there was a *depot for fuels and gasoline*, (Magasin des combustibles et des essences). This depot supplied the Army with coal, fire-wood, oils and fuel. It was also equipped with special apparatus for putting the gasoline, etc., into cans.

A depot of oats and forage, (Magasin des avoines et fourrages), in which were stored, principally, oats coming from overseas. Existing stocks of hay and straw were very small and this forage was generally stored near the front in the depots of the Intendance. The latter were created in 1915 and were established for the purpose of enabling the various units to supply themselves with forage, coal, wood, etc., by means of their own animal-drawn transportation. These depots never contained more than a ten days' reserve of supplies and, in case of retrograde movement, they could have been easily destroyed by fire.

A depot of groceries and canned goods, (Magasin des petits-vivres et conserves). Besides groceries and canned goods, this depot contained beverages and tobacco necessary for current use.

A depot for frozen meat and a cattle-park (*stock yards*), (Magasin de viande congelée et parc de bétail). Frozen meat was received either from the British (Boulogne) or from the French (Dunkerque). However, in order to prevent shortages, the Belgian Army maintained a reserve stock of frozen meat on barges (péniches). (Four barges of 85 tons each).

At Bourbourg there was a cattle-park (stock yards) containing a reserve of four days' fresh meat (on the hoof). The cattle from this "park" was distributed to the divisions of the Army in accordance with orders from the Command of the Army.

A depot of flour and bakeries, (Magasin à farine et des boulangeries). The flour received from steamers was stored in a depot. The latter suplied the military bakeries with a three to four days' supply of flour.

There was a bakery at Bourbourg, equipped with "Perkins" ovens, and a bakery at Adinkerke with stationary ovens.

Clothing depots and shops, (Magasins et ateliers d'habillement). These contained about one month's supplies.

Laundry and cleaning establishments, (Buanderie et dégraissage). Early in the period of "stabilization," soiled clothing was sent to Calais to be laundered and cleaned. Later on establishments were created at Elsendamme and at La Panne, which permitted carrying out of these operations more regularly and more rapidly. These installations, which were located close to the front, could only be established as a result of the "stabilization" of the front line.

II. PARCEL POST SERVICE. (Service de l'agence des colis).—This service was charged with:

1) *The delivery of packages destined to the various units.* When one of the establishments in the region of Calais desired to forward a package to a certain regiment, it entrusted the package to the "parcel post agency" which undertook its delivery to the destinee by means of its convoy on the daily train.

2) *Delivery of packages destined to individuals.* The shipping services gave the package to the "parcel post agency". The latter sorted the packages by divisions and loaded them on the daily train destined to the division concerned. The divisional services received the packages and delivered them to the individuals.

3. *Sorting of (évacuations) salvage.* Corps (units) which had unserviceable matériel for salvage (évacuation), delivered this matériel to the daily train, turning it over to the representative of the parcel post agency. The latter loaded this matériel on the cars which returned to Calais. There, the matériel was sorted according to destination. The same agency undertook the transfer of this matériel to the establishments concerned.

III. SERVICE OF MATÉRIEL, MATERIALS, MUNITIONS. (Service du matériel, matériaux, munitions.)

Artillery: The principal establishment was the "Main Field Park" (Grand Parc de Campagne) which supplied the Army with guns, caissons, matériel, artifices, animal drawn vehicles, harness, apparatus, spare parts, accessories, various machines, horseshoes, paints, varnish, etc., (for the historical account of this establishment see Chapter IX—Section III).

The "Main Field Park" (G. P. C.), was also charged with the supply of ammunition. Its establishments extended to Calais, Gravelines, Loon-Plage.

The "Artillery Park on wheels" (Parc d'Artillerie sur Rails) also belonged to the "Main Field Park". It consisted of about one day's supply of ammunition loaded on railroad cars.

Engineer (Génie): The matériel and materials for the Engineers were stored in the "Engineer Park of the Army" (Parc du Génie de l'Armée). To facilitate their distribution to the various units, "Zone Depots" (Dépôts de Zone) were created in the territory occupied by the troops. The latter contained a certain quantity of engineer matériel which was of current use.

Artillery and Engineer repair shops (Ateliers de réparation d'Artillerie et du Génie).—To avoid sending artillery and engineer matériel which required only minor repairs to Le Havre, repair shops were established in the region of Calais.

Motor Transport Reserve Park and motor transport repair shops (Parc automobile de réserve et ateliers de réparations d'autos).—The "Motor Transport reserve Park" contained a reserve of motor vehicles to replace those in current use, as well as a reserve stock of spare parts and accessories required for the field army. The repair shops undertook the repairs which could not be made by the units themselves. The repair shops in the Calais region effected only minor repairs. Motor vehicles requiring extensive repairs were sent further to the rear to the shop at Le Havre.

IV. Medical Service (Service de Santé).—Drugs and medicines, materials for dressings, surgical appliances, gas-masks, etc., were supplied the field army by the "Army Pharmacy" (Pharmacie d'Armée). The latter contained sufficient supplies for one month's requirements.

B. EVACUATIONS.

1) *Men:* The Army organization which was charged with the evacuation of the sick and wounded was the "Army Evacuation Hospital" (Hopital d'Evacuation d'Armée). It was composed of four sections. Each section comprised the necessary matériel and personnel to function as an "Evacuation Center" (Centre d'Evacuation).

Theoretically, an "Evacuation Center" (Center d'Evacuation) was established in a railroad station. When a certain number of sick and wounded were assembled, they were loaded into a hospital train (train sanitaire) and sent to the rear.

Collectively, the hospital trains were known as the: "Park on wheels of the Medical Service" (Parc sur rails du Service de Santé).

At the time of the Armistice the "Park on wheels of the Medical Service" was organized as follows:—

The "P. S. R." consisting of three sections and a reserve:

The first section: six "mixed" evacuation trains (T. E. M.)

The second section: nine evacuation trains for lying cases (T. E. C.)

The third: two evacuation trains for sitting cases (T. E. A.)

A "T. E. M." was composed of:

Eight "S. S. A." cars;

Four third-class corridor coaches;

Four baggage-cars (fourgons), one of which was used as a kitchen and one for arms and equipment. Two cars, one at each end of the train, were assigned to the railroad personnel in charge of train operation.

A "T. E. C." was composed of:

Seven "S. S. A." cars;
One third-class corridor coach;
One second-class converted coach, assigned to the permanent personnel;
Three baggage-cars, one of which was used as a kitchen.

The "Hospital train reserve" (Réserve des trains sanitaires) consisted of:

One light railway coach, which served as an office;
One baggage-car, which was used as a pharmacy;
Four baggage-cars;
Two second-class coaches;
One third-class coach;
Four "S. S. A." cars;
Three "N. D. de la Croix" cars;
Two kitchen-cars.

The sick and wounded were brought by hospital train to a "classification hospital" (Hôpital de passage). These "Hôpitaux de passage" were generally established in the waiting-room of a railroad station. From the "Hôpitaux de passage," the patients were forwarded towards one or the other of the hospitals in the region of Calais.

2) *Horses:* In the same manner, there was an "Evacuation Infirmary" (Infirmerie d'Evacuation) for the horses, where animals which were to be evacuated were assembled. Those requiring considerable care and attention were sent to the "Army Veterinary Infirmary" (Infirmerie Vétérinaire d'Armée) at Bourbourg. The latter consisted of a group of farms and pastures where the horses could receive prolonged treatment.

3) *Matériel:* For the purpose of assuring the evacuation of the matériel, the Command designated collecting centers, that is to say, stations where matériel was brought by the units. The hours during which these centers were to be in operation were prescribed by the Command, in order that there would be no interference with the regular train service and to avoid holding trains too long in the proximity of a collecting center.

TRANSPORTATION.

Rail Transportation.

At the beginning of the war, the Railroad Administration was charged with assuring military transportation by means of priority schedules. The Belgians possessed a very dense railway system, with numerous personnel and matériel, so that all transportation was executed with perfect regularity. After the evacuation of Antwerp and

the Belgian coastal region the situation, from the standpoint of rail transportation, was completely modified. The national railway system was almost entirely in the hands of the enemy, only a portion of the matériel had been saved and the greater part of the railway personnel remained in the invaded territory. Among the railway personnel who had escaped into France, many were not under obligation to perform military service.

Owing to these circumstances, after the battle of the Yser the methods employed in the operation of rail transportation, and which were still in effect, had to be modified. The Belgian system was changed to conform to that which was in operation in France. A "Regulating Commission' (Commission Régulatrice) was created and the "Railway Engineer Company" (Compagnie de Chemin de fer) was increased to a battalion. The battalion was charged with the operation and maintenance of the railroad lines closest to the front.

A "Field Railway Section" (Section des Chemins de fer de campagne) was also organized. It was composed of employees (agents) of the civil Railroad Administration who were liable to military service, or whose services were requisitioned, and this section was charged with the operation and maintenance of the railroad system in the zone in the rear of that assigned to the "Railway Battalion" (B. C. F.). These two organizations: the B. C. F. and the S. C. F. C., were under the orders of the "Regulating Commissioner" (Commissaire Régulateur).

A detailed statement of the Belgian railway system is given in Chapter XIV, Section III, Vol. II.

Water transportation.

At the beginning of the campaign no special organization had been provided to assure the service of transportation by water.

In 1915, the lack of railroad rolling stock obliged the Army Command to utilize the system of navigable waterways for the transportation of bulky materials and an organization, known as the "T. E. I." (Transports par Eaux Intérieures) or "Inland Water Transportation service," was created. It was composed of navigating personnel, together with barge and towing material, and included crews of stevedores and a "salvage" unit. This organization rendered very important services during the campaign and after the armistice. During the latter period it was employed to clear the navigable waterways of material which had been sunk by the Germans, provide the necessary river transportation and assist in reestablishing normal economic conditions.

Road transportation.

The difficulties which confronted the Belgian Army in the procurement of the necessary motor vehicles for the equipment of the various units, did not permit the formation of an "Army Motor Transport Grouping" (Groupement Automobile d'Armée) until the latter part of the war.

Traffic from the Zone of the Army towards the rear was regulated by the "Commander of the line of communications" (Commandant des Etapes), in accordance with the orders of the Command of the Army.

A road, which was known as a "line of communications road" (ligne d'étapes), was reserved in the rear of the Army for the traffic towards the Calais region. On this road were established "line of communications shelters" (gites d'étapes), where the detachments using the highway were quartered. The "line of communications road" leading towards the Army was subdivided into several lines which ended in "line of communications stations" (têtes d'étapes).

Special measures for the control of traffic were in force on the "line of communications roads."

CHAPTER VI.

SECTION IV.

CENTRAL ORGANIZATIONS CHARGED WITH THE SUPPLY OF THE ARMY DURING THE WAR (ITALIAN).

(Charts 7, 8, 9, Chapter VII, Volume I.)

As has been shown in the preceding chapters, various central organizations were created during the war to supply the needs of the Italian Army and civilian population.

The more important among these organization are considered in this chapter. These were concerned with the supply of:

A. Arms, munitions, motor vehicles, artillery and engineer material, including the raw materials required for manufacturing purposes.

B. Aviation material.

C. Food and forage.

D. Fuel.

A. ARMS AND MUNITIONS, ARTILLERY AND ENGINEER MATERIAL, ETC.

At the outbreak of the war, the supply of arms, munitions and various materials required for the Artillery and Engineers devolved upon the Ministry of War and, within the Ministry, upon the General Administration of Artillery and Engineers.

At the end of June 1915, an industrial mobilization was instituted. Under the terms of various decrees, the Government was empowered to order and direct the manufacture of war material with the object of increasing the production of private industry. It was further provided that the personnel of industrial organizations would furnish all necessary information concerning the capacity of their plants. The Government was also empowered to order the installation in any factory of machinery, etc., in accordance with the specifications and designs obtained from some other concern and to impose cooperation between industrial concerns in the production of war materials.

For this purpose a Supreme Committee for the Supply of Arms and Munitions was created, composed of the following Ministers: War, Navy, Treasury and Foreign Affairs, and presided over by

the President of the Council. This committee was also charged with determining means to expedite and increase the production of arms and munitions.

At the same time, an Under Secretaryship for Arms and Munitions was created which, in addition to the normal functions devolving upon it as a subordinate agency of the Ministry of War, was charged with carrying out the duties entrusted to it by the above mentioned Supreme Committee. The General Administration of Ordnance, Engineer Branch, and the Inspection of Ordnance and Construction were placed under its direction.

In order to coordinate all matters pertaining to the industrial mobilization, Regional Industrial Mobilization Committees were formed, with a Central Committee in Rome.

In June 1917, the duties and scope of the Under Secretaryship for Arms and Munitions having been extended, this organization became the Ministry of Arms and Munitions and functioned as such until the end of November 1918. This Ministry not only assured the production of arms and munitions for the needs of the Army and Navy, but also supplied material for the use of the State railways.

B. AVIATION MATÉRIEL.

At the beginning of the war the Under Secretaryship for Arms and Munitions provided aviation material. This was accomplished through the General Aviation Administration and supplied both the Army and the Navy. Subsequently, on account of the importance assumed by this new branch of the service, a General Aviation Commissariat was established which formed part of the Ministry of Arms and Munitions. The Commissariat prepared programs for the Aviation, in agreement with the Supreme Command, the Ministry of War and the Ministry of Arms and Munitions. It provided for the organization of the various offices and commands (Comandi); drew up contracts; carried out tests; and handled all matters pertaining to the Air service, including international agreements and relations.

C. FOOD AND FORAGE.

The Ministry of War was responsible for the supply of all food and forage requirements of the Army.

Until June 1916, this supply was provided for by the Ministry of War, through purchases in Italy and abroad. Later, however, it also became necessary to obtain food supplies for the civilian population and the Ministry of War delegated these duties to the new central

administrations which had been created for the purpose during the war. The latter, in chronological order, were:

1. *The Ministry of Agriculture* (formed from the pre-existing Ministry of Agriculture, Commerce and Industry, and created as a separate Ministry in June 1916). This Ministry was charged with the supply of foods and alimentary products which were in great general demand. A Central Supply Commission was established in the Ministry of Agriculture and charged with all matters concerning the acquisition, sale, transportation and administrative management of supplies. A Temporary Supply Service was also created for the acquisition from abroad of grains, oats, flour, frozen meat, beef, sugar, coffee and, in general, of all foodstuffs and alimentary products required by the military administration and the civilian population.

2. *General Commission for Food Consumption* (formed in January 1917 and subordinate to a special committee composed of Ministers of the Crown). This commission took over a part of the duties formerly performed by the Ministry of Agriculture concerning the control of food consumption, with the exception of food supplies obtained from abroad. The latter remained under the control of the Temporary Supply Service.

3. *General Commission for Supply and Consumption* (formed in June 1917). This commission took over and combined the functions formerly devolving upon the General Commission for Food Consumption (which had been abolished) and the Temporary Supply Service. The latter was placed under its control in all matters pertaining to supply.

4. *The Ministry of Food Supply and Consumption* (created in May 1918, after the suppression of the General Commission for Supply and Consumption). It controlled all the food supply services in the interior and abroad, as well as the distribution of alimentary products.

D. FUEL.

It is necessary to distinguish between:

a) The service for the supply of national fuel.

b) The service for the supply of coal imported from abroad.

a. National Fuel.

The difficulty of obtaining supplies from abroad, together with existing high prices (which were aggravated by the rates of exchange), resulted in the formation of a Committee for the mobilization of coal for auxiliary and assimilated military establishments (factories).

b. Service for Imported Coal.

In February 1917, the above organization was modified and merged with a Committee of Ministers for the supply and distribution of coal. The principle duties of the latter were:

(*a*) The acquisition and loading of fossil coal from foreign countries (the State Railway services were employed for the transportation of this fuel).

(*b*) The transportation of coal on Government owned ships, or on ships requisitioned, hired or sequestered by the Government.

(*c*) The unloading of the coal and its dispatch and allocation, in agreement with the Central Committee.

(*d*) The requisition of foreign mineral coal deposited in national territory and which was needed by the State.

Finally, in June 1917, the functions of the Committee of Ministers and of the General Coal Commissariat were taken over by the Ministry of Transportation (by land and sea). This Ministry, in existence since June 1916, regulated the mercantile marine services and the State Railways.

CHAPTER VI.

SECTION V.

DEVELOPMENT OF STAFF AND COMMAND OF THE AMERICAN EXPEDITIONARY FORCES WITH SPECIAL REFERENCE TO FUNCTIONS OF SUPPLY.[1]

In time of war, practically all the nations of Europe divide the activities of their military establishments into two great divisions, designated respectively as the Service of the Interior and the Service of the Theatre of Operations.

The Service of the Interior functions in peace as well as in war and is administered by the central government through the agency of its War Department. The country is quite usually divided into geographical departments or regions in which are quartered the troops constituting the Army on a peace footing and which contain the necessary depots, camps and other instrumentalities for mobilizing the Army and placing it on a war footing. Under the War Department, the Service of the Interior is administered by bureau chiefs in charge of various activities relating to organization, equipment and supply, and having control of supply depots, arsenals, hospitals and other necessary elements. There are, in addition, Department ("regional") commanders who command the troops and supervise their training and administration.

The Service of the Theater of Operations functions only during periods of actual or threatened hostilities. It is administered under the direct control of the Commander in Chief of the Forces in the Field. The Theater of Operations is in turn divided into two large regions or zones, designated respectively, the Zone of the Lines of Communication and the Zone of the Advance. In the event of overseas operations, the Zone of the Lines of Communication contains the base ports for debarkation of men and materials, depots for reserve supplies, hospitals, arsenals, bakeries, repair shops, salvage plants and other establishments, whose number and capacity depend upon the magnitude of the prospective operations, the distance from the base ports, difficulties of shipping and other factors of a kindred nature.

[1] Extract from the report of General Moseley G–4, G. H. Q., to the C. in C., A. E. F.

The Zone of the Armies contains the forces engaged in actual operations against the enemy as well as the various elements of supply required in direct support thereof, comprising advance supply depots, evacuation hospitals, remount stations, repair shops and the line.

The Commander in Chief of the Forces in the Field is assisted by a staff which is separated into two principal groups, viz: a general staff-group and an administrative, technical and supply staff-group.

The duties of the general staff involve consideration of every detail which concerns the efficiency of the field forces and their state of preparation for military operations. It considers and reports upon all questions relating to organization, distribution, equipment, armament and training. It studies possible theatres of campaign and strategic questions in general. It is charged with the duty of preparing plans for combat, both of an offensive and defensive nature. It studies reports of campaigns, battle engagements and expeditions, and compiles technical histories of the various military operations.

The administrative, technical and supply staff is charged with matters of administration, records, statistics, inspection, law and the construction, operation and maintenance of all agencies of supply and transportation in the Theatre of Operations. In these activities, it is directed and coordinated by the general staff, the responsible officers of which, as direct representatives of the Commander in Chief, communicate his plans and intentions to the chiefs of the various bureaus, with a view to the execution.

The Commander in Chief of the American Expeditionary Forces drew up a tentative organization for a suitable Staff before crossing the Atlantic and shortly after his arrival in Paris, issued his first order with table of organization. This order prescribed that these tables were to form the basis of co-ordinated action between the several staff departments in this command. They had been prepared after a comprehensive study of the staff organizations of the French and British Armies and were intended to adapt our old staff system to the requirements of modern field conditions. They provided for a general staff divided into three major sections: Intelligence, Operation and Administrative, together with an Administrative and Technical and Supply Staff consisting of a Judge Advocate, Inspector General, Chief Quartermaster, Adjutant General, Chief Engineer, Chief Ordnance Officer, Chief Surgeon, Chief Signal Officer and an Aviation Officer.

On August 14, 1917, a revision of this order was announced which created the office of Secretary and two new sections of the general

staff, namely, Training and Co-ordination. The Co-ordination Section took over some of the duties previously devolving upon the Administrative Section and their respective functions were defined as follows:

"The Administrative Section is charged in general with the discussion and determination of policies. Its work will cover policy as related to Staff Organization, priority of shipments to France, replacements of losses, police and discipline, ammunition and other supplies, evacuation of sick and wounded, line of communication, camps and billets, liaison and organization not pertaining exclusively to Operations and Intelligence.

"The Co-ordination Section may be considered the connecting link between the General Staff and the regular supply and staff departments and the lines of communication service. Its functions in maintaining intimate relations between the office of the Chief of Staff and these various services will be both executive and advisory. It will keep on hand the latest information regarding supplies, state of construction, efficiency of rail transportation and will study and frequently report upon the practical working of all staff and supply departments".

This revision provided three new agencies, destined to play an important part in our services of supply. These were a General Purchasing Agent and, associated with him, a General Purchasing Board; a Department of Transportation with a Director General of Transportation at its head and a Commanding General, Line of Communications. These were equal in rank and co-ordinate with each other and with the chiefs of the previously existing supply bureaus and divested the latter of some of the duties devolving upon them under the previously existing organization.

The Line of Communications had necessarily come into existence on a provisional basis with our advent in France, but was more definitely organized by G. O. 20, H. A. E. F., August 13, 1917. Its geographical limits extended from the sea to the points where delivery of supplies was made to field transportation of the combatant forces and included the command of all camps and troops maintained within these limits. It was organized into three Base Sections of which the first included the ports of Brest and St. Nazaire and other facilities on the river Loire; the second included the ports on the river Gironde and La Pallice; while the third included the ports in the British Isles and the channel ports in France. In addition to these Base Sections, an Intermediate and an Advance Section were announced, the latter coinciding with the French "Zone des Armées." With the development of the S. O. S. there were altogether seven Base Sections on the date of the Armistice and, in addition, a sepa-

rate jurisdiction known as the Paris District, which included the city and environs.[2]

As the troop arrivals from the United States increased, their appearance in divisional training areas brought about new questions of administration, particularly with reference to our relationship with the French Government and the French Military authorities. The Co-ordination Section of the General Staff, as it then existed, enlarged its scope and supervised more closely the various supply bureaus with a view to keeping all establishments upon a corresponding footing.

A Memorandum [3] issued November 19, 1917, defined the duties of the Co-ordination Section as follows:

"All questions concerning supply and transportation in France. Operations of technical services, except the Red Cross, Y. M. C. A., and similar agencies, the G. P. B., War Risk Bureau, Auditors and Field Ambulance Service. Operations of the L. of C. and the T. D. Statistics concerning supply, construction and transportation. Supply and transportation arrangements for combat. Assignments of labor and labor troops. Location of railway and supply establishments. Hospitalization and evacuation of sick and wounded. Orders for the assignment of new units."

As to the interior organization of the Co-ordination Section, it was divided at this time into four groups with duties as follows:

Group I.—All matters of a general staff nature relating to Aviation and the Medical Corps, also matters relating to the Line of Communications.

Group II.—Staff matters arising in the Signal, Engineer and Quartermaster departments.

Group III.—Staff matters relating to Ordnance and Gas Service.

Group IV.—Staff matters relating to transportation and labor.

Further study of the British, French and of our own staff organizations resulted in the Co-ordinating Section restricting its jurisdiction to questions of supply within the A. E. F., leaving to the Administrative Section the supervision of the procurement from the United States, allotment of tonnage and arrangements for transportation to France.

The supply of troops in France was divided into three phases:

1. The procurement of supplies.
2. The storage and care of supplies.
3. The transportation of supplies.

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[2] See General Harbord's report in re. Selection of Base Ports and Establishment of Section.

[3] See Memorandum 139, H. A. E. F., November 19, 1917, contained in Appendix J of the report of the 4th Section of the General Staff.

For the first of these, the chiefs of the various supply bureaus were responsible; for the second the Commanding General, L. of C., was responsible; and for the third, the responsibility for the construction, maintenance and operation of such railroad lines and rolling stock as came under American control rested upon the Director General of Transportation. The general supervision of all these activities was exercised by the General Staff at G. H. Q. and as a rule through the Co-ordination Section.

While the American E. F., was small, centralization at G. H. Q. was expedient, but with the expansion of the American Army this centralized control became unwieldy and it was determined to reorganize the L. of C. under the designation of the Services of Supply. The Chiefs of the Supply Services exercised all of their functions in matters of procurement, transportation and supply under the direction of the C. G., S. O. S. by whom their activities were coordinated. Their principal offices were moved to Tours, which became the Headquarters of the S. O. S.

Finally the General Staff was reconstituted. A Deputy Chief of Staff was provided for and numerical designations corresponding closely to the French were given to the five sections of the General Staff facilitating thereby future transactions with the French.

The Administrative Section became the 1st Section or G—1

The Intelligence Section became the 2nd Section or G—2

The Operations Section became the 3rd Section or G—3

The Co-ordination Section became the 4th Section or G—4

The Training Section became the 5th Section or G—5

The officers at the head of the various sections were known as Assistant Chiefs of Staff. The whole system was generally known as the "G" System of staff organization.

Somewhat later, to confirm practice already instituted by the letters and oral instructions, the basic principles covering the development of the Services of Supply were enunciated. The C. G., S. O. S., was charged with all matters relating to the automatic supply from the United States in accordance with policies approved by the C. in C. The duties of the C. G., S. O. S., also embraced the handling of requisitions initiated by the Supply Departments and the direction of purchases through the G. P. B. The discharge and transportation of supplies by rail and water; the chartering and requisition of vessels; the necessary construction of facilities for these various purposes and the procurement from the United States of personnel necessary to the administration of all activities under his control in accordance with further letters of instruction issued to him from time to time. He also was charged with the development of port facilities, storage facilities, railroad transportation and allotments of tonnage.

The General Staff at G. H. Q. concerned itself with the broader phases of policy, including those relating to new troops, new scales of equipment and excepting only those pertaining to the troops in Services of Supply. G. H. Q. also retained immediate control of military transportation and supply in the Zone of the Armies, and control of war material required in the conduct of military operations against the enemy. Thus, for example, the Deputy Director General of Transportation, in charge of railway transportation in the Advance Zone became the chief of that sub-section of G–4 which dealt with transportation matters; and again, the senior medical officer on duty in the medical sub-section of G–4 served as Deputy Chief Surgeon, and in that capacity controlled all agencies of hospitalization and evacuation in the Advance Zone. So also, G–4 acted directly on all questions relating to the assignment of motor transportation and the allotment and distribution of ammunition and engineer materials and equipment required by combat forces in the field.

The precise duties of the 4th Section were as follows:[4]

Supervised: Supply, construction and transportation in France, including location of railway and supply establishments.

Analyzed: Statistics concerning the above.

Guaranteed: Supply and transportation arrangements for combat.

Supervised: Hospitalization and evacuation of the sick and wounded.
All operations of the Services of Supply not assigned to other sections of the General Staff.

Made Assignment: Of all new units arriving in France.
Of all labor and labor troops.

G–4 in addition to keeping close touch with the plans of the Commander in Chief for future operations of the Allies, together with arrangements for the employment of the American troops, for the supply and transportation of whom G–4 was responsible, kept in close touch with the primary activities of the S.O.S. Projects of any importance involving the location of facilities were examined and harmonized by this section of the General Staff.

Conforming to the above indicated distribution of duties G–4 was organized into a number of sub-sections designated by the letters of the alphabet for enumeration of which see chart on organization of G. H. Q.[5]

At each Army Headquarters and at Headquarters S.O.S., there was organized a similar group of the General Staff, composed of officers

[4] G. O. 130, G. H. Q., A. E. F. Aug. 6, 1918. See Appendix J of the Report of the 4th Section, General Staff.

[5] Chart 4, Chapter VII–Vol. I.

COL. LUIGI LAZZI

Italian Section Military Board of Allied Supply; Italian Member of the Editing Committee

especially selected for the purpose, and familiar with the duties and operations of the 4th Section, G. H. Q. In a measure, this section was in turn duplicated at the headquarters of Corps and Divisions, but was there consolidated with G–1 a circumstance which proved to be undesirable and confusing.

The closest liaison was maintained with these officers, insuring thereby cooperation and increased efficiency of the whole system of supply. In addition, liaison officers were maintained at Headquarters Allied Armies, and at Advance G. H. Q. and with the Military Board of Allied Supply.

From the foregoing pages, it is evident that G–4 was the natural result of the evolution which characterized our activities since we entered the war. The supplies for our army were now grouped under eight major departments, each headed by an officer selected for his experience and special fitness. Each chief was responsible for but one department. He was not in a position to know or influence the activities of other departments and it is evident, therefore, that to keep the supply machine balanced, control of some sort was necessary.

Corodination of these activities, including procurement, storage, transportation and construction was provided by the 4th Section of the General Staff.

NOTE.—Further details as to functioning of the Supply System of the American E. F. are given in Chapters VII, Section V, and Chapter XIII, Section V.

CHAPTER VII.

SECTION I.

TERRITORIAL SUBDIVISION OF SUPPLY (BRITISH).

(Chart 1, Chapter VIII, Vol. I.)

The British Army in France and Flanders was situated in a manner differing completely from that of any of the Allies in regard to the problem of maintenance. It was based upon the United Kingdom for the great bulk of its supplies. This base, owing to the protection afforded by the Navy, was virtually outside any theatre of war thus materially altering the situation in comparison with France and Italy. As a base, however, it was near enough to the zone of active operations to render it responsive to quick variations in army demands, unlike the situation of America and the American Army demands. Thus it was possible on the one hand to utilize the United Kingdom as a real base to all intents and purposes secure from direct enemy action, and on the other hand to avoid the establishment of a great storage organization actually in a theatre of war similar to that of the American Service of Supply forced upon the American Army by the great distance separating it from its main source of supply in America.

The problem of maintenance for the British Army resolved itself into a comparatively simple series of problems. These were as follows, and the organization of the maintenance service followed logically upon the solution of these problems.

(*a*) Who was to be responsible for procuring the material required, and where was it to be procured and stored?

(*b*) Who was to be responsible for demanding the material and for distributing it to the units requiring it?

(*c*) Who was to be responsible for transporting it from the purchasing area to the units?

In the final form of the maintenance service, that is in the form in force at the date of the Armistice, the answers to these queries were as follows:

(*a*) The Ministry of Munitions, acting on the demands of the War Office, procured armament material and the Surveyor General of Supply, War Office, procured general stores. If it was obtained in the United Kingdom it was delivered in bulk to War Office depots

under the control of the Quartermaster General to the Forces. If obtained in foreign countries it was delivered to the order of the Quartermaster General to the Forces on contracts established by the Ministry of Munitions and the Surveyor General of Supply. If obtained in France or Flanders the responsibility for purchase and storage lay with the Quartermaster General, Expeditionary Force, acting through Directors of Services.

(*b*) The responsibility for demanding material and for distributing it to the troops lay with the Commander in Chief in the Field, acting as to policy through the Quartermaster General, British Expeditionary Force, and as to details through the Directors of Services forming part of his headquarters.

(*c*) The responsibility for transporting it was divided as follows:

(1) *For material originating in the United Kingdom.*—From factory or contractor to storage depot the responsibility lay with the Ministry of Munitions and Surveyor General of Supply. From storage to overseas base port the responsibility lay with the Quartermaster General to the Forces acting through the Director General of Movements and Railways, War Office, and in conjunction with the Ministry of Shipping. From overseas base port to troops the responsibility lay with the Quartermaster General, Expeditionary Force, acting through the Director General of Transportation and the agency of the transport forming an integral portion of Armies, lower formations and units.

(2) *For material originating outside the United Kingdom* (*but not in a theatre of war*).—From factory to embarkation port by contractors under contract with the Ministry of Munitions and the Surveyor General of Supplies. From embarkation port to base port in the theatre of war by the Quartermaster General to the Forces acting through the Director General of Movements and Railways, War Office, in conjunction with the Ministry of Shipping. From base port in the theatre of war to troops by the Quartermaster General, Expeditionary Force, acting through the Director General of Transport and formations transport.

(3) Thus all material wherever obtained converged in on the troops in the main through the agencies given by the following table, which shows the chain of responsibility for supply.

Chain of responsibility for supply

Place of origin	Authorities responsible for—						
	Procurement	Bulk Storage	Transit and detailed storage	Movement between—			
				Factory and Bulk Storage	Bulk storage and Port of Embarkation	Port of Embarkation and Port of Disembarkation	Port of Disembarkation and Troops
United Kingdom...	Surveyor General of Supply and Ministry of Munitions.	Quartermaster General, War Office.	In United Kingdom: Quartermaster General, War Office. In Theatre: Quartermaster General, Expeditionary Force.	Ministry of Munitions or Surveyor General of Supply.	Quartermaster General, War Office.	Quartermaster General, War Office.	Quartermaster General, Expeditionary Force.
Foreign Country not Theatre of War.	Ministry of Munitions[1] and Surveyor General of Supply.	Ministry of Munitions[1] or Surveyor General of Supply (through contractor).	In Foreign Country: Contractors to Ministry of Munitions[1] or Surveyor General of Supply. (In Theatre Q. M. G. Exped. Force.)	Ministry of Munitions[1] or Surveyor General of Supply.	Ministry of Munitions[1] or Surveyor General of Supply (through contractor).	Quartermaster General, War Office.	Quartermaster General, Expeditionary Force.
Theatre of War.....	Quartermaster General, Expeditionary Force (through Director).	Quartermaster General, Expeditionary Force.	Quartermaster General, Expeditionary Force.	Quartermaster General, Expeditionary Force (through Director and local contractor).	----------	----------	Quartermaster General, Expeditionary Force.

[1] In certain cases special purchasing missions were created by the Quartermaster General, War Office, in foreign countries, notably for horses and forage. In these cases Quartermaster General, War Office, should be substituted for Ministry of Munitions and Surveyor General of Supply

The Ministry of Munitions and the Surveyor General of Supply were procuring agencies. Their responsibility to the Armies was discharged as soon as they handed over material in bulk to the War Office (Q. M. G.). The Quartermaster General, War Office, took over all storage and movement from this point until material entered the base port in the theatre of war. Thenceforward the whole responsibility rested upon the Quartermaster General, Expeditionary Force, on behalf of the Commander in Chief. There was, therefore, a clear-cut line of division of responsibility between the General Headquarters of an Expeditionary Force and War Office at the point of entry to the overseas base port. Between this point and the troops the responsibility for maintenance lay wholly with the Quartermaster General, Expeditionary Force, but this was exercised only in part directly by the Quartermaster General, the forward portion being exercised through the organ of command from Armies down to units. The dividing line of this executive was the line of division between the "Lines of Communication Area" and "Army Areas," but in point of fact, owing to the many administrative details affected, it was not practicable to make a clear cut line of this nature, and while the executive authority of Armies and lesser formations was confined to "Army Areas," the direct executive control, which the Quartermaster General, Expeditionary Force, exercised through Directors extended in some cases into Army Areas. This was notably the case in regard to movement by railway and inland waterway.

The territorial subdivision of supply inside the theatre of war was thus divided into:—

(*a*) Lines of Communication Area.

(*b*) Army Areas.

In the former the Quartermaster General exercised direct control of the service of maintenance through the agency of Directors of Services, both for storage and movement, and also for local procurement. In the latter the Quartermaster General retained direct control of movement by railway and inland waterway, but in other respects, while still charged with a general responsibility, he did not act executively. The whole of the executive duty in Army Areas was carried out by Commanders of Armies and lesser formations through the subordinate branches of directorates attached to the various headquarters, and by commanders of units through their regimental organization.

In the Lines of Communication Area were located the reserve depots for all material (base depots, intermediate depots, and

advanced depots). These contained the whole of the reserve supplies of all material in the theatre of war except the following:

(1) *Reserves on the man and in unit transport.* These were maintained by sending forward material on the demand of the unit commander from base depots direct in the case of supplies and ordnance stores, and from forward "dumps" in the case of ammunition and engineer material.

(2) *Reserves in unit, Division, Corps, and Army "Dumps."* These were maintained on demand placed on the headquarters of the next higher formation by unit commander, or headquarters of the formation concerned, within the limitations imposed by the general instructions issued by the Quartermaster General. Daily expenditure was maintained automatically without demand by a simple system of reporting expenditure to the next higher formation. Abnormal expenditure required special demand.

(3) *Reserves in base depots.* These were replenished by direct demand by Director of Services on the War Office.

(4) *Material in transit.* This varied chiefly with the intensity of operations. The responsibility for recording it lay with the Director General of Transport down to "truck loads." No record was kept of individual consignments except by consignors, officers in charge of depots, etc., with a view to keeping a check on stock and reporting expenditure.

The whole of this material constituted the reserves in the country. The greater part of it was held in Lines of Communication Area, and the lesser part either in transit or in Army Areas. The reserves in the country were laid down by the Quartermaster General, Expeditionary Force, in consultation with the Quartermaster General, War Office, and varied from time to time with such factors as the intensity of operations in contemplation, the anticipated strength in men, animals, and guns, and the security of the sea-line of communications. To avoid over large storage installation overseas the reserves were kept at a minimum, thus taking advantage of the proximity of the United Kingdom for bulk storage.

Beyond the main division of the theatre of war into "Lines of Communication Area" and "Army Areas," further subdivision was necessitated to ensure adequate local control of administrative matters, such as discipline, the regular issue of rations and forage etc., to troops in the area. In the Lines of Communication Area this subdivision took the form of "Administration Areas" arranged so as normally to comprise in each area an approximately equal number of men. Each of these areas was placed under the control of an Administrative Commandant. Thus each of the Base Ports—Dunkerque, Calais, Boulogne, Rouen, Havre, and Marseille—constituted

an administrative area to itself owing to the large number of army installations, and consequently personnel, concentrated in each. Each of these areas was under a base commandant who was entirely responsible for the administration of all such services located inside the Base Port Area which did not operate directly under General Headquarters. The remainder of the Lines of Communication Area was organized in larger administrative areas, such as the St. Omer Area, Amiens Area, and Abbeville Area, each under its own Administrative Commandant. The Commandants were provided with headquarters, each of which was self-contained in the matter of staff, but formed on a special establishment arranged to cope adequately with the work of the area in question. In control of all the Area Commandants and with the administrative power of an Army Commander was established the General Officer Commanding, Lines of Communication Area, with a suitable headquarters at Pourville. The authority of the General Officer Commanding, Lines of Communication, was analogous to that of the Administrative Commandants though higher in degree. It did not confer any power, even locally, over services dealt with directly by General Headquarters, such as railways or docks. Even in the case of the administrative areas the matters to be dealt with by an Administrative Commandant were so numerous and of so varied a character that it was not possible satisfactorily to administer all of them from a centralized headquarters. Sub-officials were therefore appointed in all important towns, camps, etc., to administer such matters as sanitation, counter-espionage, and the allocation of temporary quarters in billets or camps to troops in transit. These officials were called "Town Majors" in the case of towns and villages, or "Camp Commandants" for camps and hutments. They were normally assisted by a Provost Marshal staff of police, under an Assistant Provost Marshal, for counter-espionage, discipline, and the regulation of road traffic.

Outside the Lines of Communication Area proper, which extended from the rear of the Army to the coast between limits drawn approximately directly to the rear from the outer flanks of Army Areas, there were numerous units and individuals of the British Army in France. Notably there were the Forestry units exploiting the French forests for timber as far south as Bordeaux, and the many troops in transit to and from the East by the overland route via Paris and Marseilles. To secure the local administration of these the whole of France outside Army and Lines of Communication Areas proper was organized as an Administrative Area under the General Officer Commanding the Lines of Communication Area and called the Paris Area. An Administrative Commandant with

a suitable headquarters was placed in Paris. Paris itself was constituted a special subdivision of the Administrative Area of Paris, and placed under an Assistant Commandant, Paris, who was charged with the administrative care of the numerous British personnel who were permitted to visit Paris on leave.

The sub-division of the Army Areas called for no special organization except for the appointment of Town Majors and Camp Commandants. It followed the normal army organization of formations, each of the latter being held responsible for the administration of a definite area allotted to it.

Thus an Army Area was sub-divided into Corps Areas and an area called the "___th Army Area", retained directly under the Army Headquarters and used chiefly for troops not allocated to Corps.

Similarly the Corps Area was sub-divided into Divisional Areas and the "___th Corps Area", and the Divisional Area into Brigade Areas and the "___th Divisional Area".

In most cases the Camp Commandant of the Army, Corps, or Divisional Headquarters acted as the Administrative Commandant of the portion of the Army, Corps, or Divisional Area not definitely allocated to the next lower formation, though in some cases a Special Administrative Commandant was appointed.

It was found that the processes of billetting and sanitation caused so much work to troops on the march during the numerous relief movements between the front lines and resting areas, that the appointment of Town Majors and Camp Commandants, on the same lines as in the Lines of Communication, was justified. Their presence allowed tired troops to settle down in quarters almost immediately on arrival in a halting place, and thus ensured the maximum of rest to the officers and men. At the same time they collected information about the locality which was of the greatest value to incoming units. The appointment of these Town Majors and Camp Commandants throughout Army Areas was, therefore, practically universal.

CHAPTER VII.

SECTION II.

TERRITORIAL SUBDIVISIONS FOR SUPPLY (AMERICAN).

(Chart 2, Chapter VIII, Vol. I.)

ORGANIZATION OF HEADQUARTERS, S. O. S.[1]

In the S. O. S. the necessity for a general staff existed with particular force. The supply services with headquarters at Tours, each controlled large personnel and material, distributed throughout the entire A. E. F., and each rendered a particular service that was vital to the Army. The requirements of these services varied and were at times in conflict. Limited tonnage, labor, transportation and storage demanded that a priority be established, subject to constant readjustment, based upon a just and wise appreciation of the necessities of each service; but above all, meeting the most pressing demands of the Army as a whole. It was this important function that was satisfactorily performed by the General Staff, S. O. S. Through this body the Commanding General, S. O. S., directed his policy, thereby maintaining cooperation between the great supply services. (Extract from Report of Commanding General, S. O. S., to the Commander in Chief.)

THE COMMANDING GENERAL, SERVICES OF SUPPLY.

As previously stated, the functions of the Commanding General, Services of Supply, were finally defined by General Order No. 31, General Headquarters, February 16, 1918; General Orders No. 44, General Headquarters, March 23, 1918.[2]

General Orders No. 31, General Headquarters, created five sections of the General Staff, assigned to each its functions, and directed that subordinate commands should conform in principle to General Staff organization. This permitted sufficient elasticity in the organization of the General Staff at Headquarters, Services of Supply and authorized such changes and reorganization as were from time to time found necessary. General Orders No. 1, Headquarters, Service of the Rear, February 16, 1918, organized the General Staff, Headquarters, Services of Supply, which was then known as

[redacted]

[1] Monograph No. 7, Historical Branch, War Plans Division, General Staff, prepared by Colonel J. W. Wright, General Staff. See Chart 2, Chapter VIII, Vol. I.

[2] [illegible] "E," "G," "H," "I," "J."

the Service of the Rear. Special functions and duties not foreseen at the time General Orders No. 31, were published were later assigned to the most suitable General Staff section, when the necessity arose. The original General Staff of the Services of the Rear consisted of a first, second, third, and fourth sections (G–1, 2, 3, and 4). No fifth section (G–5) was ever established, as training and instruction were supervised directly by General Headquarters. The Operations Section (G–3) was established and functioned until July 12, 1918, when it was absorbed by G–4.

CHIEF OF STAFF AND DEPUTY CHIEF OF STAFF.

There was a Chief of Staff and a Deputy Chief of Staff. The duties of the former corresponded to those usually exercised by that office. The Deputy Chief of Staff was at first the channel through which papers passed intended for the Chief of Staff, and final action of the Commanding General, Services of Supply, but as these papers increased in volume this system was changed and the Deputy Chief of Staff was engaged chiefly in questions of classification and assignment of personnel with special reference to reclassified personnel from Blois.[3]

G–1, Services of Supply

G–1 was chiefly concerned with:

(*a*) Supervision and direction of the replacing of troops through depot divisions, regional replacement battalions, and other agencies designated to handle this class of personnel.

(*b*) Disposition of casual officers and soldiers.

(*c*) Determining the number and kind of Services of Supply troops needed from the United States within the number allotted by higher authority, and determining the priority in which said troops should be sent.

(*d*) Preparation of tonnage statistics and designation of priority for all tonnage from the United States.

(*e*) Matters pertaining to the supplies and equipment of Services of Supply troops.

(*f*) General control of leave areas, athletics and entertainment.

(*g*) Preparation of graphics and charts showing Services of Supply activities in operation.

In addition to the above, general supervision was maintained over all welfare activities and militarized societies.

Upon the signing of the Armistice all matters in connection with the embarkation of troops for repatriation were placed under G–1

[3] For a description of the reclassification system, casual officers' depot at Blois, see report of Commanding General, Services of Supply, to Commanding General, General Headquarters, on file Historical Branch, General Staff.

and an embarkation section was formed in that section to handle them.

A detailed discussion of the functions of this section is contained in the report of the Commanding General, Services of Supply, to the Commanding General, Expeditionary Forces.

G–2, Services of Supply

The function of G–2 (Intelligence) in the Services of Supply was to create a system of counter-espionage as follows:

(*a*) To prevent enemy agents from entering France.

(*b*) To control the movements of civilians in such a manner as to prevent enemy agents from circulating along the American Army's line of communications.

(*c*) To detect enemy agents who might have succeeded in entering France.

(*d*) To prevent the transmission of information by enemy agents across the frontier.

G–4, Services of Supply

G–4 Headquarters, Services of Supply, was concerned with supplies, construction hospitalization, transportation, labor, salvage, troop movements, grave registration, fire prevention, garden service, and billeting. This section maintained representatives at base ports and in training areas in the Services of Supply, to expedite the arrival of supplies and equipment.

In charge of each section of the General Staff was an Assistant Chief of Staff. A Deputy Assistant Chief of Staff was designated to act in the absence of the Assistant Chief of Staff.

Administrative Staff, Headquarters, Services of Supply.

The administrative staff at Headquarters, Services of Supply, consisted of an Adjutant General, Inspector General, and Judge Advocate.

ADJUTANT GENERAL, SERVICES OF SUPPLY

The Adjutant General's Department was subdivided, as follows:

Statistical Division.—This division embraced the following subsections:

(*a*) Personnel Section: This subsection kept complete record of personnel at headquarters, Line of Communications. On December 3, 1918, statistical subsections were established at each of the technical and supply services. The Personnel Section compiled, published, and distributed various lists and directories.

(*b*) Troop Movement Section: Furnished information covering location of organizations in the Services of Supply with their ship-

ping, telegraphic, and postal addresses. A semi-monthly station list of the troops in the Services of Supply was compiled and published.

(*c*) Returns Section: Organized to compile and consolidate monthly returns of all troops in the Services of Supply.

(*d*) Tours Section: A statistical section charged with keeping a card file of every enlisted man in Tours.

(*e*) Officers' Qualification Card Section: This branch provided and procured officers on requisition for special services, selected through information covered by their qualification card.

(*f*) Soldiers' Qualification Card Section: From the soldiers' qualification cards men were selected with special civil vocational qualifications for assignment where their special qualifications could be used to the best interests of the service. These cards were also used to select men with particular military qualifications as a result of specialized training at Army training schools.

Record Division.—This division had charge of Adjutant General records.

Cable and Code Division.—All cablegrams were indexed and filed in the form of a permanent record. On August 6, 1918, the Commanding General, Services of Supply, was authorized to send cables direct to the War Department where they involved matters other than questions of policy.

Orders Division.—Organized to prepare general orders, special orders, and bulletins issued from Headquarters, Services of Supply.

Personnel Division.—Formed to carry on correspondence pertaining to individual officers and soldiers of the Services of Supply.

Chief Clerk's Division.—Organized to receive mail.

Identification Cards and Information Division.—Organized to issue identification cards to officers and to report and index same.

Mailing and Courier Division.—Charged with the duty of addressing and forwarding all official mail.

Headquarters, Printing Division.—Organized a plant for printing at Headquarters, Services of Supply.

Supply Division.—(Blank forms and Adjutant General's Office property.) Furnished the necessary supply of blank forms of the Adjutant General's Office for the Services of Supply. This division supplied officers and men with such postcards as were authorized.

Censor Division: Organized to censor mail.

Miscellaneous Division.—To this division was referred, in addition to miscellaneous matter, all translating done in Headquarters.

INSPECTOR GENERAL'S DEPARTMENT.

This department performed the usual duties assigned to the Inspector General.

JUDGE ADVOCATE'S DEPARTMENT.

General court-martial jurisdiction was granted the Commanding General, Services of Supply, by the President under the special provisions of the 8th Article of War on September 4, 1917. It was also granted to the Commanding Generals of Base Sections Nos. 1, 2, and 5, the advance section and intermediate section, on April 7, 1918, to the Commanding General, District of Paris, on December 23, 1918, and to the Commanding General, Base Section No. 8, on November 8, 1918. The general plan of organization in the Services of Supply called for a Judge Advocate and an Assistant Judge Advocate for each section. Trial judge advocates were secured from line officers. Acting Judge Advocates were stationed in all sections.

The following special matters outside of the duties actually pertaining to his department were referred to the Judge Advocate:

(*a*) The recommendations concerning the immunity of members of the American Expeditionary Forces from French criminal jurisdiction.

(*b*) Immunity of members of the American Expeditionary Forces and its agents from French civil jurisdiction.

(*c*) The establishment of the Rents, Requisitions, and Claims Service.

ALLIED MILITARY MISSIONS AT HEADQUARTERS, SERVICES OF SUPPLY.

Two military missions were established at Headquarters, Services of Supply, French and British. The French Mission was originally under the direction of the "Organe Central des Relations Franco-Américaines." Questions of a purely military nature were, however, referred by the mission directly to the French General Staff.[4]

French officers, constituting a part of the personnel of the mission were attached to the various technical and supply services at Tours and to headquarters of the various sections to facilitate the settlement of Franco-American matters.

The British Mission at Headquarters, Services of Supply, represented the British Quartermaster General.[5] It rendered valuable service by assisting the various supply services to obtain supplies and labor in Great Britain.

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[4] There is on file in the Historical Branch, General Staff, a report by the French Mission at Tours, dated April 16, 1919, prepared at the request of Headquarters, Services of Supply, giving a summary of their duties and a résumé of important questions settled through them.

[5] See memorandum on file in Historical Branch, General Staff, prepared by British Mission, Headquarters, Service of Supplies, giving a résumé of duties.

CHAPTER VIII.

SECTION I.

THE SUPPLIES PURCHASE DEPARTMENT (BRITISH).[1]

In addition to the purchases made by the armies and later by the Central Purchase Board, larger operations had to be entered upon consequent upon enemy submarine activity and the grave necessity for economizing ocean-going tonnage. Early in 1916 the Supplies Purchase Department was formed to exploit the local resources of France for the benefit of the British Expeditionary Force, as far as could be done without encroaching upon the needs of the French Army or the civilian population. At a comparatively early date, however, it was found necessary to expand the Department considerably, and branches were established in Spain, Portugal, Italy, Algeria, and in the French Departments of the Bouches-du-Rhône and the Orne. The head office of the Supplies Purchase Department was in Paris, and worked in close cooperation with the various departments of the French Government.

Considerable quantities of supplies of all kinds were purchased, among which may be cited: Hay and straw, dried fruits, potatoes, onions, linseed cake, bran, pigeon food, champagne, brandy, claret, oranges, chestnuts, fresh vegetables, solidified paraffin, chemicals of various kinds (required for anti-trench feet preparations).

These purchases were primarily intended to meet the requirements of the Army in France, but purchases of certain items were also made on behalf of other theatres of war, e. g., Egypt, Salonica and Italy. From time to time also purchases were made for shipment to England for reserve purposes, notably in the case of champagne and brandy, while, pending the formation of its own purchasing of organization, certain transactions were undertaken in favor of the American Expeditionary Force.

CENTRAL PURCHASE BOARD.

Purchase of Forage in Army Areas.

As the result of an understanding between the British General Staff and the French Military Mission, it was decided in October 1915 that the British should purchase locally the straw required for each division or brigade.

[1] Prepared for the M. B. A. S., through the Office of the Quartermaster General to the Forces, British Expeditionary Forces, by the Director of Purchases.

Purchasing officers were to request the mayor in each "Commune," to inform them of the amount of straw available in commune, allowance being made for the needs of the inhabitants. A list of the names of farmers in a position to sell, and the quantity of straw to be had from each, was also to be furnished by the mayor.

When the purchasing officer had obtained this information, he was to go to the farmers mentioned and endeavor to procure the commodity by purchase, following the instructions about prices laid down by the British military authorities in agreement with the French General Staff. If the purchasing officer could not come to an understanding as to price with one or more farmers, he was to go to the mayor again and hand him a requisition note, and the mayor was bound to give him satisfaction in accordance with the law.

The purchasing officer could not purchase or requisition quantities of straw exceeding the amounts given by the mayor as obtainable.

In certain communes farmers had in their possession crops which had not been threshed, and sometimes they refused to have the threshing done. In such cases the purchasing officer sent a requisition note to the mayor for the quantity of straw he required and it was the mayor's duty to take all necessary steps to give satisfaction to the British military authorities.

Actually, the British General Staff impressed upon purchasing officers that they were to make use of their right to requisition as little as possible, and only when absolutely forced to do so.

Army Purchase Boards.

By November 1915 it was found that considerable quantities of forage existed in the area of the First Army. The D. D. of S. & T. collected it together into a dump, and in January 1916 formed a First Army Purchase Board. Similar purchase boards were established in the other armies.

Schemes to Centralize Purchase Boards.

Early in 1917 it was realized that some army areas contained considerable supplies of forage, while others were almost without it, and on May 3rd, at a conference held at G. H. Q., the Director of Supplies laid down proposals for the establishment of a Central Purchase Board.

At this time the French authorities had decided to requisition for themselves the whole of the available wheat in the army areas. Farmers were to be compelled to thresh existing stocks of unthreshed wheat, and fifty per cent of the resulting straw was to be for the use of the British armies.

In order to deal with this question the Director of Supplies decided to remodel and centralize the existing Army Purchase Boards under G. H. Q. The chief reason for this necessity lay in the fact that the southern armies had in some parts made an advance of at least thirty miles, and were unable to exploit their back areas, and that also certain of these back areas had then passed to the L. of C., for which no purchase board existed.

Under the new conditions, the straw in any particular army area was not to be regarded as exclusively for the use of that army. It would be the duty of the Central Purchase Board to collect this straw at points where the armies required dumps to be made. It was decided to withdraw one Requisitioning Officer from each division to form the Board, and to appoint one officer as president working immediately under the Director of Supplies. The Board would collect the statistics as to available straw, and arrange for its collection and delivery in army areas as required. All threshing and baling machines would also come under the control of the proposed Board.

Inauguration of the Central Purchase Board.

The Central Purchase Board began to function on July 1st, 1917, the president's headquarters being at St. Pol.

Labor was supplied by the Labor Directorate, the men being selected from different labor companies as far as possible according to trade. This system did not work satisfactorily, because men other than those employed on technical work, e. g., engine drivers, feeders, etc., were always subject to removal. To overcome this difficulty it was suggested that three area employment companies should be formed and attached to the Central Purchase Board. The Director of Labor agreed to this, and the three companies were formed in July 1918. Each company consisted of one officer and 273 other ranks, the officer being O. C. Company and a Central Purchase Board Group Officer.

Group Divisions.

The area in which purchases were to be effected was divided into nine groups, each including a number of French cantons, ranging from three to six.

Cantons in army areas were grouped as nearly as possible to conform to the existing five army areas, excepting the southern portion which had to be divided into two, thus making six groups in army areas. In addition, there were three groups of back area cantons. The boundaries of each canton were according to the French map.

One officer (a captain or subaltern) was in charge of each canton, and one officer (a captain) was in charge of each group.

Mode of Purchase.

Canton Officers purchased as much as they could from farmers and others, the principals in each transaction being the Canton Officer and the vendor. Any definite refusal to sell was brought to the notice of the Group Officer, and if no amicable settlement was arrived at through the medium of "Présidents des Commissions de Réception" and local mayors, help was given by the "Intendance de la Région du Nord," through the Central Office.

Threshing for Farmers.

Friendly relations existed between the purchasing officers and the farmers, who seldom raised any objection to selling to the British, though owing to the scarcity of French labor and machinery it was frequently necessary for the Central Purchase Board to carry out threshing operations with British machinery before the straw could be obtained. For this work farmers paid 2.50 francs per quintal of grain realized. Before entering into a contract for threshing, an agreement was made between the farmer and the Board representative that the farmer should sell to the British authorities at least one-third of the resulting straw.

Dumps.

The choosing of dumps was left entirely in the hands of Group and Canton Officers. As a general rule, a dump was created for every three villages, and near a railway station. (Broad gauge).

Prices.

Maximum prices were quoted by the French "Intendance" monthly, and circulated to all groups immediately upon receipt at headquarters. The "Intendance" prices were hardly ever paid, Group Officers always taking care to leave a fairly good margin.

Baling and Machinery.

Before issue, forage was baled, each canton being provided with machinery for this purpose; W. D. where possible, though additional machines were hired when necessary.

Transport.

Groups in army areas were provided with motor and horse transport through the D. D. S. & T. of the army concerned. Groups in back areas were provided through H. Q., L. of C.

Evacuation owing to Enemy Advance.

In March 1918, owing to the rapid advance of the enemy, a number of cantons and dumps had to be evacuated. Large quantities of hay and straw were destroyed by shell fire, and, where possible, what was saved was issued to passing troops or handed over to the French.

Harvesting 1918 Crops in Evacuated Areas.

In July 1918 it was decided that the harvesting of crops in the evacuated and partially evacuated areas should be done by the British authorities, under the following conditions:

(*a*) The work of harvesting was to be carried out by armies under the supervision of the Agricultural Officer, who was responsible for the cutting and stacking of the grain.

(*b*) The Central Purchase Board was then to be responsible for threshing, baling and handling over the produce.

(*c*) Straw was to be bought on charge by the Board, and the French Government credited at the rate of the existing "Intendance" price.

(*d*) Breadmaking grain was to be returned to the French.

(*e*) Oats were to be issued to D. Ds. S. & T. of armies, and accounted for on the same lines as straw.

(*f*) The French authorities agreed to pay the following prices for work done:

		Francs.
Harvesting:	Wheat, oats, rye, and barley ---- per hectare	67.
	Potatoes (carted to dump) ---- do	115.
	Beetroot ---- do	100.
	Hay (stacked) ---- do	50.
Threshing:	per quintal of grain	2.50

As a result the following quantities were realized:

Grain.	Kilos.	*Hay and straw.*	Kilos.
Wheat	2,415,264	Hay	----------
Rye	146,055	Wheat straw	2,644,534
Barley	43,897	Oat straw	263,351
Oats	317,389	Rye straw	185,058
Peas	1,440	Barley straw	18,001
Total	2,924,045	Total	3,110,944

Supply of Forage to the French Mines.

Complaints were received frequently by the President of the Central Purchase Board through Group Officers, that the agents for the French mines were buying forage in their areas, and in order to secure all the available stocks, were paying approximately 20% over and above the maximum prices allowed by the Board, rendering these districts useless as far as the Board was concerned. In order to overcome this difficulty and continue to regulate the market prices, the President of the Board suggested through the Director of Supplies that from January 1, 1918, the mines should be supplied with forage through the Central Purchase Board, by placing their demands for hay and straw one month in advance.

This suggestion was agreed to and forage was supplied at the maximum "Intendance" prices, plus baling and other incidental expenses. Monthly accounts (bills for supplies) were rendered direct by the Investigation Department to the mines authorities, who either handed a bank draft to the nearest Field Cashier, or forwarded it to the Command Paymaster.

Quantities of Forage Supplied to the French Mines.

Year and Month.	*Hay.*	*Straw.*
1918	Kilos.	Kilos.
January	254, 010	214, 800
February	263, 715	212, 325
March	245, 464	253, 210
April	142, 737	153, 083
May	316, 690	357, 545
June	247, 762	218, 069
July	190, 268	171, 511
August	200, 056	160, 844
September	223, 069	160, 380
October	314, 370	218, 132
November	261, 940	223, 622
December	273, 726	267, 305
1919		
January	269, 813	240, 795
February	369, 819	771, 939
March	434, 400	1, 127, 707
April	-------	95, 550
May	898, 966	-------
	4, 906, 805	4, 846, 817

Winding up of the Board.

The Central Purchase Board ceased to purchase on December 31st, 1918, and in May, 1919, instructions were received from the Quartermaster General concerning the disposal of the machinery belonging to the Director of Agriculture, which had been attached to the Board.

The following were returned to England: 5 tractors, 2 stationary engines.

The following machines were sold by the Disposals Board to French civilians, at prices fixed by the Director of Munitions: 8 threshing machines, 20 baling machines, 13 binders, 8 tractors, 4 portable engines, baling wire, saw bench, shafting, lathe, etc.

The remaining machinery was handed over to the French authorities: 21 threshing machines, 21 baling machines, 1 portable engine, 21 tractors, 5 stationary engines.

The Board was finally wound up on September 1st, 1919. At that date there were only two officers and eight other ranks at head-

quarters, and one officer and forty other ranks at Frévent machinery depot.

Central Purchase Board Statistics.

Average personnel strength:		
Officers		51
Other ranks		1,324
Average transport attached:		
Lorries		73
G. S. Wagons		143
Cars and W. D. machinery on charge at the Armistice:		
Cars	49	
Tractors	34	
Threshers	29	
Balers	41	
Bundlers	13	
Oil engines	7	
Portable engines	5	
Average number of civilian owned threshing machines worked by the C. P. B.		182
Hired balers		10
Operations during twelve months:		
Purchases—		
Hay	kilos	31,892,369
Straw	do	37,905,368
Vegetables	do	4,904,372
Linseed cake	do	1,340,344
Threshing of grain for the French	quintaux	266,494
Financial turnover	francs	8,182,256
Cash expenditure on forage:		
July to December, 1917	francs	2,773,876
January to June, 1918	do	4,263,932
July to December, 1918	do	6,133,197
January to August, 1919	do	222,839
		13,393,844

Additional expenditure:	Francs	Additional expenditure—(Continued).	Francs
Hire of civilian transport where Government transport unavailable	141,196	Repairs to machinery where terms of contract necessitated, and upkeep of Government machinery	8,380
Hire of machinery, threshers, balers, etc.	207,944		

Maximum Prices Paid for Forage Purchased

		Loose. Francs.	Bundled. Francs.	Baled. Francs.
Hay	per 1,000 kilos	220	235	245
Wheat straw	do	150	155	175
Oat straw	do	135	140	160
Rye straw	do	150	155	175
Barley straw	do	115	120	140

Note.—25 francs was the maximum price allowed for baled forage.

Prices charged for supplies issued on repayment.

		Francs.
Coal	per 1,000 kilos	80
Petrol	per 100 litres	80
Lubricating oil	do	110
Mineral burning oil	per 45 litres	26
Axle grease	per 25 pounds	15.90

Receipts.

	Francs
Received from farmers for coal, petrol, oils, etc., issued on repayment	435,589.40
Received from farmers for threshing	157,366.87

Losses Owing to Enemy Advance and Enemy Shell Fire.

1918	Group	Dump	Hay	Wheat Straw	Oat Straw	Rye Straw
			Kilos	*Kilos*	*Kilos*	*Kilos*
April 7	D	Acheux	3,752	2,088	151	
April 14	K	Moreuil	37,412	59,110	91,070	
April 30	E	Marceleave	19,734	62,260	53,325	2,370
May 14	A	Strazeele	570	78,283	26,690	
May 14	B	Merville		573,540	255,130	
May 14	B	Gonnehem	2,000	64,533	90,948	4,085
May 14	E	Boves	48,382	195,657	183,833	58,166
			111,850	1,035,471	701,147	64,621

Purchases and Issues Monthly.

(In tons)

Year	Month	Forage		Other commodities	
		Purchases	Issues	Purchases	Issues
	Balance	5,802			
1917	July	3,997	2,937		
	August	3,999	4,136		
	September	6,657	5,392		
	October	6,753	6,686		
	November	5,261	5,996		
	December	4,133	5,227		
1918	January	4,942	4,682		
	February	7,300	5,409	97	97
	March	6,855	6,152	4,213	4,204
	April	2,351	4,869	1,016	938
	May	2,108	5,393	774	861
	June	12,590	14,050	146	146
	July	10,775	6,878	49	48
	August	10,043	8,490	92	93
	September	11,155	6,227	21	21
	October	7,351	4,889	540	540
	November	4,083	4,493	379	361
	December	2,465	4,045	618	612
1919	January	377	6,181	1,084	1,108
	February	326	4,877	396	396
	March	131	2,230		
	April	21	178		
	May	21	79		
	June	899	899		
		120,395	120,395	9,425	9,425*

*Cake	tons	1,171
Roots	do	7,543
Vegetables	do	711
		9,425

CHAPTER VIII.

SECTION II.

DIFFERENT METHODS OF PROCUREMENT IN FRANCE.

The Ministers who were charged with the procurement of food and supplies of all kinds for the armies, caused the services under their orders to prepare estimates or plans for the preparation of the budget. This budget was submitted for approval to the Parliament which voted the appropriations.

Purchases were then made by each of the services concerned according to the funds placed at their disposal. The "Auditing Department" (Direction du Contrôle) verified expenditures and saw to it that the credits authorized were not exceeded.

Purchases were made under contracts by the Government. These contracts were competitive and their conditions were determined by specifications. Contracts were made by means of proposals for bids but, in certain specified cases, private contracts between Government representatives and contractors could also be made and for sums less than fifty thousand francs.

Except in cases beyond the control of the Government public bids for works, supplies, and transports, called for the determination of "limit-prices". By "limit-prices" is meant: the price above which the Government would not negotiate for a certain proposal.

This price can be expressed as being either the lowest acceptable bid (rabais) under the published "base price," or, the highest bid (surenchère) above the "base price" (prix de base) specified in the documents pertaining to the contract. The "limit-price" (prix-limite), was, therefore: either a maximum price which could not be exceeded; the lowest acceptable bid *under* the "base price," or the highest bid *above* the "base price" published. (See explanatory note at the end of this section.)

"Limit-prices" were *never to be made public.* Their determination was the subject of proposals from local services to the Minister concerned and were based upon prevalent economic conditions.

"Limit-prices" were definitely determined either by the Director of the service concerned at the central administration, and acting as the representative of the Minister, or, by the Minister himself in the case of specially regulated proposals for bids.

Bidders were obliged to deposit as guarantee a sum varying from one-tenth to one-twentieth of the bid.

Proposals for bids were approved by "Proposals Commissions" (Commissions d'adjudications). Private contracts were approved by the Minister or by his representatives.

Contracts once approved the Minister concerned was empowered, if it was a question of manufacture, to cause all details thereof to be supervised; this supervision was exercised by persons designated by the Minister for the purpose. These supervisors had free access, day or night, to the plants and shops of the contractor; they could make all verifications, carry out whatever tests they deemed necessary and could also take samples of all manufactured articles or goods.

"Receiving Commissions" (Commissions de réception) verified, accepted, or refused supplies before delivery. "Appeal Commissions" (Commissions d'appel) were established to settle litigations between the "Receiving Commissions" and the contractors. The decisions of the "Appeal Commissions" were mandatory except on appeal to the Minister.

The "Appeal Commissions" were composed as follows:

A Chairman (Président) who was a member of the Chamber of Commerce in whose jurisdiction the establishment chosen as the place of reception was located. The Chairman was appointed by the Minister.

Two suitable members, one appointed by the Administration and the other by the contractors.

The "Appeal Commissions" were appointed for one year.

The arrival in France of Allied units in constantly increasing numbers, caused the French Government to make special conventions with each of the Allied Governments and to participate in the creation of interallied organizations. (The latter are shown in detail in Chapter III.) Most of these interallied agencies functioned outside of France.

In order to prevent a shortage of raw materials and foodstuffs in the French market, the French Government came to an agreement with the Allied Governments so that the latter could not make purchases in France except with its approval.

Furthermore, on account of the distance which separated the American Army from its home territory, it was necessary to provide special regulations to govern the relations between the American purchasing service and the French services.

It was stipulated, at first, that purchases not exceeding the sum of five thousand francs could be made by the American services without being submitted for approval by the French Government. Estimates of purchases were drawn up for periods of three months.

Despite these arrangements, the delivery of matériel to the American troops was extremely slow on account of the lack of liaison between the various organizations of the two Armies.

In December, 1917, a "Central Bureau for Franco-American War Affairs" (Commissariat Général des Affaires de Guerre Franco-Américaines) was created in the French Ministry of War. The purpose of this bureau was to facilitate relations between the American and the French services.

The requests made by the Americans were then satisfied by direct cessions from the French Government to the American Government. Moreover, the chiefs of the American Services could purchase from certain designated agencies or establishments and at fixed maximum prices.

Whenever prices asked by the furnishers were excessive, the French Government requisitioned the merchandise and then ceded it to the American Government.

EXPLANATORY NOTE.—In France, proposals for bids specified a certain sum upon which prospective contractors based their estimates. This *published* price was known as the "*base price*" (prix de base).

The "*limit-price*" (prix-limite) was *not* made public. It was held at the office of the Ministry concerned in a sealed envelope which was not opened until all competitive bids had been received. When all bids were in, the "limit price" (which had been previously determined by competent authorities and which was based upon prevalent market conditions) was opened, bids received were compared therewith and contracts awarded to the contractors making the most advantageous offers, or should no acceptable offers be made, proposals were withdrawn.

Proposals for bids covered three general classes of contracts:

(*a*) Contracts for materials, labor, transportation, etc., for a given project.

(*b*) Contracts to furnish certain supplies *to* the Government (generally periodically).

(*c*) Contracts to purchase certain materials or supplies, etc., *from* the Government.

In the first case (*a*) the "*base-price*" was evidently the "limit-price," because the amount specified in the proposal for bids was "a maximum price which could not be exceeded" or "the price above which the Government would not negotiate for a certain proposal" (see text above). In this case the competing contractors tried to obtain the contract by offering the "lowest acceptable bid (rabais) *under* the published "base price."

The second case (*b*) was practically the same as case (*a*) except that while the "base price" might be published, the "limit-price" was unknown to the bidders.

The third case (*c*) was similar to case (*b*) except that the process was reversed. In this case, the competitors endeavored to secure the contract by offering the "highest bid (surenchère) *above* the 'base-price' published."

Concerning the lowest *acceptable* bid, this may be described as the lowest figure at which it was really possible for the bidder to undertake a contract. A contractor, for the purpose of under-bidding his competitors and thus securing a contract, might submit a very low estimate of cost with the knowledge

that it was utterly impossible for him to fulfill the contract and, were his bid accepted, the Government risked accepting a half-fulfilled contract or being obliged, later, to furnish additional funds for the completion thereof.

RELATIONS EXISTING BETWEEN THE AMERICAN PURCHASING AGENT AND THE FRENCH.[1]

(Annex Chapter VIII, Section II.)

In June, 1917, for the purpose of centralizing consideration of American questions, there was established a "Section Américaine" at the General Staff of the French Army, in connection with the Third Bureau of the General Staff—*Advance Group* (attached to Headquarters Marshal Foch). The matters of supply submitted at that time by the Americans were those dictated by the urgency of the moment and there was no coordination or combination of their necessities. The first steps taken towards this coordination or combination was after the establishment of the General Purchasing Board in Paris and upon Colonel Ragueneau's recommendation. There was established at Paris a section of that Military Mission which was assigned to the American Headquarters. This gave the officers acting in liaison between the General Purchase Board (G. P. B.) and the French services an official standing and, it was during this period that recommendations were first made which led to the establishment of 5,000 francs as the maximum single purchase to be made by an American service without approval by the French. Arrangements were also made for the preparation of quarterly forecasts of needs. The lines of communication between the American and French services were indirect, inasmuch as requests from the American services went first to this Paris group, then to the French Mission at G. H. Q., thence to French General Headquarters and, finally, to the French service concerned. There was an insufficiency for the supply for the French services themselves so that the American requests were complied with by the French services only when there was an abundance of material.

In December, 1917, upon Mr. Tardieu's return from the United States, he was directed by the President of the Council to investigate the question of Franco-American relations. As a result of his recommendations, there was established in the French Ministry of War a "Commissariat Général des Affaires de Guerre Franco-Américaines." The Paris section of the French Mission at G. H. Q., now became the Paris section of the "Commissariat Général" and, as a

[1] Extract from the report of Commandant Varaigne, Chief of the Paris Section, Office General Purchasing Agent, American Army.

result of the centralization of these questions by the Minister of War, the matter of supply to the American troops was looked upon in a larger way and arrangements were made for allocation or allotment of raw materials or finished products by the French to the American services.

With the establishment of this "Commissariat Général" there came a more direct relation with the French services, inasmuch as requests were made by the American services to the General Purchasing Agent, thence to the French Mission, and thence, in unimportant matters not involving a principle, direct to the French service concerned. In case a principle was involved the matter was taken up with the "Commissariat Général" of the French Ministry of War.

The consolidation of requests, the establishment of forecasts by the American troops, and the establishment of direct communication between the Americans and the French led to a very workable arrangement between the two Armies.

In many cases, such as in the use of material or of work in which various ministries were concerned, there were established by the French, inter-ministerial committees whose approval had to be secured before the official arrangement for purchase or supply could be made; such was the "Commission Inter-Ministérielle des Métaux" and the "Inspection Générale des Bois".

There was, of course, established in the Office of the General Purchasing Agent a "Control Bureau" to see that the summation of the requests for any particular article by the American services did not exceed the amounts of that material alloted by the French for American needs.

Requests made by the Americans were met by the French by direct cession by the French Government to the American Government or by authority being given to the chiefs of American services to purchase from certain designated agencies or concerns but always with a certain limitation set as to price to be paid. Oftentimes the price asked was in excess of that authorized, in which case the French Government requisitioned the material and ceded it to the Americans.

NOTE.—It is interesting to note, in the matter of organization, that the Paris section of the "Commissariat Général," in order to function smoothly with the American services had to divide itself into sections corresponding to these services. Perhaps the chief cause of delay in the furnishing of material by the French, was the necessity of rearranging and consolidating requests from the American services so that they could be forwarded to the French services handling the material asked, as the latter services did not correspond in the least to the American. Each of the French services, after the establishment of the "Commissariat Général", established within itself an "American bureau" whose duty it was to expedite American requests.

CHAPTER VIII.

SECTION III—PART I.

ORGANIZATION AND OPERATION OF THE "GENERAL DIRECTION OF THE ARMAMENT AND OF THE TECHNICAL SERVICES OF THE ARMY" DURING THE WAR (D. G. A. S. T. A.) (BELGIAN).[1]

INTRODUCTION.

The requirements of an army in the field are numerous and varied. Not only does it require:

A. Food, beverages, forage, clothing and equipment, etc., but it also needs:

B. Infantry matériel and ammunition; artillery matériel and ammunition; engineer supplies, including railway matériel, tools, equipment, lumber, metals, stone, cement, etc.; aviation matériel; motor transport matériel; liaison matériel, including telephone, telegraph, wireless and signaling equipment; scientific and optical instruments; electrical matériel; matériel for defense against gas attacks; medical equipment and pharmaceutical, as well as hospital supplies.

All of these needs were felt by the Belgian Army. How to satisfy them became one of the most difficult problems of the war for Belgium, especially as she had been deprived of her bases and because her national territory was occupied by the enemy.

From the beginning of the campaign, all the requirements under the heading "A" devolved upon the military "Intendance" services; they will, therefore, not be mentioned again in this section.

At the end of the war the requirements mentioned—and they were the most perplexing—under the heading "B", were obtained through the agency of the "General Direction of the Armament and of the Technical Services of the Army" (Direction Générale de l'Armement et des Services Techniques de l'Armée), which will henceforth to be designated by its initials: D. G. A..S. T. A.

As will be shown in that portion of this section entitled "Historique," the organization which functioned during the last months of the war was only attained little by little. Only the experience

[1] Prepared for the M. B. A. S. by the Chief of the D. G. A. S. T. A. at Paris, pursuant to instructions from the Belgian Ministry of War.

gained during the campaign made possible the conception of an organization, sufficiently important and possessing the necessary autonomy, for the successful execution of its mission.

What was the D. G. A. S. T. A.? How was it organized? How did it function? An endeavor will be made to answer these questions in the following sections.

I.

What was the D. G. A. S. T. A.?
What were its functions, its aims?

A Royal Decree, dated September 10, 1917, determined the functions of the Director General.

These duties were compatible with the abilities of General Baron Empain, who alone possessed the necessary qualifications and knowledge (those of a great merchant and, at the same time, of a great financier) to act as technical and economic advisor to the Minister of War, which duties devolved upon the D. G. A. S. T. A. in all matters concerning armament, the "technical" services[2] and supplies, with the exception of questions of supply concerning the "Intendance."

The other functions, which were not of such exceptional character and in which the Director General acted as representative of the Minister (although, in certain cases, matters had to be submitted to the latter for approval), can be summed up in two words: *Study*, *Procurement.*

Preparation of studies concerning the Army's future requirements, improvements and economies to be effected, either upon his own initiative, or upon the request of the Minister of War, or of the Commander of the Army.

Procurement of all of the Army's requirements, either through purchase or through production.

By purchase: from Allied Governments, through cessions from these Governments, or, from French, British, American or Italian (in exceptional cases) private concerns.

By production: through orders to manufacture to one of the manufacturing or exploitation services of the Army over whom the authority of the D. G. A. S. T. A. extended. These manufacturing and exploitation services will be described in subsequent sections.

How was the D. G. A. S. T. A. organized to enable it to fulfill its twofold mission? This will be explained in the following section.

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[2] The "technical" services were: Aviation, Ballooning, Field Railways and Railway Engineer Battalion, Wireless, Signaling, Searchlights, Chemical Warfare, Water Supply, etc.

II.

Organization of the D. G. A. S. T. A.

The D. G. A. S. T. A. was organized as follows:

1st. The "Direction" (headquarters) at Paris.
2nd. The "Paris Services".
3rd. A purchasing commission at London.
4th. A purchasing commission at New York.
5th. Various "services", in proximity of the front, at La Panne.

The organizations which comprised the D. G. A. S. T. A. will be examined successively. It is important to remember, however, that this information is rather theoretical. The scarcity of officers from which the Army suffered accounts for the fact that several of the services or functions mentioned only existed during a few months, some of them for a few weeks only. The organization given here is that which existed during the first three months of 1918.

III.

The "Direction" and the "Paris Services."

1. The Direction.

Composition: A. The Director General.
B. A staff officer detailed to assist him.
C. A superior officer, known as the "Director of War Manufactories" (Directeur des Fabrications de Guerre), who was specially charged with the manufacturing and exploitation services.

2. The "Paris Services."

A. *The Staff* (Direction) and the central administration mentioned above.

B. *A Headquarters* (Secrétariat) whose functions were:

1st. Assist the Staff in all matters concerning the administration of the services.
2nd. Maintain liaison with the important French administrative departments (Ministry of Armament and War Production, Ministry of War, etc.).
3rd. Handle incoming and outgoing mail. (During the war from four to five hundred letters were received and an equal amount were sent out daily.)

4th. Manage the storehouse in which supplies arriving from various places in France were stored.

5th. Direct the motor transport service for the hauling of merchandise in Paris and in the vicinity of Paris.

6th. Direct the rail transport and the convoy services.

C. *Research and Purchasing Services* which were subdivided as follows:

Service I. Artillery matériel; machine tools; wires; nails and gratings.

Service II. Artillery ammunition; explosives and powders, artifices, solid and liquid combustible materials.

Service III. Technical Artillery questions.

Service IV. Engineer matériel and supplies.

Service V. Infantry matériel and ammunition.

Service VI. Metals; railway matériel.

Service VII. Tools; hoisting apparatus; pumps.

Service VIII. Motor transport matériel; harness.

Service IX. Aviation and ballooning matériel.

Service X. Electrical equipment; steam engines.

Service XI. Liaison matériel, signalling, telegraph, searchlight, telephone, wireless, equipment.

Service XII. Precision instruments; measuring and optical instruments; printing and lithographing; cables and ropes.

Service XIII. Chemical matériel and products; anti-gas matériel.

Service XIV. Pharmaceutical supplies and medical matériel.

Service XV. Hospital and office equipment.

Service XVI. Wood supply service. (Also directed the forestry exploitation services.)

D. *Auditing Service.*—Paid for all purchases made by these offices by means of checks on the "Banque de France;" on an average 5,000,000 francs per month.

E. *A Statistical Service* which also verified purchase orders.

F. *An administrative unit* (company) for the administration of the subordinate military personnel.

G. *An Inspection Service* attached to the D. G. A. S. T. A., which controlled certain manufactures in the producing plants.

Theoretically, each of these services was composed of one officer and one or two non-commissioned officers, the latter acting as clerks or bookkeepers. In practice, two or more services were directed by one officer.

Assignment to the various services mentioned above was made according to the qualifications and special knowledge of the officers placed at the disposal of General Empain by the Minister of War; most of these were Reserve Officers who had been manufacturers or

business men in civil life. It was only towards the end of 1917, that officers from the active list of the Army were assigned to duty with the D. G. A. S. T. A., so that this organization could be maintained after the demobilization.

The organization of the research and purchasing offices at Paris having been described, it will now be shown how these services operated, each in its particular field, to procure the Army's requirements.

IV.

Purchases in France. Cessions from the French Government.

As already shown in a preceding section various articles or supplies which could not be manufactured or produced by the manufacturing or exploitation services of the Belgian Army (which will be described later) were purchased either from private industrial concerns or from an Allied Government. The latter ceded such supplies to Belgium.

The French Government aided Belgium very generously. The personal ability of General Baron Empain, as well as his broad connections and the ease with which he gained access to the various Ministers of the French Republic, greatly facilitated the task of the D. G. A. S. T. A., nevertheless, it is true also that the name "Belgium" often sufficed to conciliate the sympathies and obtain the good will of all.

The supplies which were more often ceded to the Belgian Government were:

Certain models of French artillery matériel[3]; shells, powders and explosives; small arms; helmets; Engineer material; aviation material; tractors, motor trucks and trailers; telephone apparata and searchlights; anti-gas material and medical supplies.

Belgian relations with the various French Ministries were not limited to requests for cessions. The Belgians frequently called upon the French technical services (which were composed of officers whose competence and kindness were equally admirable) for assistance and a large measure of the success achieved by the officers of the D. G. A. S. T. A. in technical studies was due to the friendly aid which the Belgians received from the French.

Purchases from private industry were only made after appeal to competition.

[3] The Schneider matériel in use in the Belgian Army was not the object of cessions. It was delivered to Belgium by Schneider and Company in exchange for labor furnished by the Belgian artillery establishments at Le Havre, in accordance with the terms of a special contract.

Orders were given to the most favorable bidder and were drawn up on standardized blanks; these were numbered and included "receipt coupons" to be filled and returned by the contractor.

A few remarks are necessary on this subject.

1. *Reception.*—The shortage of personnel made it impossible, except for certain particularly important manufactures such as the making of shells, to maintain control at the producing plant or at the storehouse. Of necessity, the Belgians had to adopt the system of controlling products upon delivery of same, through the receiving services.

2. *Place of delivery.*—One of the most difficult problems which the D. G. A. S. T. A. had to solve was the transport of merchandise.

The railway transportation crisis in France became particularly acute towards the end of the war. Military transports alone were authorized; even then, it was necessary to obtain priority orders from the various railway commissions (Commissions de Réseau) which had been organized by the French Government.

Direct shipments from the producers to the services concerned, in spite of the military transport orders which authorized them, were liable to several months' delay. For this reason, deliveries were made in most cases to the storehouse which had been established in Paris by the D. G. A. S. T. A., even though the merchandise was not procured in the region of Paris; hence, the necessity of organizing storage services, motor transport services for the hauling of supplies to and from railway stations, as well as railway transport services. In addition thereto there was a convoy service, as all shipments were convoyed. Shipments amounted to from fifteen to twenty carloads per week and required maintaining a personnel of 70 to 100 convoy guards. Despite all these difficulties, transports were carried out efficiently throughout the war. Here again thanks are due to the French services, as they did all in their power to assist the Belgians.

V.

The Manufacturing Establishments or Services.

The manufacturing services over which the D. G. A. S. T. A. maintained a technical industrial and commercial control, whose operations it supervised with obligation of studying possible improvements in connection therewith and of determining the general economic policies thereof, were:

1. The war manufacturing plants which were generally known under the name of *Artillery Establishments* (Etablissements d'Artillerie—E. A.)

2. *The shops belonging to the "technical services"* already mentioned: aviation, ballooning, railway, wireless, etc., etc.

The organization, history, and operation of the E. A. has been fully described elsewhere. Repetition here would be useless and it will therefore suffice to enumerate the shops which composed them and thus recall their activities.

Most of the artillery establishments were located at Le Havre. Others were at Calais, at Dunkerque, and in England.

The establishments at Le Havre (Etablissements du Havre) comprised:

1. *A "Direction" of the artillery establishments* (Direction des établissements d'artillerie—D. E. A.

2. *Shops for the manufacture of munitions* (Ateliers de fabrication de munitions—A. F. M.), some of these were located at Gainneville and the others at Bundy.

The Bundy establishments manufactured explosives, loaded the shells (including shrapnel ammunition), assembled them and finally added the cartridge cases. These shops only employed 1,600 workmen and were naturally unable to supply all of the Belgian Artillery's ammunition requirements. The adoption of artillery matériel of the same caliber as the French enabled the Belgian Army to obtain supplies of artillery ammunition from its Allies by means of cessions.

3. *Foundry Shops* (Ateliers de fonderie—A. F.) for iron castings, copper founding and copper alloys.

4. *Shops for the construction of animal drawn transportation* (Ateliers de construction du charroi hippomobile—A. C. C. H.) for the construction of vehicles for animal traction, carts, vans, caissons, etc., of all types in use in the Army, as well as saddle bars and, in general, all articles made from wood.

5. *Precision Shops* (Ateliers de précision—A. P.) for optical instruments (sights, levels, etc.) and clock work.

6. *Saddlery Shops* (Ateliers de sellerie—A. S.) for the manufacture of harness and equipment and, in a general way, all leather work, tarpaulins and rope material.

7. *Blacksmith Shops* (Ateliers de maréchalerie—A. M.) which manufactured all the horse-shoes, nails, etc., required by the Army.

8. *A Service for the construction of military buildings* (Service de construction des bâtiments—S. C. B.) charged with all construction work on shops, barracks, etc., for the artillery establishments at Le Havre.

9. *Artillery and Engineer Stores* (Magasin d'Artillerie et du Génie—M. A. G.) which supplied the Army with tools, kitchen equipment, various materials, arms, as well as necessary fuels and

lighting materials. This establishment also made minor repairs on tool equipment.

10. *Shops for the construction of artillery matériel* (Ateliers de construction de matériel d'Artillerie—A. C. M. A.).—These shops manufactured artillery matériel, artillery carriages, and caissons for the Belgian Army.

They specialized in the manufacture of 75 mm. field pieces, 105 mm. long, Schneider model guns, and 105 mm. howitzers. The even created a new, powerful, long-range 75 mm. gun. Only the lack of equipment prevented these shops from undertaking the manufacture of 155 mm. and heavier caliber guns complete. The cost of such equipment was so great that General Empain deemed it preferable to enter into a contract with Schneider and Company. By the terms of this contract the Belgian artillery establishments executed such work for the Schneider Company as could be done with the equipment at their disposal, and they received in exchange artillery matériel of all calibers and of the most improved pattern.

As a matter of fact, the work furnished by the Belgian artillery establishments was rated at the same cost as that of the other subcontractors of the Schneider Company. Thanks to this contract, the Belgian Army was enabled to equip its artillery with matériel similar to that used in the French Army and in proportionately larger number.

11. *The Electrical Service* (Service Electrique—S. E.) which operated the main electrical power plant of the artillery establishments. It also installed the electrical equipment of these establishments and maintained a shop, with facilities for the construction of certain electrical apparatus and for the repair of the electrical matériel of the Army.

12. *The Shops for the construction of motor transportation* (Ateliers de construction du charroi automobile—A. C. A.)—These shops carried out all work for the repair and upkeep of the Army's motor cars, motorcycles and bicycles; they also maintained a carriage-shop.

13. *The Transport Service* (Service des Transports—S. T.) which handled freight in the railway stations, haulage by animal-drawn transportation and assured the parcel-post and courier services.

14. *The Transport Corps of Le Havre* (Corps des Transports du Havre—C. T. H.) or motor transport service, which had charge of all motor trucks, tractors and trailers.

15. *A "Detachment of Artillery workmen"* (Détachment d'ouvriers d'Artillerie—D. O. A. H.) This was a unit for the administration and supervision of the 8,500 men who worked at Le Havre.

CALAIS.

There was a "Detachment of Artillery workmen" at Calais, similar to the one at Le Havre and it furnished the personnel for the establishment known as the "*Shop for the repair of matériel*" (Atelier de réparation du matériel—A. R. M.). The A. R. M. comprised two subdivisions:

1. *The small arms shops* (Ateliers d'armes portatives) for the repair of pistols, rifles, carbines, side arms, tripods, shields, machine-guns, etc., etc., and, in general, of all infantry armament.

2. *The shops for the repair of matériel* (A. R. M.), to provide for the repair of guns, gun carriages, caissons, field kitchens, animal drawn transportation, etc., at a place in closer proximity and more convenient to the front than the establishments at Le Havre.

To reduce transportation, the A. R. M. detailed crews to the front to repair matériel on the spot and organized the following mobile units for that purpose: A repair shop for guns, a repair shop for caissons and a repair shop for field kitchens.

Besides these, it maintained a small shop in each army division for the repair of the animal drawn vehicles of the transport corps, forage carts of the units, etc.

DUNKERQUE.

At Dunkerque, in the shipyards known as the "Chantiers de France," a "Service for the construction of barges" was established for the construction and repair of the numerous barges required by the Belgian Army for transports in the canal region in which it had to fight. This service was also under the A. R. M.

MARCK.

At Marck there was a *shop for the repair of motor transport matériel* (Atelier de réparation de matériel automobile—A. R. M. A.) and a large motor transport reserve park (Grand Parc automobile de réserve—G. P. A. R.)

The A. R. M. A. maintained a *shop for the repair of motor transportation* (Atelier de réparation du charroi automobile—A. R. C. A.) at the front. It will be seen that, according to the importance of repairs to be effected, vehicles were sent either to the A. R. C. A. at the front, to the A. R. M. A. at Marck or, finally, to the A. C. A. at Le Havre.

ENGLAND.

The Belgian manufacturing establishments located in England were:

1. The *Birmingham Small Arms Factory* (Ateliers de fabrication d'armes portatives de Birmingham—A. F. A. P.) which manu-

factured and repaired infantry armament; rifles, carbines, machine-guns, bayonets, etc.

2. *The Colnbrook Factories* which manufactured nitrate explosives.

The enumeration of the artillery establishments shows what a vast organization they formed. A better idea of their importance may be gained by giving the number of personnel which they employed, i. e.: 160 engineers or officers; 10,250 troops and about 2,000 civilian employees.

Finally, as it was under the orders of the D. E. A., and consequently of the D. G. A. S. T. A., the "*Invention Service*" (Service des Inventions.—S. I.) which had been established at Paris must also be mentioned. This service was charged with investigating, examining and reporting all inventions pertaining to warfare which appeared in France or abroad.

In connection with the "Artillery Establishments," it seems necessary to mention herewith the special corps of "*Artillery Engineers*" (Ingénieurs d'Artillerie) which formed the staff of these establishments. This is a purely Belgian institution and one which will not be found in any other country. The Corps of "Artillery Engineers" was created in 1913. The members of the Corps are civilians but are given a military rating and rank. They are recruited from among Artillery and Engineer officers who have shown themselves to be particularly qualified and who have made special technical studies. Their pay is higher than that of other officers of the same age, and advancement is selective.

During the war, the Corps of Artillery Engineers was brought up to full strength by calling Reserve Artillery Engineer officers into active service for the duration of the emergency only. The latter were recruited from among the Reserve Artillery and Engineer officers and from civilian engineers and industrial managers, whether reserve officers or not, who, in time of peace, were engaged in special work similar to that accomplished by the Artillery Establishments.

The Corps of Artillery Engineers rendered valuable service during the war. Although numerous engineering specialists from civilian establishments came into the Service, it should not be forgotten, however, that it was the peace time Engineer organization which formed the nucleus around which the newcomers assembled. The French technical services were much impressed and requested permission to study the organization of the Belgian Artillery Engineers Corps.

At the beginning of this section it was stated that the manufacturing services which functioned under the D. G. A. S. T. A., in addition to the artillery establishments, comprised the "*Shops for the Technical Services*" (Ateliers des Services Techniques).

The definition of what is meant by "technical services" has already been given. Each of these services maintained its own shops for the repair and upkeep of the special (technical) matériel employed; these were so organized as to enable them to carry out practical experiments and, eventually, to undertake minor construction work. These shops were, for the most part, located at Calais. They comprised:

1. *The Aviation Shops* (Ateliers d'Aviation)—(known as "Services annexes").—These shops received all airplanes obtained through cessions from the Allied Governments and made final tests. They repaired all aviation material in service, undertook minor construction work, classified spare parts and constituted, so to speak, a general supply depot for the aviation service.

2. *The Shops for the Balloon Service* (Ateliers de l'Aérostation) which undertook repair work only.

3. *The Shop for the Wireless Service* (Atelier de la T. S. F.).—This shop repaired all of the Army's wireless equipment and constructed certain apparatus, particularly trench equipment.

4. *The Shop for the searchlights of the Army* (Atelier des projecteurs de l'Armée) for repairs only.

5. *The Shop for the Signal Service* (Atelier de la Signalisation) for the repair and upkeep of all signal matériel, including telephone apparatus. It also manufactured trench telephone equipment.

6. *The Shop for Trench Artillery matériel* (Atelier de l'Artillerie de tranchée) for the repair of trench mortars and for carrying out experiments. It was in these shops that the "V. D." (Van Deuren) trench mortar was perfected. This mortar was adopted by the Belgian and by the Italian Armies; it was also used by the French Army for a while.

Outside of Calais were located the shops of the military railways. These were organized as follows:

7. *The Railway Engineer Battalion* (Bataillon de Chemin de fer du Génie), (charged with the organization and operation of railways in proximity to the front) maintained two depots, with shops in connection therewith. The first at Adinkerke and the second, for narrow-gauge material, at Klein-Leysele.

8. *The Field Railways Section* (Section des Chemins de fer de campagne) (which functioned as an organ of transition between the railways operated by the Railway Engineer Battalion and those operated by the normal civilian railway agencies) maintained three depots and shops, namely at Marck, located ten kilometers from Calais on the Calais-Bourbourg line; at Oissel, located ten kilometers south of Rouen on the Seine, and at Adinkerke Finally, there was also:

9. *The Shop of the Direction of Inland Water Transports* (Atelier de la direction des transports par eaux intérieures—T. E. I.) located at Bourbourg, which was charged with the repair of the matériel of the T. E. I.

VI.

Exploitation Services.

The exploitation services under the D. G. A. S. T. A. must be subdivided into two separate classes:

A. *The exploitation services* in Flanders and in the Pas-de-Calais, with headquarters at La Panne.

B. *The forestry services*, whose headquarters were at Paris.

A. *Exploitation services in Flanders and in the Pas-de-Calais.*

It has already been seen in the section pertaining to the organization of the D. G. A. S. T. A., that it maintained services in proximity to the front at La Panne.

The function of these services was to exploit the region in proximity to the front for the purpose of obtaining Engineer material. Particularly: Building stone and road metal; stone for concrete work; cement and cement pipe lines; bricks.

The quarries, plants and brick-yards, which were directed by the services at La Panne, and which were operated by means of military labor are enumerated below.

1. *Quarries.*—There were ten quarries in the Pas-de-Calais, namely:

a) Pebbles, quarry at Virval near Calais.
b) Stone for concrete, "Médard" quarries at Noyelle.
c) Stone for concrete, "Gérard et Vanier" quarry at Noyelle.
d) Limestone, black-bank quarry at Caffiers.
e) Limestone, high-bank quarry at Elinghem.
f) Limestone, "Carbon" quarry at Elinghem.
g) Gravel, "Leroy" quarry at Arques.
h) Gravel, "Gilson" quarry at Campagne.
i) Gravel, "Payelleville" quarry at Campagne.
j) Sandstone, "Dannebroecq" quarry at Dannebroecq.

2. *Peat.*—A peat-bog was exploited at Nieurlet, near St. Omer.

3. *Cement works.*—Cement works at Camiers were leased for the duration of the war and were operated by means of military labor. These works were able to supply the enormous quantities of cement required for the entire Belgian Army.

4. As the aquaceous nature of the Flanders region necessitated employing a considerable amount of drainage pipes. a factory was established at Klein Leysele for the manufacture of cement pipes.

5. Finally four brick yards, three at Furnes and one at Rosendaele, furnished the millions of bricks used in the construction of shelters.

The exploitations in Flanders and in the Pas-de-Calais rendered valuable services to the Army and the enemy's aviation and artillery sought frequently to interrupt their work.

B. *Forestry Services.*

In the organization of the research and purchasing offices at Paris, it was seen that a service known as the "Wood Supply Service" (Service des Bois) was charged, not only with the purchase of the Army's requirements in wood, but also with the direction of the Army's forestry services.

The functions of the "Wood Supply Service" were:

1. The exploitation of forests by means of military labor.

2. Contract with civilian contractors for the acquirement of their entire output, and facilitate production by placing military labor and prisoners of war at their disposal.

3. Purchase from private concerns.

4. In case of necessity, make requests for cessions from the Allied armies.

At the end of the war, the situation of the Belgian forestry operations was as follows:

1. *Military Operations.*

a) Exploitation in the region of Guines, which made direct shipment to the front, either by water or by rail.

b) Exploitation in the Orne region at Mayenne (with headquarters at Neuilly-le-Vendin), shipments through Honfleur.

c) Exploitation in the Coulonche region (Orne), shipments through Honfleur.

d) Exploitation of the "Huisserie" near Laval (Mayenne), shipments through Honfleur.

e) Saw-mills at Dunkerque, put into operation about October 15, 1918, and discontinued immediately after the Armistice.

f) The Belgian establishments at Le Havre, Calais, Gravelines and the depots at the front.

2. *Civilian Contractors.*

Certain contractors turned their entire production over to the Belgian Army and employed military labor or prisoners of war furnished for this purpose. These civil establishments were located at: Chambly, Chars, Jumiéges, Rouen, Orbec, Beaumont-le-Roger, Pontorson, Villechauve and Onzain.

3. *Direct Purchases.*

Purchases outside of France were null. In France, wood supplies were purchased from contractors throughout the country.

4. *Cessions.*

The French and British services authorized cessions to the Belgian Army.

5. *Personnel.*

At the date of November 11, 1918, the Belgian personnel engaged in forestry operations consisted of:

1. *With the military exploitations:* 22 officers, 1,242 troops and 220 prisoners of war.

2. *With civilian contractors:* 170 troops and 650 prisoners of war.

An idea of the importance of the Belgian forestry services may be gained from the following figures, pertaining to total production:

5,000,000 stakes.
1,500,000 meters of poles.
30,500 cubic meters of billets.
15,000 posts.
38,000 cubic meters of timber.
20,000 cubic meters of sawed lumber.
70,000 cross-pieces.
650,000 bundles of gabion-rods.
100,000 cubic meters of fuel wood.

VII.

Storage Services—Parks and Stores

It has already been stated that in addition to his being a technical and economic advisor, the D. G. A. S. T. A. was also charged with two principal functions which were summed in the words: "Study" and "Procurement."

There was a third function which was closely connected therewith, i. e, The direction of the storage services (parks and stores, etc.) of the Army, with the exception of those devolving upon the Ministry of the Intendance or upon the Chief of the General Staff.

The study of these storage services will form the subject of this section.

The supplies of the Belgian Army were assembled in proximity to the front, at Gravelines, in two main parks:

a) The "Army Engineer Park" (Parc du Génie d'Armée—P. G. A.)

b) The "Main Field Park" (Grand Parc de Campagne—G. P. C.)

A.—*The P. G. A.*

As a matter of fact, the P. G. A. was the depot for all Engineer matériel and supplies. It operated two shops, a saw-mill and a carpenter shop.

It also maintained two secondary parks or "parcs annexes", with saw-mills attached, near the front. One was located at Adinkerque and the other at Klein Leysele.

A *Camouflage Service* supplied the P. G. A. with burlap and other materials for the organization of positions. It also detailed specialists to the Army divisions to handle these materials.

The shop of the Camouflage Service was originally located at Amiens, by the side of the analogous French and British services. It was obliged to leave Amiens during the operations in March, 1918, and establish itself at Neuchatel; it was to move to Gravelines, but the signing of the Armistice prevented.

B.—*The G. P. C.*

The Main Field Park formed a depot for: Artillery matériel, guns, shells, etc.; infantry matériel and ammunition, small arms, trench material, etc.; animal drawn transportation; lubricants, oils, lighting materials, etc.

The G. P. C. maintained a secondary ammunition depot which was located at Marck.

In addition to these "parks" there was a huge storehouse at Le Havre, the "M. A. G.", which has been described in connection with the Belgian artillery establishments at Le Havre. The M. A. G. constituted a second echelon or second reserve of supplies. It was, therefore, the only source of supply of the P. G. A. and G. P. C. for materials, arms, fuels, tools, hardware and metals, and for supplies of all kinds included in its stocks.

HISTORICAL STATEMENT (HISTORIQUE).

At the beginning of the war outside of the "Intendance" service, which specialized in certain supplies, there existed no special organization in Belgium for the procurement of the Army's requirements. As a matter of fact, this task was undertaken by the Cabinet of the Minister of War with the assistance of the Belgian Military Attachés at London and at Paris. But if this was possible at the outset, owing to the fact that the Belgian Army subsisted upon the reserves of supplies which had been accumulated in peace time, it was evident that this condition could not endure. At the end of a few months the Belgian Army found itself deprived of everything and its stocks of supplies had to be replenished; moreover, the introduction of new methods of warfare, as well as the stabilization, increased the needs of the Army beyond all previous estimates. At the end of the battle of the Yser, the Minister's Cabinet was engaged in other labors and it began to

relieve itself of a part of the task of purchasing the necessary materials and supplies for the Army. Furthermore, the Belgian Military Attachés were overwhelmed with work.

In November 1914, when the Belgian Minister of War was at Dunkerque with Colonel Baron Empain, he suggested that Baron Empain undertake the acquisition of matériel. It should be mentioned that at that time, when Belgium was in the hands of the enemy and the Government was seriously embarassed because the question of credits to be ceded by the Allies had not, as yet, been settled, Baron Empain unhesitatingly placed his fortune and his personal credit at the disposal of his country and ordered his bankers at Paris to pay all furnishers to the Belgian Army. It was therefore quite natural that the Minister of War request him to handle purchases.

Colonel Empain established himself in Paris and assumed the title of "representative of the Minister of War" (Délégué du Ministre de la Guerre).

No well defined limit had been specified as to the purchases which he was to handle. He kept in touch with the Minister and acted in his name.

March 24, 1915, six "technical directions" (directions techniques) were created: Aviation; military telephones and telegraphs; military wireless; balloon service; field railways and, finally, searchlight service.

At the same time, a "special supply direction" (direction spéciale d'approvisionnement) was created for these "technical directions," under the command of Colonel Baron Empain. His functions consisted, particularly, in acquiring the necessary matériel for the technical services as recommended by the chiefs of services and with the approval of the Minister of War. Furthermore, Colonel Empain was to submit to the Minister whatever recommendations he deemed advisable with regard to the improvement of the technical services. There was evidently no question of exercising military command over these services or of interfering with military operations.

The creation of this special direction was but a step toward the development of a larger and more independent organization for the coordination of purchases and the preparation studies in connection therewith.

On July 5, 1916, the "superior direction of the Engineer technical services" (direction supérieure des services techniques du Génie—D. S. S. T. G.) was created. Colonel Empain was no longer charged with purchasing for the technical services only, but with the purchase of all Engineer matériel. He personally examined requests for purchases, thus relieving the Minister of this burden. He had

superior direction over the Government controlled cement works, the forestry exploitations and the Engineer establishments of the Army. He controlled the supplies and storehouses of the technical services, as well as the activities of the shops for the repair and upkeep of Engineer matériel.

September 10, 1917, the Minister of War created the D. G. A. S. T. A., as it existed at the end of the war and as it has been described in this study.

In résumé, the history of the D. G. A. S. T. A. can be divided into five phases:

1. There is nothing.
2. The Minister of War has a representative at Paris.
3. The Minister creates the "special supply direction" for the technical directions.
4. The Minister creates the D. S. S. T. G.
5. The Minister creates the D. G. A. S. T. A.

With each phase there is a corresponding increase in functions and a greater autonomy.

SECTION III—PART 2.

NOTES ON THE ORGANIZATION AND OPERATION OF THE "PURCHASING SERVICE" (SERVICE DES ACHATS—S. A.) DURING THE WAR (BELGIAN).[1]

The Purchasing Service (Service des Achats—S. A.)[2] was created in 1917. Until then, supplies had been purchased by the Direction of the "Intendance" supply services (Direction des services d'approvisionnements de l'Intendance—D. S. A. I.).

It was apparent at the time when the Purchasing Service was created, that the old method of making purchases by calling for bids would be unsatisfactory, furthermore, it gave no assurance of regularity in the supply of the Army. At that time, the shortage of supplies was already felt, calls for bids remained unanswered, and the situation only became worse subsequently.

The Purchasing Service was organized in accordance with the prevailing methods of business organization and a business man was placed at its head. Its personnel was chosen from among those who had had long business experience, either as employers or employees, and modern commercial methods were applied in the procurement of supplies.

The "Intendance" service maintained Purchasing Commissions at London, Paris, and New York. However, it will be seen further on that the functions of these Commissions were not solely commercial.

At the outset, the functions of the Purchasing Service were limited to the procurement of food, forage, and equipment for the Army. During the first six months of 1917, these functions were increased.

As the various departments of the Ministry acted independently, it often happened that representatives from various Ministries found themselves in the same markets and seeking the same supplies; this inevitably caused a raise in prices. The Purchasing Service was therefore gradually charged with making all purchases for the different Belgian Ministries: Colonies, Interior, Justice, etc., etc. It ended

[1] Prepared for the M. B. A. S. by the Inspector General of the "Service de l'Intendance" of the Belgian Army.

[2] Chart 1, Chapter IX, Vol. I.

by taking charge of all questions pertaining to Government purchases concerning foodstuffs and articles of equipment.

Several existing private organizations were taken over at the beginning of the war. Special reference being made to the "Supply Stores for the Troops of the Rear" (Magasins d'Approvisionnements des Troupes de l'Arrière—M. A. T. A.) and the "Sales Commissaries for Officers and Troops" (Magasins et Cantines pour Officiers et Troupes—M. C. O. T.). As these organizations had been taken over by the State they therefore functioned under its control. In normal times, regulations would probably have given these organizations a civililan status; in fact, they were functioning as though they came under the rules of war. They were granted credits by the Ministry of Finance and sold supplies to the soldiers and to their families at cost, all of which was forbidden by the regulations governing such organizations.

During the war the Purchasing Service was composed of a General Director, assisted by another director who was designated by the Cabinet and who maintained liaison between the Cabinet and the Purchasing Service, a technical director, and three divisions.

One of these divisions concerned itself with the food supply of the Army; another supplied the canteens for the troops and the third division handled all supplies of clothing and bedding material. According to the articles they purchased, each of these divisions was assigned to make purchases for other ministerial departments.

It must be added that later, at the request of the Allied authorities and under the stress of circumstances, the Minister of the "Intendance" was also obliged to undertake the supply of the welfare organizations which, under the guise of private enterprises, supplied the troops, refugees, child welfare societies, etc. (school colonies, recreation tents, refugee societies, etc.). These organizations were, for this reason, in relations with the Cabinet of the Ministry of the "Intendance" and the Ministry furnished them with supplies.

An Interallied Council was formed, composed of various sub-committees for each of the materials to be purchased. Purchase orders were cabled to New York by these sub-committees. In the United States there functioned Food Administration committees whose authority corresponded to that of the London sub-committee. These sub-committees proceeded to make purchases, after agreement with the Belgian "Intendance" Commission and, under the control of the Food Administration. As an example, the method followed in the purchase of textile materials will be described.

Textiles were purchased in England. Requests were sent to the "Interallied Supply Commission," which forwarded them to the British War Office which, in turn, transmitted them to the Treasury.

After approval the "Interallied Supply Commission", or the Belgian "Intendance" Commission at London, negotiated with the contractors from whom the purchases were to be made.

If a purchase was made outside of the United Kingdom, as was the case in the purchase of canned meats, it had to be approved by the "International Supply Commission" or by the sub-committee of the Interallied Council (Meats and Fats Executive), which cabled to the "Allied Provisions Export Committee" (A. P. R. C.); the latter was a sub-committee of the Food Administration at Washington.

After the approval of this Administration had been received, the purchase was made in agreement with the "Allied Provisions Export Committee" and the Belgian "Intendance" Commission at New York.

The Allies, in fact, desired to extend their authority over all the industries of their countries and had to regulate, in England as well as in the United States, the total production of the factories according to necessity and in such a manner as to prevent factories from manufacturing certain merchandise, when these same factories might be used advantageously in manufacturing other materials for war purposes.

The Belgian Purchasing Commissions at London, Paris and New York have already been mentioned. These Purchasing Commissions not only determined the available resources of merchandise, but were also charged with negotiating with the Governments and supply services of Allied countries concerning credits, purchase authorizations, assignments of contracts and cessions, etc. They maintained constant liaison with the Allies. The Purchasing Service was even obliged at times to send agents into neutral countries for the procurement of supplies which were unobtainable either in France or in England. It was under such circumstances that the Belgian Purchasing Service was obliged to purchase certain supplies in Spain.

It may be of interest to note that the clothing department of the Belgian Purchasing Service, alone, purchased more than 300 different articles of equipment and bedding, while the Food Supply Bureau handled more than 300 kinds of supplies.

The Belgian Purchasing Service maintained a complete accounting system. Supplies were kept up to capacity and were controlled in such a manner that the bases were constantly provided with everything they needed. This system of accounting had been so perfected that the Belgian Purchasing Service could, for example, readily ascertain the quantity of supplies being transported aboard a certain ship and advise organizations concerned of its arrival, so

that the cargo could be discharged and distributed under best possible conditions.

To complete this short report of the activities and organization of the Belgian Purchasing Service during the war, it should be added that, after purchases had been made, the supplies were received and stored by the "Intendance" service proper, in the "Intendance" depots which were located at Le Havre, Calais and Gravelines; these establishments functioned under the orders of the Inspector General of the "Intendance" Service (I. G. S.). The Inspector General also controlled various services which had been assigned to him by the Minister of the "Intendance" such as: butcheries, bakeries, clothing-shops, administrative services, etc. At the same time, he maintained liaison between the Ministry of War and the Ministry of "Intendance."

When supplies left the "Intendance" depots the responsibility of the Minister of the "Intendance" ceased. Distribution was made by the War Department (Intendance in the field).

After January, 1918, the supplies for the repatriated civil populations were purchased by the Minister of the "Intendance," through the Minister of the Interior who controlled the supply for the civil population.

To these activities must be added those which devolved upon the Purchasing Service on account of the numerous demands made upon it by the various Ministerial departments.

The Belgian Purchasing Service also had charge of numerous other organizations of which the Council of Ministers has kept a list. A depot, called the "Central Supply Depot," was created in connection therewith. In connection with the Belgian official organizations at London, the Minister of the civil and military "Intendance" directed various civil organizations which had been organized in England at the beginning of the war, as well as others which were created later, thanks to the generosity of the American Red Cross. Among these organizations and societies were: "Gifts for Belgian Soldiers"; the "Clothing Committee" charged with the distribution of clothing to disabled soldiers and to men who had been demobilized; a welfare society which rendered assistance to soldiers' families; the "London Workingmen's Fund"; the "British and Allied Soldiers' Evangelist Mission" and a society directed by Mr. and Mrs. Horton.

When the Armistice was declared, a Royal Decree dated November 21, 1918, established the Departments of Industry, Labor and Supply and transferred the functions of the Minister of the civil and military "Intendance" to these departments.

In accordance with the terms of a Royal Decree of December 30, 1918, which determined the status of the personnel of the Supply

Administration, the Belgian Minister of Supply issued instructions that, although the General Purchasing Direction was transferred thereby, this Direction be charged as heretofore with purchasing supplies abroad for the Army, as well as for the various ministerial departments or official organizations having recourse to his department.

As the permanent Purchasing Commissions abroad were directly controlled by the General Purchasing Direction, they were maintained temporarily. After having functioned under the above instructions for almost a year, events caused a gradual reduction in the activities of the Purchasing Service. The Belgian demobilization finally brought about the abolition of the "special" depots and there remained only the depots for the officers and troops of the Belgian Army of Occupation in Germany.

CHAPTER VIII.

SECTION IV.

EXTRACTS FROM THE REPORT OF THE GENERAL PURCHASING AGENT OF THE AMERICAN EXPEDITIONARY FORCES TO THE COMMANDER IN CHIEF.[1]

(Charts 2 and 3, Chapter IX, Vol. I.)

1. In compliance with your instructions, I submit a report of the activities of the General Purchasing Agent and the General Purchasing Board of the American Expeditionary Forces, covering the period from the beginning of operations to the present time.

2. From the middle of June, 1917, until December 31, 1918, approximately eighteen months, about 10,000,000 ship tons (40 cu. ft. equals one ship ton) of material were acquired in Europe for the use and maintenance of the American Army, being approximately 555,000 ship tons of material per month. This material was procured on the continent and in England through the operations of the General Purchasing Board and the G. P. A. under the supervision and with the cooperation of our allies France and Great Britain. It is of record that during these eighteen months it was only possible to send to the A. E. F. from U. S. 7,675,410 ship tons, or 426,000 ship tons per month, based upon Army Transport figures showing an average of 56.43 cu. ft. per 2,000 ship tons received from the U. S. Due to the lack of ships during the first seven months of the existence of the A. E. F. in France, only 484,550 ship tons were received from the U. S. From June 1917 to May 1918, inclusive, the A. E. F. received from the United States 2,156,238 ship tons of supplies. From June 1, 1918, to the Armistice, five months and eleven days, it received 4,059,695 ship tons or in other words, during the last five months preceding the Armistice, nearly twice as much tonnage was received from the U. S. than in the whole of the preceding year. The latter fact was due to the success of the shipbuilding program of the U. S., for as long as ships were lacking, the A. E. F. could not be largely supplied from across the ocean. More tonnage was not supplied from America for the A. E. F. because the ships did not exist with which to transport it, and this inability

[1] Report of the General Purchasing Agent and Chairman of the General Purchasing Board, A. E. F.—(February 28, 1919).

for greater recourse to American products was deeply regretted from every standpoint by supply officers of the A. E. F.

3. The paramount question of importance was Victory through the provisioning, arming, maintaining and caring for American troops in the fighting line, and the supply procurement service of the A. E. F. subordinated ordinary business considerations to this question of proper supply at the same time applying as safeguards the checks, regulations and restrictions of normal business organizations where these did not involve a diminution in supplies of the first military emergency.

4. The A. E. F. to the date of the Armistice had sufficient supplies to enable it to exist and function, but in view of the 4,000,000 men program for June 1919, every possible purchase of supplies and material in Europe was justified for the purpose of saving tonnage from America.

5. In the consideration of the question whether or not the A. E. F. should buy their articles in Europe or requisition them from the U. S., the probable time which would be consumed by securing them from the U. S. by requisition was a most important element. Many articles probably could have been secured in the U. S. much more cheaply than in Europe had it been possible to wait the requisite time for ship tonnage to carry them. The questions of priority and relative necessities in the use of the limited tonnage were such that the advisability of purchases in the U. S., as distinguished from purchases in Europe, was controlled by the continuing tonnage emergency.

GENERAL PURCHASING BOARD AND GENERAL PURCHASING AGENT, A. E. F.

6. The plan for the creation of the Office of the General Purchasing Agent and the General Purchasing Board was conceived by General Pershing. In general it may be stated that the department of the administrative staff under the G. P. A. was the result of a supply emergency existing at the time of its creation and which continued throughout America's participation in the war.

7. This condition was first due to the independent action of the separate services, and the plan devised by General Pershing owed much of its eventual effectiveness to its simplicity. Foreseeing the necessity for the continued extension of central authority in supply procurement, General Pershing did not attempt in the first order constituting the G. P. A. and G. P. B. to fully define their duties. In this particular case, the G. P. A. was designed at first to be simply a co-ordinator of purchases. He *did not possess, nor has he exercised*, the power of direct purchase, but his power of direction and veto over the purchasing activities of the Army and

his contact with the chiefs of the purchasing services and our allies, resulted in the evolution in him of large powers over the general policy of supply procurement.

8. Coincident with the assumption of the power of coordination, he inaugurated under the direction of the C. in C., in order to save trans-Atlantic tonnage, a system to supplement the supply procurement activities of the independent services in Europe and superimposed this organization upon the separate services in such a way as to expedite rather than interfere with their functioning.

9. The G. P. A. being the only executive officer of the Administrative Staff, with headquarters in Paris, resulted in his being used by the C. in C. and the C. G., S. O. S., as their agent in allied inter-army and inter-governmental supply negotiation. In effect, the system of the G. P. A. and G. P. B. was a device superimposed upon the regular army organization, the prime responsibility for the consummation of purchases was with the independent services, subject only for coordination purposes to the control of the G. P. A.

10. The results were obtained through the members of the G. P. B. representing the independent services, supplemented, expedited, and coordinated by the superimposed organization of the G. P. A. to whom all orders for supplies or material, before being placed by the different purchasing departments of the A. E. F., were required to be submitted for approval.

SPECIAL ACTIVITIES OF THE G. P. A.

After taking into consideration that portion of the administration of the A. E. F. assigned to him, the G. P. A. realized that the foreign environment and relation to our allies required new departments of activity in the existing army organizations to provide for the proper conduct of its business, and his suggested formations when authorized were placed under his jurisdiction.

The following is a classification of the authority and functions of the G. P. A. and G. P. B.

11. *First—Coordination of Purchases.*—The supply divisions of the A. E. F. composed of eight independent services, namely:

1. Quartermaster Corps
2. Medical Corps
3. Engineer Corps
4. Air Service
5. Signal Corps
6. Ordnance Department
7. Chemical Warfare Service
8. Motor Transport Corps,

each possessing its own appropriations from Congress and authority to make purchases for its own department. By G. O. 23, G. H. Q., 20 Aug. 1917, was established in Paris a G. P. B. composed of eight independent officers of the above services, with the G. P. A. as Chairman. At the first meeting of the G. P. B. the G. P. A., its chairman, made the statement that it was not, except as he might determine, a deliberate body, that its organization was military and that it would act as ordered and not as it might decide.

12. *Second—Supplemental Organization of G. P. A. to Increase Procurement of Supplies in Europe.*—In addition to the control and approval of purchases, the G. P. A. was also charged with the work of locating supplies in Europe with a view to saving tonnage from the United States. Upon the first day of his appointment, he commenced the formation of this organization. Under it he maintained representatives in France, Great Britain, Spain, Portugal, Italy, and Switzerland, through whom passed all purchases made by the A. E. F. in those countries and to whom all purchasing officers of the A. E. F. reported when assigned to those countries for procurement. Those representatives worked in close cooperation with the chief purchasing officers of the allied countries and with our diplomatic agents and representatives of the War Trade Board, and in this manner were able to secure supplies which in many cases would otherwise have been unobtainable. Their duties were also to furnish reports of available supplies, copies of the forward requirements of the A. E. F. having been furnished them as rapidly as possible as a basis upon which to figure requirements in advance of the receipt of requisitions. Purchases were made by these representatives only on orders from the chiefs of the various services forwarded to them with approval through the office of the G. P. A. These representatives of the G. P. A. were designated as General Purchasing Agents for the respective countries in which they were located, with the exception of France, and an organization partly military and partly civilian in each country built up under them. The agency in Great Britain was established by General William Lassiter a short time prior to the appointment of the G. P. A., and this organization was transferred to the jurisdiction of the G. P. A. In the allied countries, the representatives of the G. P. A. dealt with the representatives of the governments, and orders were handled in conformity with the regulations and agreements imposed by the governments, both as regarded requisitions upon the governments and purchases in the open market. In neutral countries purchases of supplies and commodities for which export permits were obtainable were made from individuals and firms.

13. The G. P. A. sent experts to adjoining countries to investigate the textile industry, the question of raw materials, timber, lumber, horses and mules, tinned food supply, shipping facilities, etc. His representatives, in conference with the officials of the "Ministère de l'Armement," through the "Comité Technique Permanent d'Etudes Franco-Américaines," studied the industrial situation in France in relation to the question of importing raw materials for manufacturing in France with the object of saving tonnage from the United States and utilizing the available local labor. These efforts met with considerable success in connection with the manufacture from tin plate and from other raw material, cylindrical and other bulky articles.

14. *Third—Bureau of Foreign Agencies.*—Supervision and control of orders sent to foreign countries was effected not only through the purchasing agents for the different countries, but through the Bureau of Foreign Agencies in the office of the G. P. A., which was charged with the direction and supervision of European purchasing agencies outside of France. This bureau operated under the general supervision of Lt. Col. N. D. Jay, Asst. G. P. A., and under its chief, Captain R. H. Cabell, Jr.

15. *Fourth—Purchase by Category Department.*—In order to more effectively and intelligently control purchases, to prevent competition between services and to secure the business advantages incident to large transactions, the G. P. A. initiated and secured the promulgation of G. O. 41, S. O. S., of Sept. 2, 1918, establishing categories of supplies used by more than one service and authorizing the G. P. A. with the approval of the C. G., S. O. S., to designate specific services to purchase such supplies for all other departments. Under this arrangement only one department of the A. E. F. was authorized to secure any one class of supplies, except in case of extreme emergency, when the purchase was required to be certified by some responsible purchasing officer. The institution of this system was the work chiefly of Lt. Col. Jay, Asst. G. P. A. of the A. E. F.

16. Prior to the establishment, by order, of the machinery for categorical purchases and under the pressure of a great emergency in connection with machine tools, since the lack of ships prevented the shipment of tools from the United States for almost one full year, the G. P. A., in the early period of the existence of the A. E. F., established a Machine Tool Section in his office, which, under the authority of the Q. M. C. located, negotiated and distributed among the supply services of the A. E. F. for the equipment of repair shops, all machine tools obtainable in allied and neutral countries.

Prior to September 1, when the Machine Tool Section was transferred to the Ordnance Department, more than 5,000 machine tools were procured and transferred by that section of his office. This work, initiated in November, 1917, at the suggestion of Lt. Col. Drake, saved, in the judgment of the G. P. A., the mechanical situation of the A. E. F. It was these machine tools which enabled the A. E. F. to repair the damaged Belgian locomotives secured by the G. P. A. as a cession from the Belgian Government, which not only resulted in a large saving of tonnage but furnished the A. E. F. with absolutely essential locomotive power impossible at the time to be obtained elsewhere. The G. P. A. also endeavored from time to time to secure the interchange of surplus stocks of materials between the different departments, and in other ways to induce the heads of the independent services to think in terms of the Army as a whole instead of in terms of eight separate services. Even when purchases by category were effected the division of stocks into the eight separate custodianships of the different services resulted in a failure to secure the most economical use of existing supply.

17. When one service, through foresight and in order to carry out its program of accomplishment, was possessed of a surplus of supplies which could be diverted to the satisfaction of the acute necessities of another service, the machinery of transfer was extremely cumbersome and the opposition to its exercise on the part of the heads of the services extremely embarrassing.

18. *Fifth—Statistical Bureau.*—The rapid development of the need for procuring supplies in Europe in order to save tonnage from the United States necessitated the creation of a bureau for collecting, classifying and analyzing the requirements of the supply departments of the A. E. F. The Statistical Bureau was established on December 3, 1917, and was organized under the authority of Major J. C. Roop, its first chief, who was largely responsible for the scope of its work of collecting and compiling, on the basis of the forecasts issued by the supply departments, information regarding material procurable in France and adjoining European countries. The bureau likewise maintained a record of all purchase orders which passed through the office of the G. P. A., and, upon the establishment of the Metal Control Bureau, of the metals consumed in filling such orders.

19. *Preparation of Supply Forecasts of the A. E. F.*—As has been before stated, the work of organization of the G. P. A.'s office and the G. P. B. was progressive. While early appreciation was had of the objects which it was desirable to obtain in the way of coordination with the French and the English governments and of the activities of our own supply services, the Army was handicapped in its

early stages by a great lack of personnel accompanied by a constantly expanding program of supply procurement. It was very difficult to secure the preparation of the quarterly forecasts of the requirements of the Army outside of the forecasts relative to food and clothing. The estimate of future requirements for construction purposes was especially difficult, as construction programs were constantly being enlarged or altered. However, by constant cooperation between the services and the G. P. A., the quarterly forecasts became progressively more fixed. The final forecasts by category of the requirements of the A. E. F. for the last quarter of 1918, given in the appendix of this report, well indicate the magnitude of our Army transactions and necessities.

20. *Sixth—Bureau of Purchase Program and Classification.*—After the promulgation of G. O. 41, S. O. S., the work in connection with forecasts of requirements and purchase classifications rendered advisable withdrawing this work from the Statistical Bureau and creating a special bureau to handle it.

21. For carrying out the supervision of the category system of purchasing, provided for in paragraph 3 of G. O. 41, H. Q., S. O. S., Sept. 2, 1918, the Bureau of Purchase Program and Classification was established in the office of the G. P. A. and was further charged with the supervision of the compilation and classification of consolidated lists of requirements as shown on the quarterly forecasts of the supply services of the A. E. F. The duties of the bureau comprised likewise the recording of data and information obtained from the allied governments and from purchasing officers in Europe regarding available supplies in Europe and the standardization of descriptions of supplies requisitioned by the A. E. F., for the purpose of compiling a supply catalogue including the names and types of similar articles used by the French and British armies.

22. *Seventh—Control Bureau.*—Through the Control Bureau, Office of the G. P. A., passed for approval all purchase orders and requisitions upon the allied governments, with the exception of certain small local purchases made by supply officers outside of Paris. An examination of orders was made by this bureau to prevent interdepartmental competition for the limited quantities of merchandise available, and the consequent payment of unduly increased prices. Through this bureau was maintained a liaison with the French Mission established in the headquarters of the G. P. A., under which the approval of the French Government was given to all transactions save those involving very small amounts, and in this way gave French governmental protection to the A. E. F. against the payment of exorbitant prices. No requests for purchases by the A. E. F. were authorized by the French Government at prices higher than those

actually paid by that Government for similar material, except in very rare cases of special emergency. When the prices asked seemed exorbitant to the French Government it would itself requisition the material at the fair price and turn it over in the form of a concession to the A. E. F. Under this arrangement no purchase exceeding the amount of five thousand francs could be made by the A. E. F. without the approval of the French Government.

23. *Eighth—Wood Section (under Control Bureau).*—The supervision and correlation of all purchases of lumber and lumber products in Continental Europe having been delegated to the G. P. A. by G. O., No. 8, S. O. S., of April 8, 1918, this bureau was established for the control of wood procurement both in the open market and through, and with the collaboration of, the French and other allied purchasing and distributing agencies. A liaison service was organized between the Wood Section and the "Inspection Générale des Bois" (Wood Service) of the Ministry of Armament.

24. *Ninth—Metal Control Bureau (under Control Bureau).*—At the request of the Ministry of Armament, based upon the fact that the purchasing departments of the A. E. F. has been steadily exceeding, through their purchases in France, the monthly allotment of metals assigned to the use of the A. E. F. by the Metallurgical Section of the Ministry of Armament, the Metal Control Bureau was organized on June 28, 1918. The duties of the bureau comprised the examination and approval of all purchases of metal goods and equipment, both with regard to weight of metal and prices, as well as the preparation, for transmission to the United States, of orders for metal for distribution among all departments to meet their manufacturing needs in France. A liason service was organized between the bureau and the 'Inspection des Forges" of the French Ministry of Armament.

25. *Tenth—Central Printing Office (under Control Bureau).*—The difficulty of procuring the large quantities of printed matter and stationery necessary for the various departments of the A. E. F. and the rapidly increasing prices of such work occasioned by constant canvassing of the market by purchasing departments, brought about the establishment on December 1, 1917, under the G. P. A. of a Central Printing Plant. This plant handled a large percentage of the printed matter for the various staff departments. It was transferred, by recommendation of the General Purchasing Agent, on October 21, 1918, to the Chief Quartermaster.

26. *Eleventh—Procurment of Civilian Manual Labor for A. E. F.*—The responsibility for the procurement, organization, transportation, maintenance, and discipline of civilian manual labor in Europe for the A. E. F. (other than labor procured locally through

the French regional authorities) having been delegated by G. O. No. 5, Hq. Service of the Rear, March 4, 1918, to the General Purchasing Agent, the Labor Bureau was established and the G. P. A. was designated as the sole agent through whom negotiations with the French authorities in relation to such labor should be conducted. The bureau was operated as a subdivision of the G. P. A. until it was transferred on September 1, 1918, by G. O. No. 38, Hq. S. O. S., to the Army Service Corps.

27. The recruiting of civilian labor under G. H. Q. was found impracticable since G. H. Q. was removed from first contact with the labor supply, and for the reason that all labor contracts required careful coordination with and supervision by, the French Government. At the time this work was started an acute need for civilian labor existed in the A. E. F. So great was the pressure of the necessity for construction work along the line of communications that combat troops needed at the front were engaged in large numbers in manual labor. The labor organization was under the necessity of furnishing men immediately. The French Government rendered invaluable assistance in the work, and through negotiations with them as well as the quick institution of labor recruiting agencies throughout Europe, the labor organization was enabled to furnish men almost as fast as they could be used. In the very early stages of the labor organization the demand for labor was such that men were furnished in advance of thorough organization into labor units, but the situation was rapidly adjusted, and during the months preceding June, 1918, the labor organization furnished sufficient men to release for the early and important American offensive efforts, a number of combat troops equal to a full division. Upwards of 1,300 commissioned and non-commissioned officers were detailed to the Labor Bureau of the G. P. A. in connection with the militarizing and organizing of civilian labor. With the cooperation of the State Department, and as a result of a visit to Italy by Lt. Col. Cutcheon of the staff of the G. P. A., 3,500 militarized laborers were received from that country. A Woman's Division of Labor Bureau was established. After the first heavy pressure for workmen in the first six months had been relieved by the bureau and the civilian labor properly organized, the G. O. A. recommended that the control of the labor organization be transferred more directly to the S. O. S. and incorporated in the Army Service Corps.

28. On September 1, 1918, the G. P. A. transferred to the Army Service Corps the control of the organization consisting at that time of over twenty-nine thousand employees properly officered and organized. Among the nationalities employed were French, Spanish,

Portuguese, Italian, Belgian, Greek, North African, Senegalese, Chinese and Maltese.

29. From Sept. 1 to November 11, under the jurisdiction of the Army Service Corps, the labor battalions were so increased that at the time of the Armistice the total number of laborers, men and women, employed by the labor corps was 42,000. Including replacements, the total number of laborers procured up to this time was over 85,000.

30. The procurement of labor presented the same difficulties as the procurement of supplies. There was a great dearth of man-power in Europe owing to the large armies maintained by the Allies. The character of the labor secured was often poor and the sources of supply widely scattered, and in many cases difficult of access. Constant questions involving the domestic labor policy of France, local labor laws and customs were before the G. P. A. and labor organization for adjustment and settlement.

31. The fundamental principle underlying the whole system was a central responsibility for recruiting, care, transportation, maintenance and discipline. One reason for this central responsibility was because the French demanded an organization which they could hold to account for the keeping of the agreements which in recruiting all labor it was necessary for the A. E. F. to make with the French Government. It was also necessary from many other standpoints.

The existence of an independent central control was not only consistent with the military system as organized, but essential to its proper working. The organization was charged with the duty of keeping the labor battalions in the requisite condition to do their work when, during the hours of labor, they were turned over to the local military authorities.

32. *Twelfth—Technical Board.*—In order to coordinate, develop and utilize to the fullest extent the electrical power facilities in France, and to control the procurement in Europe of supplies and equipment which are component parts of power plants, the Technical Board was created as a subdivision of the office of the G. P. A. by G. O. No. 8, S. O. S., April 8, 1918. To this board were assigned experienced electrical engineer officers, who maintained close contact with the electrical power requirements of the A. E. F. and with the available facilities throughout France, and were able to give comprehensive advice to the construction forces on all matters pertaining to light and power.

33. Officers of thorough experience and of various lines of technical activity were assigned to duty with this board and the activities were spread to all departments of France where troops or units were stationed. The acquisition of power apparatus was supervised by

this board as well as the unification of projects, until, at the signing of the Armistice, there were more than three hundred different places in France where power or lighting, having a total energy involved of more than 75,000 H. P., had been effectively supervised and controlled by this board.

34. *Thirteenth—Board of Contracts and Adjustments.*—The Board of Contracts and Adjustments was established under G. O. 39, G. H. Q., Feb. 13, 1918, in the office of the G. P. A., to prepare contracts and agreements between the different departments of the A. E. F., and corresponding departments of the French or British governments, to advise officers charged with the handling of contracts and the obligations accruing therefrom, and to aid in the adjustment and settlement of outstanding obligations resulting from agreements of the United States with foreign governments.

35. The need of the existence of a Board of Contracts and Adjustments became evident to the G. P. A. very early in the administration of his office. It was again the ever existing emergency confronting the A. E. F. which required the temporary establishment of a legal department concerning itself largely with the inter-army and inter-government business passing through the hands of the G. P. A.

36. *Fourteenth—Financial Requisition Officer.*—On July 12, 1918, the office of Financial Requisition Officer was created in the office of the G. P. A. G. O. No. 41, Hq. S. O. S., Sept. 2, 1918, changed the system of requisitioning, receipt and disbursement of funds in the A. E. F., and put into operation a new method, effective as of October 1, which provided that funds "be credited by the Treasurer of the U. S. to the Financial Requisition Officer, A. E. F., upon approval of his requisitions, based upon estimates submitted by disbursing officers and forecasts received from the various departments." The order directed that fixed credits be established in the name of the Financial Requisition Officer in depositaries designated by the latter, these credits to be maintained by transfers from funds to his credit with the Treasurer of the U. S., that individual balances to the credit of disbursing officers in the depositaries be discontinued, and that the latter draw checks against the credits of the Financial Requisition Officer in the depositaries up to the limit of authorizations given them by the latter. The new system was designed to free the large sums of money which had in the past remained for considerable periods unavailable owing to the fact that the moneys received could be used only for disbursement under the particular appropriations under which they were requisitioned, the unused balance of one disbursing officer not being available for use by another.

37. This office should not be confused with the disbursing officers of the various corps who made the actual payments of money. The Financial Requisition Officer afforded simply a convenient method of securing funds for the disbursing officers and reducing the surplus funds needed to provide for an emergency.

38. *Fifteenth—Bureau of Accounts.*—The Bureau of Accounts was organized under G. O. No. 4, Hq. S. O. S., March 23, 1918, for the purpose of recording, compiling and furnishing information and statistics with respect to claims between the U. S. and European countries. The Bureau of Accounts was established by the G. P. A. on April 27, 1918, and functioned under him until its transfer to the office of the Finance Officer of the A. E. F., November 8, 1918. This bureau functioned under great difficulties with insufficient personnel but, notwithstanding, the results obtained were most creditable.

39. *Sixteenth—Bureau of Reciprocal Supply.*—As a result of the demands for replacement of raw materials made by foreign governments and private firms and corporations arising out of the manufacture of articles of equipment for the A. E. F., in European countries, the Bureau of Reciprocal Supply was established by G. O. No. 152, G. H. Q., Sept. 10, 1918, in the office of the G. P. A., for investigating all replacement claims pertaining to articles for military supply and for recommending to the C. G., S. O. S., the means of their adjustment. The bureau was authorized to negotiate with the War Industries Board and the Director of Purchases in Washington the necessary purchase priorities for such materials and to arrange with the C. G., S. O. S. for the allotment of the A. E. F. tonnage needed to transport them to France.

40. *French Cooperation and Coordination.*—Approximately one-half of the entire material and supplies used by the A. E. F. from the beginning to the date of the Armistice, to wit, about 7,000,000 tons were secured in France and this in spite of the fact that the cession to the A. E. F. of material and supplies by France was done at great sacrifice to the latter country. The system of coordination and cooperation which was evolved through mutual negotiation and effort, was one based upon experience and necessity, and not upon theory.

41. The great problem in procurement was to prevent the emergency from creating an indifference to price which would result in submission to exorbitant demands, and in this connection the French Bureau (Commissariat Général des Affaires de Guerre Franco-Américaines) performed invaluable services in protecting the entire purchasing processes of the A. E. F. from exorbitant prices, as well as in their efforts to expedite the furnishing of supplies, etc., from the French Government and in uncovering new sources of supply in the open market.

42. *British Cooperation.*—Over 2,000,000 tons of material absolutely requisite to the success of the American effort in France were received by cross-Channel shipping, in spite of the fact that this cut deeply into the already greatly depleted supply of the British.

43. *Origin of Finance Office, A. E. F.*—To enable the Treasury Department to make arrangements for its payments of expenses and supplies, representatives requested from time to time estimates of the future financial requirements of the Army. These requests were referred to the G. P. A., who without machinery and without authority attempted to furnish this information. A financial section of the General Staff was finally created, the duties of which were to coordinate and simplify the methods of accounting in the separate services and provide a central agency for their proper presentation to the Treasury Department.

44. *Cooperation of War Trade Board.*—To overcome the difficulty experienced in some of the neutral countries in the matter of obtaining exports permits for purchases made in the name of the A. E. F., advantage was taken of the fact that certain new products were obtained by the neutrals from the U. S., and economic pressure was brought to bear through the agency of the War Trade Board which was most effective in removing this hindrance to the purchasing activities of the A. E. F.

45. *Coordination of French, English and American Purchases in Neutral Countries.*—Effort was made to secure coordination between the purchases made by French, English and American agents in neutral countries. While the arrangements for coordination varied, the following outline of principles served as basis for such interallied operations toward the end of the war.

1. All purchases in Spain, Italy and Switzerland be made by a single board in each country, consisting of representatives from each of the three armies, each acting for all the branches of his respective service. Pending the receipt of authority to put in effect the foregoing, that each country be represented by one individual, although these boards may consist of a larger number, with due regard for the equal representation and authority for the three armies.

2. An interallied board consisting of a representative of the French, English and American armies at Paris should determine the question of the distribution of purchases made on joint accounts for the three armies.

3. No agreements need be entered into for the permanent existence of these boards so that any government by withdrawing will restore its "status quo."

4. The American E. F. recognizes the fact that in continental purchases the needs of the French Army and civil populations should have first consideration, in order that undue diversion to the A. E. F. and B. E. F. of supplies purchased in countries adjoining France, and naturally tributary, may not involve France in domestic and civil embarrassments with the consequent loss of military effectiveness.

5. The United States by reason of its control of certain sources of supply, notably cotton, is in a position through negotiations as to embargo to increase the available sources of general supply for the Allies from Spain and Switzerland.

6. These boards should be in existence now as a means of aiding with information the American Ambassador to France, Spain and Switzerland in making representations to the State Department as to the position they deem advisable for the U. S. to take in connection with embargo concessions. The commanding position of England in connection with ocean tonnage, coal, and other important supplies for the French and for the American Expeditionary Forces makes especially important to her the common information which will be derived through the operation of such boards.

46. *Principles of Army Purchase and Supply as suggested by Experience of American Expeditionary Forces in France.*—War is the oldest occupation of mankind and the system of organization for war has been the result of evolution for the longest period of any collective human activity. Therefore, what seems to be in military organization an anachronism, must always be considered as to whether our regarding it in that light is due to the different functioning of an army organization in times of peace, as compared with a time of war. The current criticism of army organization is based largely upon the assumption that it ignores certain fundamental principles of normal business organization, which should be applied to the business system of an army, notwithstanding that the ultimate purpose of an army's existence is military, as distinguished from business, success. The conventional view of the army purchase and supply system, held by the non-military business man, is that the system of independent departmental purchase is a failure, because, while it is susceptible to an outside coordinating control, this control is not accomplished, as in the normal business organization, by a complete centralization of purchase and supply through one agency acting for the army as a whole. The argument of the business man is that if all purchasing and supply activities were centralized in one distinct army department, created to supply all other branches of the service, there would be obviated competition among the various departments, piecemeal and wasteful purchases, loose methods, insufficient estimation of forward collective needs, and many other objections now incident to some extent to the present system. It is contended that the needs of an army and their satisfaction will be better ascertained and accomplished by a central body, having always the bird's-eye-view of the situation, and that equally satisfactory results will not be incident to any method of central control reached through a coordination of independent agencies. It was with this belief that I took up my duties as General Purchasing Agent of the American Expeditionary Forces under a new system of central control devised personally by General Pershing against the advice of a reporting army board to whom the subject had been first referred. This report, with the comments of General Pershing thereon, indicates clearly the legal limitations under which he acted, his entire perception of the business and military principles involved, and the final plan

he placed in operation as the best solution possible, in his judgment, under existing law, of the problem of reconciling the existing army and supply system with the fundamental principles of normal business organization without jeopardizing its efficiency from the military standpoint in time of actual war.

47. I wish I could claim a share in the conception of this plan, but, the General had worked it out fully before I arrived at his headquarters and only selected me to put it into effect, and as General Purchasing Agent, American Expeditionary Forces, and chairman, to assemble the General Purchasing Board and direct its operations. My idea, as that of many other business men, had been that the laws of the United States which so jealously guarded the independent right of purchase and supply in departments of the service, was on our statute books as a result of lack of business knowledge and foresight on the part of legislators, instead of its being as it is, the logical, legitimate and necessary evolution of thousands of years of actual military experience. Now, after six months in time of war, in a peculiar position relative to army purchase and supply activities such as does not exist in the British, French or other army, so far as I know, I am prepared to say that any change in legislation or War Department regulation designed to bring the organization of army purchase and supply more nearly into accord with the principles of modern business organization, should provide an agency of supervising coordination, which, while it will permit the application of rigid business principles under normal conditions, will not take away from independent departments the right of purchase and supply especially during the time of actual military activity, the preservation of such independent powers being absolutely essential at times to military success, which, of course, is the ultimate object of the whole system.

48. The statement is frequently made that the business organization of an army is the same in its purposes as the business organization of any great corporation. This is misleading. The chief purpose of the organization of successful business is the creation of wealth—the chief purpose of the organization of any army is the destruction of enemy life and wealth. The prime consideration in the establishment of normal business organization of central control of purchase, is the surrounding of purchasing activity with checks and balances compelling due consideration of every purchase from the standpoint of its relation to a prospective profit—in other words to compel deliberate application to every transaction of the test as to whether, if consummated, financial profit or something related to it will, immediately or ultimately, be the result. The first purpose of the army business organization in time of war is the securing of necessary military supplies irrespective of any question of financial

profit, yet as cheaply and expeditiously as possible without prejudice to military effectiveness. If the application of all the principles of normal business organization would mean the failure of supply in military emergency, business principles, in the last analysis, must yield, wherever necessary, to military emergency. The principles, however, of normal business as affecting army business organization can be made to apply through a coordinating system as we have done in the American Expeditionary Forces, where these principles are applied to any army purchase or supply transaction not involving a preponderating military necessity. I can not emphasize too strongly that for the preservation of a requisite system of supply for any army in action, the feeling of responsibility on the part of a supply procuring agent must be first to the officers needing the supply. From my experience with the field system of army supply and purchase in this war, the only reason I can imagine why anybody suggests the contrary, is because a large portion of the supplies of our army is being collected by the War Department in a country of large resources which, when collected, are shipped from America to the army in France. Business principles for obvious reasons can be given a wider application by the War Department in the United States than it is possible to give to the purchase and supply organization of an army in the field. In the business organization of an army in the field, nothing must prevent the immediate application of the greatest possible pressure directly from the point of military and emergency need, upon an agent of purchase and supply directly responsible to it. Therefore, the central business control of purchase and supply activities of an army in the field, while operating in all normal cases, must not interfere with a perfect device for the operation of a collateral independent system controlled by military necessity. Only in this way can all the needs of an army in time of action be properly met.

49. Let us assume for purpose of illustration that the American Expeditionary Forces in France, at a time when military operations are under way, had an existing central purchase and supply organization for all departments of the army without there being in existence machinery for independent collection of supplies. To that central organization would come a series of demands which we might epitomize as follows: From "A" on the line, 2,000 blankets by night time which, if not supplied meant that soldiers would perish by exposure; from "B" 1,000 shells for an expected attack the next day; from "C" 1,000 cots for wounded soldiers lying on the floors of hospitals; from "D" certain medicines and surgical apparatus with available supplies entirely inadequate and wounded still coming in; from "E" food for men who had been without it for two days. The central organization in transmitting to its purchasing and collecting agents, these demands, would use an em-

phatic tone of voice, but that tone of voice would not be the same, not interpreted by the agent in the same way, as the voice of each officer responsible for the situation at each point of necessity speaking to a man directly responsible to him, and located at a point of possible supply. If a demand came for timber to build a bridge necessary to carry 100,000 troops across a stream for reinforcement of a sorely pressed army corps, questions of the price to be paid, or the manner in which it was to be secured would not, advantageously, be first referred to a central agency for consideration of the business bearings of the transaction. It is no reply, in such a situation, to maintain that an emergency supply and purchase organization can be created for use in times of war which can function when and where it would be impossible for the central organization to do so. A purchase and supply machine to function well, must function continuously. In this war, the use of troops in restricted localities, the transportation to masses of stationary troops of large shipments of supplies, the fact that the different units of an army, as a rule, are not separated by long distances or isolated by lack of railroad or other means of communication, all make more plausible the demand for the abolition of the great army system of independent departmental supply and purchase. But if any other system is put in its place which does not recognize that the first responsibility of the supply and purchase agent must be directly to the responsible officer nearest the point of necessity, the system in time of military emergency will fail; and the whole object of the military system is not to fail in time of war. In order to give our army organization in France the benefit as far as possible of all the admirable safeguards and advantages of normal business organization, and yet not destroy that which is above all things important, the system, which, irrespective of business considerations, supplies most quickly articles at the point of use during military operations, General Pershing originated the idea of the General Purchasing Board, American Expeditionary Forces, which while operating under some disadvantages, has applied to the purchase of army supplies in France the safeguards of normal business. It has ensured collective purchasing, prevention of competition and coordination of effort without interfering with a principle firmly established in legislation and military procedure as a result of thousands of years of evolution.

50. If nothing is added to the foregoing, it may seem to over emphasize the relative importance of independent agencies of a controlling central system, which must function with it. In the American Expeditionary Forces certain large conceded and evolved powers of central control, arising out of the exigencies of war and confirmed by the Commander in Chief, are being exercised by the General Purchasing Agent, which powers are in effect direct and not nega-

tive. It is these direct powers not used to impede but to regulate, expedite and widen the action of collateral agencies, which are largely responsible for what results have been accomplished through the organization of the General Purchasing Board.

51. That the lessons in army supply and purchase taught by this war will find their future legislative interpretation and expression, there is little question. It will be difficult legislation to frame; for unfortunately it cannot be assumed that in the administration of the system in time of peace, it will be characterized by the high degree of cooperation and disposition to subordinate individual interest, which exists among the officers of a military force in active operation, welded together by the powerful pressure of military emergency, by strong leadership and the sacredness of the cause of their common effort. But even though it may not as yet be possible to frame a law recognizing the principles upheld herein, without creating some field for bureaucratic dissensions in time of peace, yet such a law in time of war will afford the competent leadership, which always develops on such an occasion, its proper engine of highest effectiveness.

CHARLES G. DAWES,
Brigadier General, Engineers,
Chairman General Purchasing Board,
General Purchasing Agent, A. E. F.

Statement of Transatlantic Cargo Unloaded in France and Transatlantic Tonnage Saved by Purchases in Europe to December 31st, 1918.

[Ship tons.]

	Transatlantic cargo unloaded in France from first arrival to Dec. 31, 1918	Transatlantic tonnage saved by A. E. F. purchases in Europe to Dec. 31, 1918	Grand monthly totals
1917			
June	34,578		34,578
July	33,529		33,529
August	39,980		39,980
September	47,732	273,430	321,162
October	97,091	181,427	278,518
November	129,904	319,713	449,617
December	101,737	294,969	396,706
1918			
January	192,184	1,041,020	1,233,204
February	189,861	139,338	329,199
March	327,020	460,777	787,797
April	424,437	346,012	770,449
May	538,186	450,129	988,315
June	643,139	476,422	1,119,561
July	661,664	985,684	1,647,348
August	740,660	1,575,070	2,315,730
September	794,037	973,787	1,767,824
October	897,115	1,129,094	2,026,209
November	901,919	855,379	1,757,298
December	880,637	690,670	1,571,307
	7,675,410	10,192,921	17,868,331

Statement of Approximate Transatlantic Ship Tonnage sent by American Expeditionary Force Purchases in Europe to December, 1918.

	Total	French Government	England Government and Commercial	Commercial other than in England
QUARTERMASTER CORPS				
Purchases through Chief Purchasing Officer	810,717	162,143	211,750	436,824
Coal	1,438,275	----------	1,438,275	----------
Autos and other vehicles purchased by Transport Department, later taken over by M. T. S.	132,284	----------	98,866	33,418
Horses and Mules	1,401,592	1,085,776	168,240	147,576
Fuelwood	1,546,038	618,415	----------	927,623
Charcoal	10,279	----------	1,463	8,816
Machine Tools (through General Purchasing Agent)	20,000	----------	----------	20,000
	5,359,185	1,866,334	1,918,594	1,574,257
ORDNANCE DEPARTMENT				
Purchases through Chief Purchasing Officer (includes orders executed here, preliminary arrangements for which were made with French Government by Chief of Ordnance at Washington, estimated at 100,000 tons)	514,260	275,361	167,329	71,570
ENGINEER CORPS				
Purchases through Chief Purchasing Officer	1,729,172	241,124	396,000	1,092,048
Purchases through Comité Interallié des Bois de Guerre:				
Lumber and ties	792,469	316,988	----------	475,481
Mf'd Fuel Wood	974,202	389,681	----------	584,521
Lumber and Ties through Wood Section (General Purchasing Board)	213,480	39,860	----------	173,620
	3,709,323	987,653	396,000	2,325,670
Air Service	253,503	190,000	18,500	45,003
MEDICAL CORPS				
Gen. Stores and Supplies	231,805	30,947	28,978	171,880
Hospital trains and Mobile Hospitals	40,250	8,750	28,500	3,000
	272,055	39,697	57,478	174,880
Signal Corps	30,765	16,995	995	12,775
Chemical Warfare Service	13,050	1,697	4,872	6,481
Motor Transport Corps	11,994	3,770	844	7,380
Total ship tonnage on purchases	10,164,135	3,381,507	2,564,612	4,218,016
Locomotives leased from Belgian State Railways	28,786	----------	----------	----------
Grand Total Ship Tonnage	10,192,921	----------	----------	----------

CHAPTER IX.

SECTION I.

ROYAL ARMY ORDNANCE SERVICES IN FRANCE (BRITISH).[1]

(1) *General organization.*

The Director of Ordnance Services (D. O. S.) controlled all arrangements in connection with Ordnance Services, and he was responsible for the provision and supply of ammunition, equipment, clothing and ordnance stores of all kinds for the forces in the field. His office was at General Headquarters and was divided into two main branches, each under a Deputy Director (D. D. O. S.). On his staff there was also a Principal Inspector of Ordnance Machinery (P. I. O. M.) and a Chief Inspecting Ordnance Officer (C. I. O. O.). The P. I. O. M. dealt with the technical questions affecting war material, designs and construction, reports on artillery and other war material, ordnance workshops and machinery. The C. I. O. O. dealt with all ammunition and technical questions arising therefrom. (See Chart 1, Chapter X, Vol. I).

At the headquarters of each Army there was a Deputy Director (D. D. O. S.) and Assistant Director, a Deputy Assistant Director and a Chief Inspector of Ordnance Machinery. At each ammunition railhead and Army ammunition depot there was an Ordnance Officer. Also with each Army there was a heavy ordnance mobile workshop and with each Corps there were light and medium workshops.

At the headquarters of each Corps there was an Assistant Director (A. D. O. S.), and with each Division, a Deputy Assistant Director (D. A. D. O. S.). At the railhead of each Corps there was a Railhead Ordnance Officer (R. O. O.), to attend to the receipt and return of all ordnance stores.

Units on the Lines of Communication (L. of C.) were administered for Ordnance Service by D. D. O. S., L. of C. (North) and D. D. O. S., L. of C. (South), who were also responsible for the coordination of the depots on their respective lines. Depots were established on the Lines of Communication for the storage and supply of arms, ammunition, clothing and equipment, and stores of all kinds. The stores were under the control of Chief Ordnance Officers (C. O. O's).

For the supervision of all ammunition services at base ammunition depots and ammunition depots on the Lines of Communication

[1] Prepared for the M. B. A. S., by the Director of Ordnance Services British Armies in France and Flanders.

there were two Chief Ordnance Officers, styled C. O. O., Ammunition (North) and C. O. O., Ammunition (South), respectively. Each ammunition depot on the Lines of Communication had an Ordnance Officer in charge. (Chart 1, Chapter X, Vol. I, shows the organization at a glance.)

(2) *Source of Supply.*

The whole of the stores, with the exception of a few items which were obtained locally owing to urgency or to the special nature of the stores, were obtained from England. Demands for the quantities required were submitted to the War Office, where they were consolidated with demands from other theatres and transmitted to the Ministry of Munitions or to the Surveyor General of Supply according to the nature of the commodity. (Any further information as to the source of supply can be obtained from the War Office and the Ministry of Munitions.)

(3) *System of Storage.*

The Bases were split into sections, Northern and Southern, Calais and Vendroux on the former line and, Havre and Rouen on the latter. A base depot was a storehouse where sufficient stock was maintained to keep the Armies equipped in the field. The following gives a rough idea of the stores dealt with at a base depot:—Accoutrements, camp equipment, which includes axes, buckets, helves, mauls, camp kettles, lanterns, "Soyer" stoves, ground sheets, tents, washing tubs and all picketing gear for horse lines, horse-shoes, harness and saddlery, tools, cordage, signal stores, surveying and drawing instruments, paints, oil, grease, waterproof covers, barracks and hospital stores (except medicines and surgical instruments, which were obtained from the Royal Army Medical Department), guns and howitzers of all calibres, trench mortars, rifles, bicycles; in fact, everything from a nail to a fourteen-inch gun. The organization for dealing with this immense amount of stores was run on the group system. Several groups were formed, each group dealing with certain sections. In each section were found the stores common to each other; for instance, in one was found oil, soap, soda, grease, paint, etc. Each group had its own staff to deal with the accounting and handling of stores. There was an officer in charge, and in this way decentralization of execution was obtained with maximum efficiency and a minimum of errors. Stores could be actually on rail within a very short time of the receipt of indent in the Indent Office,—an issue order was prepared, passed to the groups, the stores being packed, vouchered, and ready for despatch almost at a minute's notice.

The supply and maintenance of stores at a base depot was, of course, a very great responsibility and this was in the hands of the provision branch. This branch was split into Northern and Southern sections. There was an A. D. O. S., Provision North, and an A. D. O. S., Provision South, and without going into details, the method adopted to provide stores for a certain period was by taking the average issues in the field, say for six months, and then demanding on the authorities at home—any pending operations or other features likely to affect the demand, such as serviceable stores from workshops being taken into consideration.

Workshops were established at the larger bases and they did very excellent work. Practically all the stores which became unfit for service in the field were returned to base where they were sorted and handed over to workshops for repair and reissue.

Ammunition was stored in base depots at points on the L. of C., selected with reference to the railway facilities and their proximity to the ports at which ammunition was received. These depots covered a very wide area and were divided into sections so as to separate each class of ammunition as far as possible. The average capacity was from 35,000 to 60,000 tons. The distribution of ammunition was made direct from these depots to the ammunition railheads, which were entirely apart from the supply railheads. Demands were submitted by Armies to the Quartermaster General who consulted D. O. S. at a conference which was held daily at G. H. Q. as to the depots from which these demands could be met. Ammunition was sent up from the depots to the various railheads by complete trainloads. On arrival at the railhead it was normally transferred to Army dumps from which the artillery echelons drew, but in time of emergency was frequently issued direct from the railheads to the artillery echelons.

The locations of depots are as follows (Chart 2, Chapter X, Vol. I):

DEPOTS ON SOUTHERN LINE.

Guns and gun stores.

Clothing Depot	Rouen.
No. 3 Ordnance Repair Factory	Creil.
No. 8 Depots	Abbeville.
Base South	Le Havre.
No. 22 Depot	Amiens.
Salvage & Tent Repair Depot	Graville.
No. 13 Depot	Blargies.
No. 1 Ordnance Repair Factory	Le Havre.
Gum Boot Repair Factory	Pantin (Paris).
Textile & Salvage Repair Factory	Paris.

Ammunition.

No. 4 Ordnance Repair Factory	Fressenville.
No. 16 Depot	Martainville.
No. 21 Depot	Flesselles.
Wharf No. 4 Base	Dieppe.
Main Wharf	Quevilly.
No. 12 Depot	Blargies.
No. 15 Depot	Rouxmesnil.
No. 20 Depot	Saigneville.

DEPOTS ON NORTHERN LINE.

Guns and Gun Stores.

Base North	Calais.
No. 9 Ordnance Depot	Etaples.
No. 7 Ordnance Depot	St. Omer.
No. 11 Ordnance Depot	Les Attaques.
No. 2 Ordnance Repair Factory	Val-de-lièvre (Calais).
Salvage Repair Depot	Do.
Central Boot Repair Shop	Do.
Receipt Depot	Do.

Ammunition.

Wharf No. 3 Base	Boulogne.
Ammunition Repair Factory	Do.
No. 10 Depot	Andruicq.
No. 14 Depot	Zeneghem.
No. 19 Depot	Dannes.
No. 23 Depot	Bourbourg.

(4) *System of Distribution.*

Stores were distributed to units through the Ordnance officer administering the formation of which they formed part. Taking the Division as a sample formation, the D. A. D. O. S. was this officer and he was the medium through which all indents were submitted by the units of his formation. He, however, did not supply ammunition excepting .303 inch blank, the dummy cartridges .303 inch used for drill purposes and a few types of grenades used for instructional purposes. He was instructed to exercise a check on the demands of units, and therefore kept extensive records of receipt and issues of stores. No actual accounts were kept, but excess demands could always be discovered on comparison with the demands of other units operating under the same conditions.

It must be borne in mind, however, that the D. A. D. O. S. was not there to obstruct the legitimate demands of units. It was incumbent upon him to accelerate the despatch of indents to the base, and see that the stores when received were issued without delay. In other

words, he, as far as his job was concerned, saw that the fighting efficiency of his Division was not impaired. Frequent visits to units were necessary, and in this connection it was pointed out that it was the duty of the D. A. D. O. S. to see that the units did not accumulate stock with a view to meeting future requirements. That is, they could not hold stocks of stores for replacements. Stores could be replaced from the base almost within twenty-four hours. As an example, one Division after the third battle of Ypres was actually re-equipped after two and a half days and ready again for the line. Some of the units were, in fact, in the line within seven days. The stores were obtained by lorry from base and not by rail as was the usual custom. It should be noted, however, that the Ordnance Officer with a formation did not hold stocks of any kind, with the exception of a small reserve of 1,000 containers for box respirators and 5,000 pairs of socks.

The D. A. D. O. S. was instructed to see that all stores fit for repair which were replaced by the issue of new were returned to railhead for despatch to base, also that any salvage or surplus stores were collected and returned.

The D. A. D. O. S. was also responsible to a certain extent that the rifles, Vickers, and Lewis guns in his Division were in a serviceable condition. An Armorer Staff Sergeant was attached to each infantry battalion in a British Division and to each machine gun battalion. In the early stage of the war armorers were permanently with the unit, but it was found to be a much better plan to collect them and form a division armorers' shop. The divisional armorers' shop was equipped with all the tools and accessories for the repair of revolvers, rifles, machine guns, bicycles, primus stoves, steel helmets, etc., and therefore it will be seen the facilities for the repair and reissue were much greater than if the unit was left to an individual armorer.

In most Divisions there was also a boot repair shop and a tailor's shop. These shops were for the benefit of the small units of the Division not possessing bootmakers or tailors, and the strict observance of the proverb that "a stitch in time saves nine" saved many hundred pairs of boots and also suits of clothing. These shops were run under the supervision of the D. A. D. O. S.

Reference has already been made to the light and medium workshops which were established under Corps and Army supervision. These shops were set up almost in the line to carry out immediate repairs to guns and vehicles of all descriptions. These facilities were, of course, limited but all vehicles which could be repaired by the unit were sent to the Inspector of Ordnance Machinery (I. O. M's) shop. In the Division, the divisional train carried out repairs to G. S. wagons and limbers but, of course, they could only do comparatively

minor repairs. Indents to replace vehicles rendered unserviceable by the exigencies of the campaign could not be submitted to the D. A. D. O. S. unless a condemnation certificate from the Inspector of Ordnance Machinery was attached. Of course, if the vehicle had been destroyed by shell fire this was impossible and a certificate "Destroyed by Shell Fire" was enough to support the demand. All guns and howitzers were sent to I. O. M. for repair or condemnation.

There was also another admirable institution run by most of the Armies in the field, viz., the Army Gun Park. The gun park was really an advance depot, and as it was comparatively near the line it can be readily seen that guns could be quickly replaced. The gun park kept a stock of guns, howitzers, Vickers guns, Lewis guns, and components. Demands were submitted through Ordnance Officers of the formation, who either collected from the gun park or instructed the units to do so.

SCHEME OF ARMS AND AMMUNITION SUPPLY TO THE BRITISH ARMY IN FRANCE AND FLANDERS.

Guns and Carriages.

A fixed reserve was laid down to be maintained in store at the base depots and gun parks, and this was maintained by despatch from home according to the output of the factories, the natures required to be manufactured being notified by G. H. Q. If at any time the stock fell below the reserve, demands were sent by the Quartermaster General (Q. M. G.).

Technical Artillery Vehicles, Machine Guns and Trench Mortars.

A fixed reserve was laid down and maintained by demands on home by the D. O. S. The stock in France was divided between the base depots and the gun parks, the park stocks being replenished as necessary by issues from the bases. When large operations were pending in any particular Army, the park stocks of that Army was increased beforehand.

Indents.

Indents for guns, carriages and technical artillery vehicles, were submitted to the Q. M. G. and repeated to the D. O. S., the D. D. O. S. Army, the A. D. O. S. Corps and Gun Parks, and issues were made only on the authority of G. H. Q.

Indents for machine guns and trench mortars were submitted to the parks and repeated to the D. D. O. S. Army and the A. D. O. S. Corps only. Issues were made on the authority of the Army.

Channel of Indents. (See Chart 3, Chap. X, Vol. I.)

Small quantities were at times sent up to the front to replace losses, but these were few and far between. In exceptional cases

large issues were made to the front, such as re-armament of (Territorial Force) divisions with later marks of rifles, and the re-armament of American divisions cooperating with the British Army.

Small Arms.

The ordinary replacements of small arms at the front were usually effected from salvaged arms which were repaired in the divisional armorers' shop, and each Division maintained a small stock of arms in good condition for this purpose, obtained from the same source.

Until the last few months of the war, all reinforcements came out unarmed and were armed at the base reinforcement camps before proceeding to the front. For this purpose a standard stock of arms was maintained at Calais, Boulogne, Etaples, Havre and Rouen, based on an average month's requirements, and maintained by A. D. O. S. (Provision) from repaired arms from the main base depot workshops, and when necessary, by demands on home. Arms demanded from home were despatched direct to the depots concerned.

Channel of Supply. (See Chart 4, Chap. X, Vol. I.)

Ammunition.

Forecasts of requirements were prepared at G. H. Q. and the War Office stated forecasts of the output to meet them. The Q. M. G. detailed the tonnage required, and the D. O. S. worked out the detail, by rounds and natures, of the distribution between ports and from ports to depots.

Standard stocks of components and small arms ammunition were laid down and maintained by demands on home submitted by the D. O. S.

Base depots in France reported stocks daily to the Q. M. G. and the Armies demanded requirements daily from the Q. M. G., stating at which railheads required. The Q. M. G. and the D. O. S. met these requirements daily by despatch of trains from Base depots to railheads.

Historical Statement.

The history of the Royal Army Ordnance Corps in France is one of expansion, remarkable even among services which grew to proportions unimagined before the war. From a pre-war establishment of thirty officers and 1,360 other ranks, at the Armistice the Corps numbered 800 officers and 15,000 other ranks.

ORGANIZATION.

Ordnance Services at H. Q., I. G. C. and at L. of C.

At the outbreak of war the Director of Ordnance Services went to the Headquarters of the Inspector General of Communications (I. G. C.). These headquarters were changed frequently during

the retreat from Mons. About the middle of October, however, the I. G. C. moved permanently to Abbeville, G. H. Q., transferring to St. Omer.

Soon after the arrival of the I. G. C. at Abbeville, the port of Boulogne, which had been closed owing to the advance of the enemy, was reopened and a main ammunition depot was formed near the port. This Depot was responsible for the supply of ammunition trains.

At this stage a Deputy Director of Ordnance Services was appointed at Headquarters I. G. C., with Assistant and Deputy Assistant Directors, and also a Principal Inspector of Ordnance Machinery to deal with the many technical subjects relating to artillery, other technical subjects and workshops. The Deputy Director of Ordnance Services, L. of C., was also stationed at Abbeville, and controlled directly all depots on the Lines of Communication. Subsidiary depots for local supply were opened at Rouen, Abbeville, Boulogne and Etaples, the main depot being at Le Havre.

In September 1914, a depot was opened at Marseilles to deal with the re-equipment of the Indian Corps with rifles and machine guns sighted for high velocity ammunition, and another depot was opened later at Orléans for the final equipment of Indian units which were sent there for concentration before proceeding to the front. A Deputy Director of Ordnance Services, Marseilles Line, was appointed to supervise these two depots, and the line generally, and the post remained in existence until Orléans was given up early in 1915.

An ammunition depot was formed at Rouen and Chief Ordnance Officers (Ammunition), North and South, were appointed to control depots and ammunition landing ports in the areas. The base ordnance depot at Calais was gradually established, and eventually took up the supply to the northern group of armies. A large base workshop had been organized at Havre early in 1915, and a similar one created at Calais, a Chief Inspector of Ordnance Machinery being in charge of each and of all other workshops on their respective lines.

Until January 1917, the Director of Ordnance Services had his headquarters at I. G. C., Abbeville, a Deputy Director of Ordnance Services being attached to the Q. M. G. and G. H. Q. In January 1917, with the abolition of the I. G. C., and the reorganization of the Q. M. G's office, the Director of Ordnance Services moved his office to G. H. Q., and all directors thus dealt directly with the Q. M. G.

Ordnance Services at the Bases.

The Ordnance base and advanced base were opened at Havre and Amiens on August 13th, and August 20th, 1914, respectively.

The Havre depot was in the "Hangar aux Cotons" with the R. A. S. C. supply depot. During the retreat from Mons it was decided to evacuate Havre, and urgent orders were issued to load as much as possible in available ships and to destroy anything which could not be moved. In five days about 25,000 tons of ordnance stores were loaded, the cargoes being of the most varied character. These vessels with their conglomerate cargoes arrived at St. Nazaire and Nantes and, as urgent demands for stores arrived from the front at once, the already chaotic state rapidly became worse owing to frantic efforts to pick out items especially required. Considerable difficulty in berthing the ships was found, the largest vessels only being able to find a place on the side of the river some miles from the utterly inadequate accommodations provided for ordnance stores. The stores had latterly to be salvaged from various wharves and warehouses where they had been dumped, together with forage and supplies.

Early in October a fresh depot was opened at Havre for ordnance stores from England, about the same time that the Boulogne depot commenced to function. Meanwhile the Marseilles depot was augmented by the arrival of two Ordnance Field Parks from India, the contents of which, together with the Indian Ordnance personnel, had to be incorporated into one main depot. While in the process of being established, this depot had to commence making issues to the newly opened depot at Orléans, and was also receiving stores from home. All the above depots were at the same time being fed from the main base depot at Nantes, and its subsidary depot at St. Nazaire.

The advanced base, which originally had been formed at Amiens, moved to Rouen on October 26, 1914, and Le Mans on October 31st. Very little issuing was done at Amiens as the depot received practically no stores. At Le Mans the depot developed considerably, and did a large amount of detail issue to the troops until the main base depot moved to Havre from Nantes. This took place in October, 1914, when the geographical position of the advanced base rendered it unsuitable as an issuing centre.

The depot at Havre soon became congested by the receipt of stores returned from the front and consequently, in February, 1915, the depot for stocks received was moved out to Graville, two miles distant, where a very large returned stores depot was gradually built up. From that time onwards the Havre depot was divided into three main branches:

1. The main depot.
2. Workshops.
3. Returned stores depot.

The main depot was divided into groups from which the stores were issued either in detail to units or in bulk to Ordnance Officers with formations.

In March, 1915, the Clothing and Blankets Repair Depot was opened. To this depot all used blankets and clothing were sent. The depot continued to function the rest of the war.

In September, 1916, in order to provide more room at Havre for discharging cargoes, clothing for the Southern Line was moved from Havre to Rouen, and this was followed at the end of 1916 by the formation of a "Transit Strip" along the quayside of the hangars 36 feet wide, on to which the cargoes could be discharged. This strip was first under the control of the M. L. O. who was responsible for the discharge of ships. On the formation of the Docks Directorate in 1917, the M. L. O's. duties were taken over by that Directorate.

In May, 1915, the necessity for a northern base with a shorter sea route from England and a shorter L. of C. in France resulted in a new base being opened at Calais. The development of Calais was on similar lines to that of Havre, and in June, 1918, the depot was moved out of the docks to Vendroux to give more transit space in the hangars in the docks.

At the beginning of the war it was taken for granted that the main base should be situated at a port. As the volume of traffic increased and shipping became more and more difficult to obtain, the whole of the accommodation at the ports was required for stores in transit. Consequently, the base had to be moved as far as possible from the port so that stores might be obtained therefrom with the minimum of delay. The two factors that govern the proximity of the base to the front were:

(*a*) Strategical safety.

(*b*) Railway facilities.

As the base had to be at or behind the common point or regulating station which served all the front—with a short L. of C. such as the Northern Line from Calais to the front of 1915–1917, all that could be done was to put the base just outside the port.

From an Ordnance point of view an advanced base is objectionable because it involves a complication of personnel and a locking up of stocks. It was found that Havre was sufficiently near the front (forty-eight hours) to obviate the necessity of an advanced base, though Nantes required one (Le Mans).

Ammunition Supply.

When the British Armies in France and Flanders began active operations in France its ammunition requirements were met from one train of ammunition whose movements were controlled by the

military situation. This train was kept up to authorized strength by receipts from the base. By the end of December, 1914, there were two ammunition trains, one at Fère-en-Tardenois and another at Mont-Notre-Dame.

As long as the war of movement continued these trains were transferred from place to place as required, but by the middle of November they had both assumed settled positions, one at Strazeele and one at St. Venant. All ammunition despatched from the ports continued, however, to be kept on rail, and it was not until the middle of 1915 that the increased production and expenditure of ammunition led to formation of dumps in forward areas. At the time of the Armistice there were over 120 ammunition railheads.

In October, 1914, it was decided that Boulogne should be the main ammunition base, and that a reserve of approximately 5,000 tons of ammunition should be kept there, and about 800 tons of assorted ammunition loaded on rail. The general principle was to meet orders as far as possible, from this *en cas mobile* train, and to keep it up to strength from the reserve or from ships.

By the end of 1915, the storage accommodation of Boulogne amounted to 20,400 tons, including the *en cas mobile* of 800 tons. In September, 1915, an ammunition depot with a capacity of 18,000 tons had been opened at Rouen. An *en cas mobile* had also been started at Fontinettes, Calais, in October, 1915, and another at Abbeville in December, 1915. In March, 1916, the former was transferred to Audruicq depot.

Layout of ammunition depots.

In order to secure a reasonable degree of safety it was necessary to spread ammunition hangars over a considerable area of ground, and the depots consequently increased largely in size. In the selection of the sites the French stipulated that an ammunition depot should be at least 1,000 meters distant from a town or village. The base depots were all situated on flat ground or, as in the case of Dannes-Camiers depot, on easily worked land such as sand with low hills.

Sand dunes with irregular plantations formed an exceedingly suitable site for a depot, provided they were made accessible by rail. No aerial attack was made on the depot at Dannes-Camiers, although it was at one time nearly twice the size of any other depot on the Northern Line. It was almost invisible at night owing to natural camouflage. Depots on flat pastoral or cultivated land are very obvious marks, particularly when the railway lines are sand ballasted.

The minimum tonnage of a main ammunition depot may be assumed to be 38,650 tons, and the maximum in the neighborhood of 75,000 tons.

The Andruicq ammunition depot was opened on March 19, 1916. It was reconnoitred by German aeroplanes towards the end of April, but remained unmolested until July 21st, 1916, when an air raid on a small scale resulted in the almost complete destruction of the depot. The depot was much too small for its tonnage and consequently grave risks were taken. At the time of the explosion it contained only about 9,000 tons of ammunition, and its destruction did not break the continuity of the ammunition supply, as additional issues were made from the southern depots, Quévilly and Rouen. The immediate result of the destruction of the depot at Andruicq was the evacuation of the great bulk of the ammunition at Boulogne and Rouen. The Rouen depot was evacuated on July 31, 1916, and Quévilly one month later.

In July, 1916, the capacity of existing ammunition depots in France was as follows:

	Tons.
Boulogne	20,000
Andruicq	35,000
Rouen	18,000
Quévilly	44,000
Martainville	15,000
	132,000

The reserve of ammunition to be held on the L. of C. at this time was 100,000 tons, 50,000 on each Line. In October, 1918, the capacity of existing depots was:

	Tons.
Northern Line.	
Andruicq	32,100
Zeneghem	41,900
Dannes	67,550
Bourbourg	30,000
Southern Line.	
Blargies	47,260
Rouxmesnil	41,130
Conteville	24,130
Saigneville	52,380
	336,450

The reserve on the Lines of Communications at that time was about 250,000 tons.

Ammunition Transit Depots.

Except in the early days at Boulogne, ammunition was always loaded direct from ship to truck, as there was little space available on the quays, and an explosion of any considerable accumulation of

ammunition there would have involved damage dislocating the supply services.

Early in 1915, ammunition arrived at Boulogne in ships of about 400 tons capacity, 300 tons being ammunition and the remainder various other stores. The labor on the ships was French under the Deputy Naval Transport Officer, that on shore French and Army Service Corps under the Army Ordnance Department (A. O. D.).

Boulogne was for a long time the only ammunition port in France, and it was not until November, 1915, that ammunition other than small arms ammunition (S. A. A.) was sent to the first port opened for the receipt of ammunition in the south, viz., Rouen. This port was superseded in April, 1916, as far as ammunition was concerned by Quévilly wharf, which was situated on the outskirts of Rouen. The next port to be opened for regular consignment of ammunition was Dieppe, which began dealing with this work in September, 1916.

In the meantime a wharf was under construction on the canal near which Zeneghem ammunition depot was situated. Zeneghem, with the exception of a break from January 26, 1917, to May 5, 1917, continued to take ammunition by barge from Richborough regularly until the end of the war. The port of Calais was occasionally used for the intake of ammunition, but did not receive regular consignments.

The transfer of ammunition from water to rail proceeded throughout the war with great smoothness, but the use of any but small ships involved a great waste of labor at ammunition depots. There were so many subvarieties of ammunition that even in a ship of 500 tons capacity it was impossible to avoid having several kinds on board, and also impossible to keep them separate when the cargo was discharged. Detailed sorting at a port was impracticable if ships were to be discharged rapidly. Consequently, it was rarely possible at a depot after the early stages of the war to forward direct to railheads a truck of ammunition received from a port. It had to be offloaded, sorted, and eventually loaded again. As ammunition was received in France for a long time at the rate of about 7,000 tons per day, the loss of labor involved was considerable,

Machinery of Supply from Ports to Railheads in France.

Demands for ammunition in accordance with the orders of the General Staff were put forward by the Quartermaster General, France, to the Director of Artillery, England, the distribution to ports being given by the Director of Ordnance Services, France. For a few kinds of ammunition a standard stock was laid down for the Northern and Southern Lines, and ammunition to maintain this

stock was demanded from England by the Chief Ordnance Officers (Ammunition), North and South.

On arrival at the ports the ammunition was distributed between the base ammunition depots in accordance with the state of their stocks, or, in special cases, with specific instructions from the Quartermaster General by the Chief Ordnance Officers (Ammunition), North and South. Normally, ammunition arriving at a northern port was kept on the Northern Line, and similarly with the southern ports and depots.

The Quartermaster General, the Director of Ordnance Services and the Chief Ordnance Officers (Ammunition), North and South were notified daily by wire of the stocks of ammunition at the ports.

The base depots on receipt of the ammunition sorted it and stored it in their hangars, except when it was possible to utilize it in meeting issue orders before offloading. This, however, was rarely done in the later stages.

Issue orders for ammunition for railheads were given by the Quartermaster General to the Director of Ordnance Services, and by him notified to the depot concerned and the Chief Ordnance Officers (Ammunition), North and South. In the earlier part of the war orders received at night had to be despatched on the next day, but later the orders were communicated by telephone the evening before the day on which the ammunition was to be loaded.

Armies sent their requirements for spare cartridges and other components to make good losses by shell fire, etc., and also their routine demands for demolition explosives, direct to the Chief Ordnance Officers (Ammunition), North and South, but orders for complete rounds were given only by the Quartermaster General to whom also all abnormal demands on the bases were referred.

During the three months April, May and June, 1918, the Northern Line received a total of 390,659 tons of ammunition, and issued 378,783 tons. On the Southern Line receipts totalled 266,157 tons and issues 270,465 tons.

Advance Ammunition Railheads.

In November, 1916, the spread of narrow gauge lines in forward areas and the extension of the broad gauge system led to the opening of a number of advanced ammunition railheads, intended to relieve road transport by carrying the ammunition further forward by rail. These advanced railheads were on a smaller scale than main railheads. Some of them developed into large depots with a capacity of several thousand tons of ammunition. In one day as much as 2,000 tons of ammunition was issued to forward echelons from one depot.

The opening of the advanced ammunition railheads was of special interest in that for the first time ammunition depots or dumps in front of broad gauge railheads, or in other words, in forward areas as opposed to Lines of Communication, were placed in charge of Ordnance personnel. Some were so well forward that they were supplied only by narrow gauge railway. Strictly speaking they were "dumps in forward areas."

The final type of ammunition railhead consisted of 300 or 400 yards of siding for broad gauge trucks. Along the siding ran a broad road of road metal or sleepers, wide enough for handling lorries. This road had to be arranged so that the lorries entered at one end and left at the other. A narrow gauge track also ran along the siding so that ammunition could be transferred direct from broad to narrow gauge trucks.

At a distance of not less than a quarter of a mile from the railhead, and clear of all main roads, railway lines, canals, and the like, was a depot laid out on the same principles as were observed in base depots. The purpose of these depots was to store reserve stocks of ammunition to guard against a breakdown in the supply from the base, and to relieve congestion at base depots which were frequently filled to a dangerous extent.

Throughout the war there was always a fear on the part of army authorities that there would be a failure in the ammunition supply from the base through the line being cut, or from some such cause, and in consequence of this all armies and also formations hoarded ammunition. It is interesting to note that no failure ever did occur in the ammunition supply, and that throughout the whole period the ammunition arrived at railhead according to plan. Even when the depot at Andruicq was destroyed and the whole Northern Line of supply put out of action, the flow of ammunition to the northern railways continued unchecked, as it was sent up from the Southern Line. During the autumn of 1918, there were more than 120 ammunition railheads and depots in army areas.

An important lesson to be learnt from the experience of the ammunition railheads is that they should be regarded merely as transit depots where ammunition is transferred direct from broad to narrow gauge trucks or to lorries, and that stocks of ammunition should not be allowed to accumulate at them.

Ammunition Repair Factories.

During the progress of the war it was found that quantities of ammunition accumulated, which, although unfit for immediate service, needed only slight repairs to make it fit for re-use. Owing to the shortage of shipping it was not possible to send them to England

for repair, nor was there sufficient room to deal with it adequately in the base depots.

Early in 1917, two ammunition repair factories were started. One in the vacated trench munition area near Boulogne, and the other at No. 12 Ordnance Depot, Blargies, 18-pdrs., 4.5s, and shell ammunition generally were repaired there. A particularly valuable piece of work was done on one occasion when 400,000 percussion S. A. tubes were produced at short notice to meet a temporary and critical shortage at the guns. They were converted from ordinary small arms ammunition by removing the bullet and charge and replacing the latter with gunpowder. The whole of the labor employed was Chinese, and proved admirably adapted to the work.

The value of the ammunition handled per month by the two factories was about £300 sterling.

The southern factory was crippled by the air raid at Blargies in May, 1918, while the impossibility of expansion at Boulogne and the increasing number and intensity of air attacks at that port made the retention of the repair factory there undesirable. A new repair factory to supersede the other two was therefore designed and built at Fressenville. The estimated output of that factory was 300 tons per day, or three times the output of either of the original factories. This factory was completed too late to get into proper working during the war, but as an establishment for "breaking down" ammunition it proved invaluable subsequently.

Repair factories in Army Areas.

Numerous quantities of ammunition had to be collected in the Somme area in the winter of 1916–17, and in other areas after advances, and organizations had to be provided to repair such of it as was worth repairing. The repair factories at the base had their limited capacity strained to the utmost. The alternative was to establish repair factories in army areas, and this was done. The best examples of these repair shops were in the Third Army Area. These factories dealt with very large quantities of every sort of ammunition, and carried out all repairs that could be done without machinery. The experience gained shows that in any campaign where the front is not moving rapidly, an ammunition repair factory in a forward area will prove a great economy and will add to efficiency.

Ordnance with the Army.

On the 9th of April, 1917, the Vimy Ridge operations began. These were interesting from the First Army Ordnance point of view because it was the first time that they had to deal with so many guns and so large an expenditure of ammunition. Improvised

pack saddlery and various schemes for carrying ammunition, water, and stores on pack horses came to the fore during these operations. From that time onwards it was apparent that Ordnance personnel were needed in front of the Army ammunition dumps. In April, 1917, the Third Army began the battle of Arras. The system of dumping ammunition in large quantities preparatory to the battle, and the formation of Corps dumps was adopted for the first time.

The Somme fighting brought to light very serious difficulties in the way of gun spares, and careful arrangements were made to obviate this as much as possible by keeping available stocks fluid by control from Army Headquarters. As the British were acting on the offensive it was arranged to hold small stocks of essential spares as close up to the gun positions as possible, and these were established at several points in dug-outs close to the batteries. Replacements were made direct by these advance dumps to battery commanders, the dumps being replenished daily from shops which, in their turn, drew from the heavy mobile workshops by a round trip service.

Workshops.

One of the duties of the Director of Ordnance Services with the forces in the field was the repair of stores, such as artillery with all accessories, small arms, machine guns, ammunition carts and wagons, bicycles, harness and saddlery, etc. In peace time all stores needing repair were sent to the Ordnance depot of the district or command. The war organization not only included stationary workshops and depots, but had in addition a large number of mobile workshops with armies.

In connection with these workshops a card index system was instituted, and a separate record kept for every gun and howitzer, the number of rounds fired, measurements of the bore, its condition, defects, etc., and any other important matter connected with the life history of the piece. The importance of these records lies in the fact that as a gun wears, its capacity to rotate a projectile, on which accuracy of fire depends, diminishes, and at last reaches a point, varying with each nature of ordnance, when shooting becomes unreliable and the gun must be returned and re-rifled. By charting the rounds fired against wear it is easy to show graphically the behavior of any class of gun or howitzer, and to ascertain the mean average life in terms of rounds fired. The information thus obtained is of value not only for the purpose of making provision for replacing, but for determining the behavior of propellants, and the shape and material of driving bands, all of which influence wear and "life."

In 1917, 29,600 gun measurements were taken as part of the routine of inspection and, in addition, 4,000 special measurements were taken in connection with the problem of correlating peculiari-

ties of wear with the occurrence of premature expansion of shell in bores of guns.

The strength of the mobile workshops fluctuated considerably, as men came from batteries with equipments sent for repairs, and helped with the work. The following is a rough average approximation:

	No. of shops.	Personnel.
Light	40	1,300
Medium	20	800
Heavy	5	900
	65	3,000

The development of stationary workshops on the Lines of Communication proceeded even more rapidly than that of the mobile. The Havre workship was set up in a disused oil refinery, which at the time of taking over was used as a barracks for French troops. Starting with two oil engines totalling 50 H. P., in less than two years the horse power increased to 300, while the personnel rose from 40 to 1,000.

As the centre of British operations moved north, a second base was opened at Calais, and a workshop established on the Val-de-Lièvre Canal. Other stationary workshops were opened at Rouen, Abbeville, Etaples, Boulogne and Marseilles.

When tanks began to be employed a special workshop was laid down at Tank Headquarters, and mobile shops were provided for giving assistance at the front.

VARIOUS ORDNANCE ACTIVITIES.

Anti-gas Helmets.

After the first gas attack at Ypres, provision was made at Abbeville and Calais for repairing and chemically treating the flannel "smoke helmet" which was the earliest protective device used against gas. Approximately 7,667,000 anti-gas helmets were received and conditioned, of which 4,113,900 were repaired, retreated and re-issued.

Gum Boots.

In the early days of trench warfare the supply and maintenance of gum boots was a matter of considerable moment. A workshop employing French female labor under British supervision was opened in Paris for the special purpose of dealing with rubber articles such as gum boots, water-proof ground sheets, etc., 489,330 pairs of gum boots and 185,000 ground sheets were required.

Cleaning.

Paris was also the centre of the industry for cleaning furs, leather jerkins, etc. A special dry cleaning plant, unquestionably the

largest in the world, was installed. The following articles were cleaned and repaired:

Fur coats	1,027,627
Jerkins	2,341,554
Sheepskin lined coats	269,745

Boot Repairing.

The first year of the war the wastage of boots was very high, the life of a pair averaging only from six to eight weeks. Formations in the field were encouraged to make repairs and were supplied with the necessary tools. Experts from the boot trade were attached to armies for the purpose of giving advice and instruction. Repairing shops were opened at Havre, and later at Calais, which ultimately became the chief centre, and a complete plant of up to date machinery was installed there for dealing with 30,000 pairs per week. Calais workshop alone repaired 3,062,069 pairs, and it is estimated that the total number repaired in R. A. O. C. shops, approached 4,000,000 whilst the estimated number conditioned and classified amounted to 9,000,000. Those which were absolutely beyond repair were not thrown away. Laces, middle soles, heel lifts, etc., were cut from the uppers, scrap leathers, old heels and toe tips were sent home for sale.

Disposition of Nickel.

In repairing worn components of guns, carriages and machines generally by electrical deposition of nickel, etc., a good deal of pioneer work was done very successfully, and a promising field for future effort opened up.

Semi-Steel.

The manufacture of semi-steel, which consists of a mixture of cast iron and wrought steel, was also undertaken, and large quantities of serviceable articles were made of this material.

Inventions.

A very important rôle played by all workshops was the development of inventions and the manufacture of experimental fittings. To quote one example, the "elliptical sight" used in machine guns for anti-aircraft defences was designed in France, and over 8,000 sets were made in R. A. O. C. workshops before a single one was supplied from home.

In the variety of services catered for, it is probable that an Ordnance workshop at a base has no rival in civil or military life.

Tonnage of Ordnance stores landed in France.

(Exclusive of Ammunition.)

	(Aug.-Dec.) 1916	1917	1918	(Jan.-July) 1919
Boulogne	14,652	18,933	11,196	479
Calais	158,556	335,218	202,884	39,312
Dunkerque	96		29,535	576
Havre	162,365	242,750	196,951	1,678
Rouen	44,711	57,083	26,390	625
Dieppe				530
	380,380	653,984	466,956	43,200

Tonnage of Ordnance stores shipped from France to the United Kingdom.

(Exclusive of Ammunition.)

	(Aug.-Dec.) 1916	1917	1918	(Jan.-July) 1919
Boulogne			995	2,270
Calais	90,558	237,208	76,462	49,514
Havre	136,591	271,489	105,506	45,415
Dunkerque		165,635	19,769	
Zeneghem		23,803	59,220	
Rouen		217	1,755	3,163
Dieppe				770
	227,149	698,352	263,707	101,132

(Tonnage shown for period ending 31st March, 1917, is Shipping Tonnage, after which Deadweight Tonnage is given.)

CHAPTER IX.

SECTION II.

GENERAL ORGANIZATION OF SUPPLIES OF AMMUNITION AND ARTILLERY MATERIAL (FRENCH).[1]

The French scheme of supply for ammunition and artillery matériel is shown in Chart 11, Chapter X, Volume I.

The raw materials purchased for the account of the State were distributed among the factories in the interior of the country by the Ministry of Armament.

The factories were grouped, according to the nature of the articles which they manufactured, into "Regional Inspections" (Inspections Régionales) at the head of which were technical commissions which were charged with controlling the use of the raw materials and the inspection of the manufactured products.

After their manufacture the various elements, such as bodies of shells, etc., were sent to "Loading shops" (Ateliers de chargement), where they were assembled, loaded, and completely finished. (Chart 12, Chapter X, Volume I).

From the loading shops munitions were forwarded to the general reserve depots (Entrepôts de Réserve générale). Fuzes were manufactured, completed, and inspected in special establishments and sent direct from these establishments to the General reserve depots.

In the general reserve depots the ammunition was classified, according to kind and caliber, and carefully distributed over the greatest possible ground area to avoid a recurrence of the too frequent accidents which had occurred in France, particularly in depots containing grenades and rockets, as the result of piling up too large quantities of ammunition under faulty technical conditions.

Theoretically, the "Entrepôts de Réserve Générale" consisted of:

1) A large railway siding for the reception and classification of the ammunition from the "Loading shops".

2) Lines of hangars (sheds), widely separated from each other, served by special tracks in fan formation and connected with the main siding of the depot. These sheds were at least 150 meters apart.

The sheds where fuzes were stored were always more widely separated.

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[1] Prepared for the Military Board of Allied Supply by the French Section of the Board (Commandant Poupinel, Office of General Payot, D. G. C. R. A.)

From the "Entrepôts de Réserve Générale," the ammunition was shipped to the "Parcs annexes" (combination railhead and ammunition depots) and from there to the front, as described in detail further on.

ORGANIZATION FOR THE SUPPLY OF AMMUNITION

I. *General Statement.*

During the war the consumption of ammunition increased more than that of any other class of supplies.

At the beginning of the war, in France, there were only 1,300 rounds of ammunition for each 75mm. gun, of which 1,000 rounds were distributed among the various supply echelons of the armies and 300 rounds at the disposal of the Commander in Chief. After the Battle of the Marne (September 1914), there remained in the armies a miximum of 400 to 500 rounds per gun, while the reserves at the disposal of the Commander in Chief were almost exhausted and it would have been difficult to supply the needs of the armies engaged in the Battle of Flanders, had it not been decided at this time to reduce the stores of siege ammunition, which were being held in the fortresses, from a 6 months' to a 3 months' supply.

During the winter of 1914–1915, production was constantly increased and finally reached a point where, despite the enormous consumption of ammunition resulting from continual operations and notwithstanding the ever increasing number of guns of all calibers that were put into service, it became possible, at the end of the campaign, to supply the armies with the amounts of ammunition which they requested and that within the necessary limits of time.

II. *Echeloning of Ammunition Supplies.*

The food supply, which must be furnished daily and which is proportionate to the strength of the troops to be supplied, has a certain definite and permanent character while the supply of ammunition, on the contrary, whether for troops which are being attacked or which are engaged in offensive operations must be organized so as to permit the sudden and rapid supply of large quantities of ammunition.

For this reason supplies of ammunition, instead of being for the most part distributed among the armies, were maintained almost exclusively at the disposal of the Commander in Chief, while the armies and army corps only retained sufficient ammunition on hand to supply current needs or to meet the early requirements of a major action.

Ammunition supplies were echeloned as follows:

1. In an army: The batteries and the ammunition columns were fully stocked.

The army commander had certain small depots at his disposal in close proximity to the troops.

2. The commander of a group of armies disposed of:

a) depots which were close enough to the armies to enable the latter to supply themselves by motor or animal drawn convoys;

b) a credit on the supplies at the disposal of the Commander in chief (parcs annexes, etc.) sufficient to meet current requirements. This credit was renewed automatically by the Commander in Chief as soon as the group of armies had used up its allowance.

3. The Commander in Chief had at his disposal:

In the Zone of the Armies: Parcs annexes (ammunition depots).

In the Zone of the Interior: Entrepôts de Réserve Générale (general reserve depots).

The general reserve depots were under the Minister, but their contents were at the entire and exclusive disposal of the Commander in Chief. They were supplied by the "loading shops" (Ateliers de chargement), which were also under the Minister, in accordance with the plans agreed upon between the Minister and the Direction of the Rear (Direction de l'Arrière—D.A.).

The general reserve depots were well connected by railroads and had a large output (they could supply 150 lots of 75mm. ammunition and 15 trainloads of heavy artillery ammunition daily), but their distance from the front made it impossible for them to supply the armies in the field with the necessary speed and safety.

To remedy this condition "Parcs annexes de munitions" were established in the Zone of the Armies. These establishments were depots which could contain approximately 700,000 rounds of 75mm. ammunition and 200,000 rounds of heavy artillery ammunition. They were at the same time practically regulating stations for ammunition and could handle up to 30 trains, of from 25 to 30 cars each, daily.

The ammunition in these depots was completely assembled and stored either in sheds or on railway cars; the latter were known as "en cas mobiles" (mobile ammunition stores).

Operation of the Ammunition Supply System.

a. *At the front:* The supply units of the troops, such as the ammunition columns (sections de munitions), etc., obtained their supplies either from the army depots or from "supply centers" (centres de ravitaillement) where the motor convoys brought the ammunition coming from the rear and which they, in turn, collected at the railheads specially assigned to the ammunition supply service.

b. *In the rear:* 1. The requisitions for ammunition prepared by the various Army headquarters 4th Sections were sent to the 1st Section at General Headquarters which, after concurrence by the 3rd

Section, determined the allowances. The Direction of the Rear (D. A.) was informed of the decisions which had been made and provided for the shipment and delivery of the ammunition to the armies.[2]

2. The Direction of the Rear drew the necessary ammunition to satisfy the requirements of the armies from its "parcs annexes" (except trench artillery ammunition and special shells, which were sent direct from the General reserve depots to the armies).

3. The Regulating Officer (Commissaire Régulateur) in whose particular zone of action the "parc annexe" was located, shipped the ammunition from the latter to the proper stations, which were designated in agreement with the 4th Section of the army concerned.

4. The Direction of the Rear, in conjunction with the general reserve depots, regulated the movement of ammunition issued from these depots after agreement with the Regulating Officers and Railway Commissions (Commissions de Réseaux) concerned.

Development of the Ammunition Supply Agencies at the Disposal of the Commander in Chief During the War. (*Chart 10, Chapter X, Volume I.*)

1. At the beginning of the war there were six "Entrepôts de Réserve Générale", namely: Rennes, Angers, Bourges, Clermont-Ferrand, Lyon and Besançon.

At the end of 1917, there were twenty nine of these depots and they received the products manufactured or prepared by the "Loading shops" (Ateliers de chargement).

(1) 75mm. heavy artillery and infantry ammunition was stored in eleven depots: Rennes, Châteaudun, Bourges, Clermont-Ferrand, Lyon, Besançon, Thouars, Salbris, Angers, Le Mans and Méricy.

(2) Ammunition for large caliber heavy artillery (A. L. G. P.) was stored in three depots: Versailles, Mézidon and Châteaudun.

(3) Trench ammunition in three depots: Grenoble, Ingrandes and La Valbonne.

(4) Special shells in one depot: Vincennes.

(5) Grenades and rockets were stored in twelve depots: St. Denis, Bellegarde, Poitiers, Montreuil, Bellay, Grenoble, Bourges, Ingrandes, Versailles, Clermont-Ferrand, La Chappelle-St. Mesmin and Gien.

In addition to the above, four large capacity depots were under construction, namely at: Leyment, near Ambérieu; Chemilly, near Auxerre; Aubigné, near Le Mans, and at La Ferté-Haute-Rive.

2. "Parcs annexes" did not exist at the beginning of the war and they had to be specially built on account of the safety precautions which had to be provided for in their construction.

[2] However, for grenades and rockets the armies sent their requisitions direct to the Direction of the Rear.

At the end of 1917, there were four "Parcs annexes," namely: Formerie, Mitry-Claye, Brienne-le-Château and Vaivre. Mitry-Claye had a branch or "annexe" at Barberie and Vaivre had one at Vereux.

Finally, in 1917, an ammunition sorting and salvage center was created at Harbonnières, near Chaulnes, to receive the large quantities of ammunition which had been salvaged or reconditioned after the battle of the Somme (75 mm. trench artillery and infantry ammunition).

It should be noted that a part of the supplies maintained at the "Parcs annexes" was stored in railway cars. The "en cas mobiles" of the Parcs annexes could, according to the military situation, be sent to the various ammunition supply points within easy reach of the troops or which were better located than the "Parcs annexes," for eventual movement toward the front. When thus organized, these formations were often called "Parcs sur rails" (ammunition parks on wheels). Their supervising personnel and the necessary personnel for the handling of the ammunition were then detached from the "Parcs annexes" to which the "en cas mobiles" organically belonged.

During the first days of the German attack of March, 1918, the Direction of the Rear was confronted with a two-fold problem:

It had to provide for the evacuation of the establishments which were threatened by the enemy's advance.

It also had to provide for and create new agencies which would be capable of taking the place of the establishments which had to be evacuated.

The establishments at Formerie and at Mitry-Claye, including the "annexe" at Barberie, were deemed to be in a dangerous situation consequently orders were immediately issued for the removal of the ammunition at Barberie. Part of this ammunition was distributed to the armies and part was returned to Mitry-Claye and to Brienne-le-Château for storage on the "en cas mobiles."

NOTE.—It is interesting to note that although military events frequently necessitated the movement of the regulating stations, insofar as food supplies were concerned, the same procedure was impracticable with regard to ammunition supplies. In the latter case, the reorganization of the "Parcs annexes" (regulating stations for ammunition), particularly of their "en cas mobiles," had to be specially provided for. As a matter of fact, the impossibility of establishing, within a few days, permanent installations of the size and nature of the "Parcs annexes" is self evident, This condition was remedied by increasing the size and particularly the number of "en cas mobiles," however, this presented the disadvantage of causing the immobilization of a large number of railway cars or trucks.

Formerie and Mitry-Claye hastily began to load the supplies stored in the ammunition sheds upon railway cars (Formerie: 4 trains daily and Mitry-Claye: 3 trains daily). On the evening of March 27th., there still remained 75 trainloads of ammunition in the sheds at Mitry-Claye and at Formerie; however, thanks to intensive efforts, the complete evacuation (sheds and sidings) of Formerie was completed by the night of April 3–4. As far as Mitry-Claye was concerned, the ammunition in the sheds was progressively loaded on cars, but the siding remained constantly in use. Moreover, on April 19th., the situation ceased to be threatening and the use of the ammunition sheds of these two "parks" was again authorized.

Later, when Mitry-Claye was again threatened as the result of events at Chemin-des-Dames, the Minister was requested to consider the advisability of placing the General reserve depots at Châteaudun and at Salbris at the disposal of the Direction of the Rear. These were to be used as "Parcs annexes" and were to take the place of Mitry-Claye and Formerie, respectively. However, this plan was never carried out and it was completely abandoned when the offensive passed to the Allies.

These various measures had resulted in a decrease in the producing capacity of Mitry-Claye and Formerie, whereas, owing to the developments of the battle which was then in progress, tonnage requirements were increasing daily.

To meet this situation, on April 1st., 11 "en cas mobiles" were progressively organized in the zone of the regulating station at Creil; each of these mobile depots contained 5 lots of 75m.m. (H. E.) and 2 lots of shrapnel ammunition. Toward the middle of April, the maintenance of these "en cas mobiles" was no longer considered necessary. In addition to the above, 2 "en cas mobiles" (about 600 cars) were immediately constituted at Pont-de-l'Arche and at Oissel; first, to replace Formerie which was being evacuated and, later, in order to assist it.

When the "Detachment of the Army of the North" (D. A. N.) was sent to Flanders, on account of its distance from the main supply establishments, an "en cas mobile" was organized in the zone of the regulating station at Dunkerque. After the withdrawal of these troops the ammunition remaining loaded on cars at Dunkerque was unloaded in the British depots at Audruicq and at Zeneghem and, subsequently, either delivered to the armies or sent back to Mitry-Claye and Formerie.

At the beginning of June, owing to the disturbing situation which might ensue at Mitry-Claye as a possible result of military operations and on account the large quantities of ammunition which this establishment was called upon to furnish, the Minister of War

placed the railway siding of the sorting center at Trappes at the disposal of the Direction of the Rear, which placed it under the orders of the Commandant of the "Parc annexe" at Mitry Claye.

The Allied counter-offensive began in July. During the offensive part of the Battle of 1918, after the retreat of the enemy, the Direction of the Rear had 3 "Parcs annexes" at its disposal, namely: Mitry-Claye, Brienne-le-Château and Vaivre, as well as the "Parc annexe" for grenades and rockets which was located at Vereux.

Despite the enemy's retirement, the use of the "Parc Annexe" at Formerie had to be discontinued during the course of this battle owing to the fact that it was too close to the junction of the railways coming from Romescamp, Serqueux and Abancourt. Moreover, it offered too vulnerable a target for the repeated attacks which the German aviators were carrying out in this region, particularly on account of certain defective conditions of safety under which this establishment had been constructed and which it was impossible to remedy.

It had also been deemed advisable, as a measure of safety, to do away with the "Parc annexe" at Vaivre and to replace it by a new installation which was to be erected at Port d'Atelier (east of Chaumont) but, on November 11th, construction work on this park had not been started and Vaivre therefore continued to operate until the armistice.

The Direction of the Rear retained the "en cas mobiles" which it had organized during the offensive period at Port d'Atelier, Oissel and Trappes for a certain length of time, but these had to be discontinued during the latter part of August on account of frequent enemy air raids.

During the preparation for the general offensive and when the 6th French Army, together with American units, was sent to Flanders, a large "en cas mobile" was organized at Dunkerque for the supply of the troops operating in Belgium.

Artillery Matériel and Military Equipment.

The Direction of the Rear supplied the "Main Artillery Parks" (Grands Parcs d'Artillerie) with spare parts, upkeep material and artillery matériel (except latest models of artillery matériel).

For this purpose the Direction of the Rear had "Parcs annexes" at its disposal, but unlike for the supply of ammunition, it did not dispose of general reserve depots. The stocks of the "Parcs annexes" were replenished by the Minister in accordance with the requisitions submitted by the Direction of the Rear.

As a matter of fact, a certain length of time elapsed before these requisitions were filled and this was one of the reasons why the supply of this particular class of matériel, often split and furnished in single carload lots or in groups of cars, did not always attain the desirable rapidity.

There were "Material Parks" (Parcs de matériel) at:

1. Le Bourget, materials and spare parts for the 75 mm. artillery.
2. Noisy-le-Sec, materials and spare parts for machine guns.
3. Epinal, wagon park.
4. Méru, wagon park.
5. Faguinières, materials and spare parts for the heavy artillery.

Statistics.

The stocks of ammunition at the disposal of the Commander in Chief of the French Armies on October 31, 1918, are shown in the chapter on statistics under: "Artillery." (Table XI, Volume I.)

CHAPTER IX.

SECTION III.

SUPPLY OF ARMS AND AMMUNITION IN THE BELGIAN ARMY.

The arms and ammunition with which it had been provided in peace time, thanks to the activities of the "Artillery Establishments," enabled the Belgian Army to withstand the numerous operations which took place from the time when its territory was invaded until its withdrawal upon the Yser.

Thereafter, however, the Belgian artillery (ordnance) establishments (which had been transferred to France, as will be described later), were unable to manufacture the necessary infantry and artillery ammunition urgently needed by the Belgian Army. Their facilities were so limited that it was useless to think of organizing them for the manufacture of rifles and machine-guns, still less for that of artillery matériel, with which to reinforce the field equipment of the Belgian Army or to provide the latter with the indispensable heavy artillery.

Therefore, while the Belgian Minister of War and his collaborators provided for the operation of the Belgian establishments and prepared programs of activities, they occupied themselves, from the outset, with the urgent problem of procuring necessary supplies of material and ammunition.

A. Procurement of Ammunition and Material.

(Chart 5, Chapter X, Vol. I.)

I. Ammunition.

1. *Small arms ammunition* for rifles and machine-guns was obtained from private firms in France, England, and, principally, in America; the same applies to ammunition for Colt and Browning pistols. Several hundred million cartridges were delivered by these firms and this provided a large supply of ammunition for the troops, as well as means for establishing a considerable reserve.

The results thus obtained were, on the whole, so favorable that it was deemed unnecessary to proceed with the organization of a small arms ammunition factory as had been originally planned.

At first grenades were also obtained in this manner, but the Belgian services soon organized themselves so as to be able to undertake the manufacture of bombs and grenades, and this made it possible to effect appreciable economies.

2. *Artillery ammunition.*—During the critical period at the beginning of the war, the Belgian services had no alternative than to use complete rounds furnished by the French Government, or ammunition obtained from French industrial firms, and which had to undergo certain modifications.

This first phase was of short duration. As soon as the Belgian Government had established itself at Le Havre a more practical solution was adopted, which consisted in acquiring the various elements of projectiles from private concerns and then assembling them in the Belgian establishments. Large orders were immediately placed in France and in England for the delivery of main bodies of projectiles, cartridge cases, component parts of fuses and primers. The assembling, loading, and operation of making these components into cartridges were done in the "Pyrotechnical School" (Ecole de Pyrotechnie).

With the continuation of the war a third phase occurred, during which necessary installations were created for the direct manufacture of projectiles for the use of the field artillery. However, Belgium depended upon her Allies for the supply of heavy caliber projectiles until the end of the war.

3. *Powders and Explosives.*—

a) *Black Powder*: It was found possible to utilize the large stocks of black powder which had been salvaged from Antwerp, but additional requirements were readily obtainable from available reserves of black powder in the possession of the French Artillery Service.

b) *Smokeless powder*: Great difficulties were experienced in obtaining smokeless powders. The Belgian Army which, at first, had been supplied solely through the kindness of the French Government, soon found it necessary to provide its own supplies of smokeless powder. The first step in this direction was the purchase of such supplies from private industries, but this system was found impracticable and left much to be desired in the matter of regularity of production.

The Belgian Minister of War therefore decided upon the acquisition of a gun-cotton factory in England, and this plant was equipped to effect the transformation of gun-cotton into artillery powder.

c) *Explosive shells*: It was necessary to provide requirements for a consumption which attained several tons per day. As in the case of smokeless powder, recourse was first had to private industries. Later, it was decided to establish a Belgian plant for the manufacture of shells. This establishment was constructed in Eng-

land, on account of the difficulties which the Belgian services foresaw would be experienced in acquiring necessary raw materials, particularly acids, in France.

II. Material.

1. *Rifles.*—Before the war the Belgian Army's armament had been manufactured at Liège in the "National Arms Factory" (Manufacture d'Armes de l'État). Immediately after the evacuation of the national territory by the Belgian Army, all that could be done was to recondition deteriorated rifles in the repair shops which had been hurriedly established at Calais. Large stocks of new rifles were urgently needed, however, to replace damaged matériel and provide arms for the equipment of new units.

The first contracts made with private concerns for the supply of this equipment were disappointing.

After numerous failures and much bargaining, a satisfactory contract was finally entered into with an American firm, however, while awaiting delivery of these arms it was necessary to provide for the deficiency in rifles. France met the emergency by the loan of several thousand "Lebel" rifles, together with the necessary small arms ammunition, and this despite the fact that France was experiencing difficulty in obtaining armament for her own troops.

Little by little, the indispensable "Mausers" were received, but it soon became apparent that the contracts which had been made did not sufficiently guarantee delivery. It was finally found possible to take over and operate a British arms factory for the Belgian Government. Thus was created the "Belgian Arms Factory," at Birmingham, and the rifles for the Belgian Army were thereafter manufactured by Belgian artisans.

2. *Machine Guns.*—The Belgian Army entered the war with 120 machine-guns. Thanks to the existence in France and in America of large plants which were already engaged in the manufacture of these weapons, it was possible to obtain rapid and satisfactory deliveries.

3. *Pistols, lances and sabers* were ordered from private concerns but, after necessary raw materials had been obtained, the lances were manufactured by the Belgian shops.

4. *Trench mortars.*—Orders were placed with private firms for "Schneider" type mortars. Two Belgian inventors, Mr. Delattre (an engineer) and Major Van Deuren, invented two types of mortars. These were manufactured by industrial plants and delivered to the Belgian Army in gradually increasing numbers.

5. *Artillery.*—Surprised in the midst of its re-organization, the Belgian Army had a very limited number of 75 mm. field pieces and only 24 field howitzers at the beginning of the war. The prob-

lem of obtaining additional artillery was complicated by the fact that France and England were the only sources from which such matériel could be obtained, moreover these nations were facing deficiencies themselves. However, these two countries supplied Belgium within possible limits.

The Belgian Army was initially equipped with Krupp guns while the guns furnished by England and France were of different models, so that the only possible solution was the establishment of shops for the manufacture of Krupp guns.

The heavy artillery used by the Belgian Army was obtained from her allies. A great many heavy field pieces were also obtained by the remodelling of heavy artillery captured from the Germans.

6. *Miscellaneous Matériel.*—Before the war the optical instruments for field pieces and artillery batteries, as well as field glasses, used by the Belgian Army had been obtained from Germany. The French Government delivered a limited number of ranging instruments but, foreseeing future requirements, the Belgian services established a "precision shop" (atelier de précision) for the manufacture of these accessories, which were indispensable to the Army.

The preceding statement shows the activity which had to be displayed in the matter of procurement.

In conclusion, it may be added that purchases were made by commissions which were composed of recognized and competent personnel. The headquarters of these purchasing commissions were located at Paris, London and New York, respectively. Chapter VIII, Section III, gives a detailed account of the operation of these commissions.

B. The Belgian Artillery (Ordnance) Establishments (Établissements d'Artillerie).

In the preceding paragraphs it was seen that, before the war, Belgium possessed various "artillery establishments," which were equipped to supply the requirements of the Army. During the retreat the Belgian Army was obliged to abandon these establishments and it therefore became dependent upon its allies for the supply of ammunition and armament. Little by little, the Belgian Army organized plants in France and in England, similar to those which it had been obliged to abandon, and these establishments were able to provide for the new and unforeseen requirements which developed constantly throughout the war.

A brief historical statement of these establishments will be given herewith, beginning with those which existed before the war and ending with those which the Belgian Army possessed at the time of the armistice.

I. THE BELGIAN ARTILLERY ESTABLISHMENTS ON THE EVE OF THE WAR.

When hostilities began the Belgian artillery establishments consisted of the four following plants:

The Royal Gun Foundry, located at Liège.
The National Arms Factory, located at Liège.
The "Construction" Arsenal, located at Antwerp.
The Pyrotechnical School, located at Antwerp.

The Royal Gun Foundry was responsible for the upkeep and repair of artillery matériel; the manufacture of artillery projectiles and the manufacture of the 75 mm. rapid firing guns with which the Belgian Army had just been equipped.

The National Arms Factory was charged with the manufacture, upkeep and repair of small arms.

The "Construction" Arsenal manufactured and repaired all of the Army's transportation and operated a *saddlery shop* and a *blacksmith shop.*

The Pyrotechnical School manufactured small arms ammunition, artifices for the artillery and loaded artillery projectiles.

When the fortress of Liège fell into the hands of the enemy, all material that could be saved from the two above-mentioned establishments which were located in that city, was transported to Antwerp. However, it is self evident that it was impossible to remove all of the valuable equipment installed in these plants.

The remaining Army establishments at Antwerp continued to operate until the Belgians were obliged to evacuate that place. Thanks to the tireless efforts of these establishments the Belgian Army was enabled, more or less, to meet its requirements in artillery matériel and ammunition supplies.

It must be added that, at the time of the mobilization, a "Motor Transport Reserve Park" (Parc Automobile de réserve) had also been organized at Antwerp. The automobiles, motor-cycles and bicycles which had been requisitioned were assembled in this park, as well as the necessary accessories for the repair of these vehicles. It supplied the units of the Army with motor vehicles, motor cycles and bicycles and repaired the damaged matériel which the units sent there for that purpose.

II. RETREAT FROM ANTWERP—TRANSFER OF THE BELGIAN ESTABLISHMENTS TO CALAIS AND LE HAVRE.

The Belgian Army was obliged to abandon Antwerp during the early part of October 1914. This movement had been forseen and the evacuation of the place had already begun during the latter

part of September. The artillery establishments were also evacuated but, as was the case during the transfer of the Gun Foundry and of the Arms Factory from Liège to Antwerp, only a part of the equipment was saved. An attempt was first made to establish the Belgian base at Ostende, then it was decided to move further away and Calais was chosen as site for the base; what remained of the artillery establishments was therefore directed to this place. As a matter of fact, during the period immediately following the evacuation of Antwerp, particularly while the Belgian Army was desperately engaged upon the Yser, the artillery establishments were practically non-existent and all that remained was the personnel and a very limited equipment.

The "Construction" Arsenal, the Gun Foundry and the Arms Factory landed at Calais toward the middle of October; the Motor Transport Park was also proceeded there. As for the Pyrotechnical School, the latter was immediately sent to Le Havre, where means for its reconstruction were to be supplied as rapidly as possible.

Establishments evacuated to Calais.

It being impossible for these establishments to entirely resume their former functions, they were ordered to reorganize as quickly as possible and to operate as repair establishments. Their former titles were thus automatically abolished. The Gun Foundry became the "Shops for the repair of Artillery matériel" (Atelier de réparation du matériel d'Artillerie); the Arms Factory formed the "Shops for the repair of small arms" (Ateliers de réparation des armes portatives), and the "Construction Arsenal" was renamed: "Shops for the repair of the transportation matériel of the Army" (Ateliers de réparation du Charroi de l'Armée.)

The first difficulty encountered was in obtaining the necessary tools and equipment; this was met by purchases from private concerns. The various shops were thereby enabled (within possible limits), to repair damaged matériel which the Army, which was then engaged upon the Yser, sent in ever increasing quantities.

At this time, the "Motor Transport Shops" (Ateliers du Charroi automobile) were established also. Until then, the Motor Transport Reserve Park had continued to function and made repairs with the facilities at its disposal, however, it soon became insufficient and the Motor Transport Shops were created. At first, the activities of these shops were restricted to the conditioning of the new motor transport matériel which had been purchased in England and America, as their equipment did not permit heavy repair work and automobiles had to be sent to Paris or to London for repairs.

At Le Havre: *The Pyrotechnical School.*

Transferred to Le Havre direct, the Pyrotechnical School (École de Pyrotechnie) continued to exercise the functions which it fulfilled at Antwerp. Its initial activities were devoted mainly to the adaptation of ammunition which the Belgian Army was obliged to borrow from its Allies. One of the most difficult tasks assigned to this establishment was the storage of powders, the determination of firing charges and the preparation of the latter; moreover, this work had to be done with powder which the French Army had been able to furnish.

III. FINAL ORGANIZATION OF THE ARTILLERY ESTABLISHMENTS.

With the continuation of the war, the requirements of the Belgian Army increased. Almost insurmountable obstacles were experienced in the procurement of finished materials, ready for use. It therefore became necessary, as shown above, to create Belgian producing or manufacturing establishments to replace the shops whose functions were limited to repair work or to the upkeep of matériel. From the standpoint of economy and good management, these establishments had to be grouped in one region. It was also necessary to stabilize matters by centralizing all questions of organization and operation pertaining to the artillery establishments in a single directing agency or "direction," under the immediate orders of the Minister of War.

These considerations brought about a general reorganization of the Belgian artillery establishments and were the subject of an important Royal decree, dated August 16, 1915.

As a result of this reorganization the artillery establishments comprised:

1) A directing agency or "*Direction.*"

2) *Construction Shops* (ateliers de construction) and stores (magasins) of supplies or reserve stocks of materials, which were only to be moved if a change of base occurred.

3) *Repair Shops* (ateliers de réparation) and stores (magasins) containing supplies or reserve stocks for one month, which were to be located in the proximity of and which were to move with the Army.

The *construction shops* consisted of:

A) *The shops for the manufacture of ammunition* (ateliers de fabrication de munitions), which were subdivided as follows:

a) The *Pyrotechnical Section* (section de pyrotechnie) which loaded and manufactured small arms ammunition, loaded explosive shells and bombs of all kinds, shrapnel shells, primers, fuses, detonators and grenades.

b) The *Powder Section* (section des poudres) which made firing charges.

c) The *Machining Section* (section des travaux mécaniques) which manufactured grenades, primers, cartridge cases, fuses, detonators and projectiles.

B) The *Shops for the construction of artillery matériel* (ateliers de construction du matériel d'Artillerie) which were charged with the construction of guns, artillery carriages (except the wheels), limbers and armored caissons (except the wheels).

C) The *Shops for the manufacture of small arms* (ateliers de fabrication d'armes portatives), charged with the manufacture of arms and spare-parts (rifles and machine-guns) and of infantry and engineer shields (boucliers).

D) The *Shops for the construction of animal-drawn transport material* (ateliers de construction du charroi hippomobile) charged with the construction of wheels for all artillery and animal drawn transport material, unarmored caissons, wagons, forage-carts, machine-gun carts, etc.

E) The *Shops for the construction of motor transport material* (ateliers de construction du charroi automobile) charged with the repair of motor transport material exacuated by the Army, with the manufacture of spare-parts, repair of tires, building of bodies, etc.

F) The *Foundry Shops* (ateliers de fonderie) charged with founding cast iron, aluminum or bronze requirements for the other shops.

G) The "*Precision*" *Shops* (ateliers de précision) charged with the manufacture of ranging and sighting equipment and optical instruments.

H) The *Saddlery Shops* (ateliers de sellerie) charged with the manufacture of cavalry and artillery harness and leather equipment.

I) The *Farrier or Blacksmith Shops* (ateliers de maréchalerie) charged with the manufacture of certain special horse-shoes and with the finishing and classification of horse-shoes purchased from industrial concerns.

J) The *Electrical Power Service* (service de distribution d'enérgie) charged with supplying electrical motive power to all the shops.

K) The *Stores* (magasins) containing the reserve stocks of materials and the supplies procured from private industry.

All of these establishments were organized in the vicinity of Le Havre and placed under the immediate authority of the Director of the artillery establishments. The following named establishments, located in England, were also under the orders of this director (these have already been mentioned in connection with procurement):

a) The "*National Projectile Factory*" erected at Elizabethville. This plant was operated by Belgian personnel exclusively and its

mission was to cast or forge and machine, heavy and medium caliber projectiles for the use of the British Army.

b) The *plant for the manufacture of explosives.*

c) The *Birmingham Arms Factory.*

The repair shops and storehouses which were provided for in the new organization were located in the region of Calais. As stated above, these were planned so as to be able to move with the Army. Their main function was the upkeep and repair of matériel which was not sufficiently damaged to require shipment to the manufacturing establishments.

These organizations consisted of:

1) An *advanced unit of the shops for the construction of motor transport material* (organe avancé des ateliers de construction du charroi automobile).

2) The *shops for the repair of matériel* (ateliers de réparation de matériel)—(formerly the "Gun Foundry") which was gradually charged with the upkeep and repair of all matériel, with the exception of motor transport material and small arms.

3) The *advanced or front-line shops* (ateliers du front) which were advanced units of the shops for the repair of matériel and which were equipped for making minor repairs.

The organization of the artillery establishments as described above remained in force until the date of the Armistice.

There remains to be seen how the matériel manufactured by these establishments, as well as that which was obtained by direct purchase from private industries, were distributed to the troops which employed them. As already stated, this distribution was made through the "Main Field Park" (Grand Parc de Campagne) which received the necessary orders from the Chief of the General Staff. Let us therefore briefly examine the organization of the "Main Field Park."

C. Main Field Park (Grand Parc de Campagne)

The Main Field Park was an organization which was charged with supplying the Belgian Army with various matériel, particularly artillery matériel.

The Main Field Park supplied guns, armament and accessories for guns, hospital material, various transport material, spare-parts for artillery carriages, small arms, camping equipment, materials and parts for the upkeep and preservation of artillery and transport material, ammunition, horseshoes, pocket flash-lights, observation material, material for ranging stations, saddlery and leather equipment, and tanks of oxygen, acetylen and nitrogen.

It forwarded material in transit from the artillery establishments to the field army, and shipped the material and ammunition which had been evacuated by the field army to the establishments of the Rear.

The Main Field Park consisted of the following establishments:

a) The Main Field Pare at Gravelines.
b) The branch of the Main Field Park at Calais.
c) The sub-depot for ammunition at Loon-Plage.
d) The "Mobile Artillery Park" (Parc sur rails de l'artillerie).[1]

Command: The Command of the Main Field Park was under the orders of:

1. General Headquarters of the Army for all matters concerning the supply of artillery matériel to the field army.

2. The "General Direction of the Armament and Technical Services of the Army" (Direction Générale de l'Armament et des Services Techniques de l'Armée—D. G. A. S. T. A.), for all matters concerning the supply of artillery matériel to the Main Field Park.

Main Field Park at Gravelines.—The Main Field Park at Gravelines included the following services:

Ammunition Section: Charges, artifices, defective ammunition; preparation of cartridge-cases and carriers for reloading; projectiles; 2nd Group of the Mobile Artillery Park (P. S. R. A.).

Matériel Section: Saddlery and leather equipment; salvaged materials and scrap metals; small arms; supply of oxygen, acetylen and nitrogen; Artillery matériel, proper.

Sub-depot for ammunition at Loon-Plage.—The sub-depot for ammunition at Loon-Plage was a unit of the Main Field Park where, theoretically, ammunition for trench mortars, for 75 mm. field pieces, and separate loading ammunition for heavy and medium caliber guns, were stored. The purpose of this sub-depot was to relieve the Main Field Park at Gravelines.

Branch of the Main Field Park at Calais.—The branch of the Main Field Park at Calais supplied the establishments, services and units of the base, at Calais, with various materials and articles. Inversely, it received the evacuations from the above mentioned base establishments, services and units.

It received the artillery matériel destined for the Main Field Park which was unloaded from ships arriving at Calais, and loaded the supplies which were to be transported in these ships.

"*Mobile Artillery Park*" (Parc sur rail d'Artillerie).—The Mobile Artillery Park was an organization which was charged with the dis-

[1] The "Mobile Artillery Park" consisted of ammunition maintained on railway cars or trucks for transport, distribution, and storage purposes.

tribution of ammunition to the ammunition centers of the field army and with the reception of packing materials, empty carriers and cartridge-cases, defective ammunition, elements of ammunition, which had been evacuated upon the above mentioned ammunition centers by the field army.

It was composed of three "ammunition groups."

The train convoys, the guarding of the Mobile Artillery Park (P. S. R. A.) and the handling of ammunition were executed by armed infantry personnel belonging to the "ammunition groups."

There will be found appended hereto a historical statement on the operation of Main Field Park during the war.[2]

[2] Charts 6 and 7, Chapter X, Vol. I.

HISTORICAL STATEMENT ON THE BELGIAN MAIN FIELD PARK (GRÁND PARC de CAMPAGNE.—G. P. C.) DURING THE WAR 1914–1918.

At the beginning of the war all supplies for the Belgian field army were assembled in Antwerp.

At the beginning of October 1914, during the fall of the fortified position of Antwerp, these supplies were transported by rail to Zeebrugge, where they only remained a few days. At Zeebrugge, these materials and munitions were loaded aboard steamers and shipped to Calais (France) while the "Mobile Artillery Park" (P. S. R. A.) was despatched to Dunkerque and from there to Calais.

During the battle of the Yser, the Belgian field army was supplied by means of the above mentioned materials and munitions, as well as with articles and supplies which had been purchased on the spot, in France, and with 75 mm. ammunition which had been furnished by the French Army.

After a short formative period at Calais, the first échelon of the Main Field Park was transported to Gravelines on June 5, 1915, and this unit established itself in the following buildings: hangar Vauban, hangar Merlin, Buildings M. P. 1 to M. P. 15 of the abandoned fort of Gravelines and in the seventeen 6m. x 4m. barracks erected on the exterior glacis of the aforementioned fort.

The railway cars or trucks of the Mobile Artillery Park were shunted upon the railroad tracks which had been constructed for that purpose between the main railroad line from Calais to Dunkerque and the main road running from Calais to Dunkerque, that is to say, in the center of the Main Field Park.

From that time on, the Main Field Park supplied the whole field army with spare parts for matériel, observation and ranging matériel, artillery matériel proper and with materials and articles required for the upkeep of matériel and munitions. It was charged with the supply of all animal transport material demanded by the Army. It supplied the horse-shoes and all farrier equipment. It forwarded to the units of the field army all packages and supplies in transit from the artillery establishments at Le Havre.

Insofar as munitions are concerned, the stocks of supplies had accumulated from day to day and, by the end of 1915, these had already attained a considerable size.

The personnel of the pyrotechnical shop which loaded, primed, and prepared cartridge cases for loading, was still equipped with field facilities. This personnel organized and furnished crews for serving the groups of heavy and medium artillery at the front.

On February 1, 1916, an annex to the Main Field Park was created at Calais and charged with supplying the services of the rear and those of the base at Calais.

On account of the departure for Le Havre of the saddlery shops, which had been established at Calais, the annex of the Main Field Park at Calais was obliged, in April 1916, to take over the storage of the saddlery equipment which was needed for the supply of the field army. These supplies were transferred on May 7th of that year from Calais to Gravelines, where a large hangar had been erected for that purpose.

It was about this time that the barracks B–4 to B–49, inclusive, were built.

During the month of March a part of the "Mobile Artillery Park" (P. S. R. A.) was sent to Adinkerke and, in July, the 1st and 2nd groups of the P. S. R. A. were completely established at Adinkerke; only the 3rd group remained at Gravelines.

In August 1916, the Main Field Park was organized into two sections: the Munition Section and the Matériel Section.

In September 1916, the quantity of artillery matériel, harness, defective ammunition, empty cartridge-cases and carriers evacuated from the front having increased considerably, a service for the evacuation of munitions and a service for the evacuation of empty cartridge-cases and carriers were created in addition to the service for the evacuation of matériel. These evacuations and the increase in the quantity of supplies necessitated the construction of hangar B–50.

As the Main Field Park was to execute minor repairs, a carpenter shop, and a blacksmith and fitting shop were established.

Another service was created, the service for the salvage of scrap metal evacuated by units and services. This service was also responsible for the supply of oxygen, acetylen and nitrogen to the units and services of the Army.

The new artillery program provided for a considerable increase in the number of guns to be put into service and, towards the end of 1916, the construction of barracks for the storage of ammunition for these guns had to be undertaken.

For this purpose the following installations were constructed during the early part of 1917.

1) On the exterior glacis of the fortifications at Gravelines, twenty 6m. x 8m. barracks buildings were erected (these, with the seventeen 6m. x 4m. barracks already existing, formed the 37 storehouses numbered B–1 to B–37).

2) Along the No. 7 railroad track, barracks Nos. 38, 39 and 40 were built. The first two were connected with the standard gauge railroad line by "Decauville" or light railway, while the third storehouse fronted the main line.

3) A practicable carriage road was constructed alongside barracks 1 to 37.

4) A wooden bridge was built near barracks building No. 37.

The facilities of the Main Field Park having been found insufficient for the storage of all the ammunition required for the guns provided by the new artillery program, it was decided to establish a sub-depot for munitions at Loon-Plage in 1917. Theoretically, this sub-depot contained all 75mm. shells, gas shells, bombs for "C–58" matériel and for Van Deuren mortars, as well as all separate loading projectiles for medium and heavy caliber guns. There remained in storage at Gravelines, infantry munitions, grenades, signal lights, miscellaneous ammunition and all fixed ammunition for heavy and medium caliber guns.

For the above purposes, the buildings A to J and the railway facilities for serving these were constructed at Loon-Plage during the first half of 1917.

The field equipment being insufficient, building No. 54 was erected in October 1917, to contain the machine tools and various equipment for the preparation, etc., of projectiles.

In 1918, the number of guns in service at the front, as well as the number of days' ammunition, having increased considerably the Loon-Plage sub-depot was again enlarged by the construction of storehouses Nos. 1 to 13, with railway tracks for their service.

Besides, as the Main Field Park was to store the French artillery ammunition which had been placed at the disposal of the Belgian Army the following were built:

1) At Gravelines, on the exterior glacis of the fortifications, along the path serving barracks B–1 to B–37 and along No. 7 railway line, 200 platforms for holding shells, measuring 2.5m. x 2.5m. built out of cement blocks.

2) At Loon-Plage, along all the railway lines, 800 similar platforms. Shells were placed upright on their bases upon these platforms and were covered by corrugated sheet metal.

In July 1918, the loading shops having become insufficient, barracks B 11-bis and B 19-bis were erected on the exterior glacis of the Gravelines fortifications.

During the first six months of 1918, the moat of the fortifications between the Calais-Dunkerque road and the fairway was filled with dirt from the ramparts and a large earthen-platform was established

for storing the reserve guns and vehicles. This was known as the "Wagon Park" (Parc aux voitures).

The storehouses of the Main Field Park were widely dispersed. This dispersion was purposely done so as to decrease the danger of accidents and, in case of an accident, to minimize it as much as possible. It should be noted that not only were ordinary accidents to be feared but there was also the danger of aerial bombardments, to which the region of Gravelines was particularly exposed. As a matter of fact, aerial bombardments almost completely destroyed the British ammunition depot at Audruicq and partially destroyed the French ammunition depot at Oye, two communities in the vicinity of Gravelines.

During heavy movements of ammunition, the personnel of the Main Field Park was reinforced by units of L. of C. troops and various other units stationed at Gravelines and Calais.

Towards the middle of 1918, the personnel of the Main Field Park was organized into a group of four "batteries." A company of armed laborers guarded the establishments of the Main Field Park at Gravelines and at Loon-Plage. Later, this company became the "fifth battery" of the Main Field Park.

The personnel was quartered in the arsenal at Gravelines, in the ancient convent in the "Rue des Clarisses," and in the buildings located along the fairway and the fortifications, between the Calais bridge and the bridge of Petit Fort Philippe.

In normal times, the personnel worked ten hours per day, however, the personnel of the "Munitions Section" was obliged to continue their work until the trains of ammunition were completely loaded and were turned over to the convoys.

During heavy movements of ammunition night shifts were organized, officers, non-commissioned officers, and enlisted specialists then furnished 18 hours work per day.

At the time of the offensive of September 1918, the Main Field Park was at the height of its development, being well stocked with matériel and munitions; it played an active part in the supply of the Belgian Army.

After the advance of the Belgian troops, the 1st echelon of the Main Field Park established itself in the ammunition depots located in the region of Bruges (Lophem, Varsenaere and Zedelghem), while the "Mobile artillery park" (P. S. R. A.) was transferred to Oostcamp.

After the Armistice, November 11, 1918, the Main Field Park was transferred to Antwerp.

CHAPTER IX.

SECTION IV.

SUPPLY OF ARMS AND MUNITIONS (ITALIAN).[1]

The supply of arms and munitions was entrusted to the Artillery Service, which was also charged with the supply of animals, vehicles, saddlery, harness and equipment for the mounted services; infantry equipment; equipment for sappers, including sappers who were not specially assigned to Engineer units, and with the provision of materials for the preservation of artillery matériel and munitions (fats, lubricants, vaseline, ammonia, etc.).

The directing and executive agencies of this service are shown in chart 13, Chapter X, Volume I.

a) *The Arms (Ordnance) supply service functioned as follows:* Rifles were supplied at the same rate as men. Each month, the mobilization centers informed the Ministry of Arms and Munitions of the number of rifles needed to complete the equipment of soldiers declared fit for active duty. On the basis of such data, a distribution of rifles was ordered monthly. This distribution was made by the Territorial Directions of the Artillery to the mobilization centers which were located in their vicinity. The Direction of the Artillery, periodically informed the supply establishments as to its requirements and was supplied in accordance therewith by the supply establishments concerned.

Upon request of the "Intendenza Generale" the Ministry also forwarded arms direct to the war zone (Zona di guerra). In such cases the arms were sent to the field depots of the various armies in accordance with the instructions of the "Intendenza" (supply service) of the army concerned.

Arms which had deteriorated were evacuated from the war zone and shipped to certain designated "Territorial Directions of the Artillery" which were charged with repairing such matériel. The arms thus salvaged were used, together with new weapons, to supply the equipment for the mobilization centers.

b) *Machine guns and matériel for organizing machine gun detachments:* These were shipped periodically from the producing establishments to the centers for the organization of machine gun

[1] Prepared for the Military Board of Allied Supply by Major G. de Stefanis, General Staff, Italian Army, by direction of General Ugo Cavallero, Italian Member, Supreme War Council.

units. Shipments were made on the basis of previously established organization programs, modified to correspond with actual needs if necessary, and these modifications were made in accordance with the policies enunciated by the Supreme Command (Comando Supremo).

For the supply of the immediate requirements of the armies, equipment for complete sections (arms and materials) was prepared in the advanced artillery depots. This varied according to the importance of the requirements; from a minimum of 10 sections up to 50 sections.

As needs for such matériel arose, requests for supplies were sent by the armies to the organization centers at Torino and at Brescia, and the latter forwarded the necessary supplies. There were sufficient reserves for 50 sections at Torino and for 350 sections at Brescia. These reserves were constantly maintained by the Ministry of Arms and Munitions.

c) *The supply of artillery matériel functioned as follows:* The producing establishments shipped medium and large siege guns to designated Territorial Directions of the Artillery; while the field and small caliber guns were sent to the Artillery regimental depots.

From the above Territorial Directions and regimental depots the artillery matériel was distributed to the new organizations, upon their departure for the front, or else it was forwarded to the artillery depots of the second line and held there for use by the army units.

d) *Trench mortars:* Trench artillery constructed by private firms was sent to the Trench Mortar School, which functioned as a collecting or receiving center for trench artillery and bombs, as well as an organization center for trench mortar units. At this school the guns were tested and then used to equip the new units which were being formed or else shipped, according to needs, to replace the unserviceable guns of the units at the front. Requests for this matériel were made by the Army Intendenza concerned. In exceptional cases, and only when absolutely necessary, trench artillery was shipped direct to the units at the front.

Chart 14, Chapter X, Volume I, shows the functioning of the supply of artillery munitions.

The Ministry of Arms and Munitions (Technical Officer) shipped loaded shells to the Territorial Directions of the Artillery which were located near the central munitions depots. It also sent empty shells, explosives, and all necessary elements, to the Territorial Directions of the Artillery for assembly into complete rounds and, when the shells were assembled, the directions forwarded them to the central depots.

The loading of shells by pressure was done in the interior of the country: (*a*) In the military establishments (construction factory at Piacenza); (*b*) by private firms ("Societa Italiana Prodotti Esplosive" at Forthe dei Marmi; "Nobel" at Avigliana; factories at Torino and Bollate).

For the shells whose charges had to be kept separated, the loading was done by the Artillery Directions. In such cases, the Ministry shipped the necessary elements for the charge and exploding components from the manufactories to the Artillery Directions.

Completely assembled munitions were forwarded from the central munitions depots or from the intermediate munitions depots, under the control of the Intendenza Generale, and shipped direct to the Army munitions depots. From these army depots, the munitions were transported and delivered to the batteries by motor transport. Stores of munitions were maintained in special battery depots.

During active operations entire trainloads of munitions were shipped from the central munitions depots to supply the requirements of the armies which were engaged. Whenever necessary, the Intendenza Generale transferred the munitions depot of one army to another army, if the latter was in greater need of supplies and also placed one or more of the intermediate depots at its disposal.

A number of railway cars was always maintained at each of the central munitions depots, together with the necessary personnel for loading purposes. By this means, during the last offensive on the Piave, the depot at Piacenza succeeded in loading and forwarding 15 trainloads of munitions to the troops daily.

The supply of small arms ammunition for rifles and machine guns was carried out by the central artillery depots. Each of these depots had a fixed allowance which was predetermined, and every 15 days the depots reported the amount of supplies on hand to the Ministry of War, as well as the quantities of ammunition which had been issued during the preceding 15 days.

On the basis of these reports, the Ministry of War made the necessary shipments to the central depots. In addition, the Intendenza Generale notified the Minister of War concerning extraordinary expenditures of ammunition which had been supplied directly to the units. The maintenance of the stocks of supplies in the depots was thus regulated in accordance with the actual consumption. Whenever there was an overproduction of munitions, the surplus supplies were held in reserve in certain of the Artillery Territorial Directions.

The pyrotechnical establishment, at Bologna, repaired the matériel which had been salvaged in the war zone and also manufactured supplies for current needs. Salvaged small arms ammuni-

tion was not shipped back to the war zone; these munitions were specially marked and were used in the interior for training purposes.

All new matériel was shipped to units in the field. The advanced artillery depots supplied the divisional ammunition columns or trains and the latter, in turn, supplied the troops.

Shells for mortars were manufactured by private concerns (about 50 firms were engaged in this work). Mortar ammunition was loaded in separate factories according to the type of explosive used in the charge (explosive S, Echo, or Sabulite).

Mortars and ammunition for mortars were supplied to the advanced depots by a special depot. The special depot for mortars and mortar ammunition received the total production from the loading factories. It was controlled by the Supreme Command and was under the immediate authority of the "Mortar School Command." Shipments of mortar ammunition to the war zone was by series of complete rounds.

Hand grenades were manufactured by private plants and loaded by the same establishments which loaded the mortar ammunition. Grenades were also sent to the special depot mentioned in the preceding paragraph. From there the grenades were sent to the advanced depots which distributed them to the troops at the front. The supply of trench mortar ammunition and hand grenades was regulated by the Supreme Command, which controlled the special depot through its technical office. (Technical Office, or Section, of the Comando Supremo.)

The location of the Italian Ordnance depots is shown in Chart 15, Chapter X, Volume I.

CHAPTER IX.

SECTION V.

SUPPLY OF ARMS AND MUNITIONS—ORDNANCE (AMERICAN).[1]

1. ORGANIZATION.

Because of rapidly changing conditions the organization of the Ordnance Department, American Expeditionary Forces, underwent several phases. Its maximum of efficiency, it is believed, was reached just prior to the Armistice; and the organization in effect at that time is therefore the one which is here described, and whose activities may, for preliminary analysis, be classified regionally:

(*a*) Central activities—Office of the Chief of Ordnance Officer, American Expeditionary Forces.

(*b*) Field activities in the S. O. S.

(*c*) Field activities in the army areas.

A more detailed statement as to organization calls for a description of the functions of the regional groups, as follows:

(*a*) *Central activities.*

The Chief Ordnance Officer, American E. F. was charged with the administration of all ordnance affairs of the American Expeditionary Forces. Technically, he was on the staff of the Commander in Chief; but as the Ordnance Department was one of the Services of Supply, the office of the Chief Ordnance Officer, American Expeditionary Forces, was located at Headquarters, S. O. S., in Tours. It was through this office that the Chief Ordnance Officer, American Expeditionary Forces, exercised central control of all American E. F. ordnance activities.

The office of the Chief Ordnance Officer, American Expeditionary Forces, had six divisions with functions which may be very generally summarized as follows: (See Chart 8, Chapter X, Vol. I.)

Requirements Division—procurement of matériel.

Supply Division—receipt, storage, and issue of matériel.

Construction and Maintenance Division—providing buildings and repair facilities.

Engineering Division—dealing with technical questions relating to matériel and providing instructors and courses of instructions for ordnance personnel.

[1] Prepared for the M. B. A. S. by Chief Ordnance Officer, American E. F.

Personnel Division—procurement and assignment of ordnance personnel.

Administration Division—coordination of the activities of the other divisions, and the performance of duties not definitely assigned to other divisions.

An order to maintain liaison with the General Staff, the Chief Ordnance Officer was represented at G. H. Q., by a deputy who was assisted by the necessary office personnel. To further the procurement of matériel from European sources, there was located in Paris the office of the Chief Purchasing Officer, Ordnance Department, functioning, in conjunction with the General Purchasing Agent, American E. F., in filling purchase requisitions from the Requirements Division. There was also located in Paris the Aircraft Armament Section of the Engineering Division which section, because of the highly specialized nature of its activities, was charged with certain limited functions of procurement and supply. There were, in addition, certain miscellaneous activities in which the Ordnance Department was represented, such as the operations of the American regiment in Italy, the Anglo-American (Tank) Commission, etc.

(*b*) *Field activities in the S. O. S.*

The zone of the Services of Supply was divided geographically into several base sections, which included the territory surrounding the respective base ports; an intermediate section; an advance section, and the District of Paris. Each section and district was under a Commanding General who was responsible for the discipline, police, and sanitation of the area assigned to him, insofar as the American personnel in ordnance depots was concerned. On the staff of the Commanding General, was an ordnance officer having control coordinate with that of his chief.

In the base sections the ordnance officer was also given control of ordnance depots under the Chief Ordnance Officer, American Expeditionary Forces, who was immediately responsible for all ordnance depots and establishments, and exercised control over them. In certain of the base sections, as well as in the intermediate and advance sections, were located great general supply depots and ammunition depots. At Mehun-sur-Yèvre, in the intermediate section and, at Is-sur-Tille, in the advance section, there were large and well equipped ordnance repair shops. Lesser depots and repair shops were located at the various organization and training centers for combatant troops. Schools for the instruction of ordnance personnel in the inspection, storage and handling of ammunition and in the inspection and repair of artillery, small arms and motor equipment were conducted in the advance section and certain other sections. In the District of Paris there were shops for the production

of aircraft armament matériel, a field where planes were equipped with armament, and a school for the instruction of aircraft armament officers and squadron armorers. (See Chart 9, Chapter X, Vol. 1.)

(*c*) *Field activities in the army area.*

Each army and corps had its chief ordnance officer, and each division its division ordnance officer.

The chief ordnance officer of an army was concerned with general supply, ammunition supply and inspection and repair of matériel. Through several assistants and the necessary office force, he passed upon requisitions and supervised artillery repair parks, machine gun and small arms centers, mobile ordnance repair shops, ammunition dumps, and general supply dumps. The chief of artillery of an army was also provided with ordnance personnel to assist in the allocation of artillery ammunition.

The chief ordnance officer of a corps was technically responsible only for the supply and maintenance of the ordnance matériel of the corps artillery and other corps troops; but as a rule he sought other opportunities to be of service, by assisting the corps munitions officer, and in some instances, by general supervision of the ordnance activities of the divisions which were under the jurisdiction of the corps.

The division ordnance officer was charged with the responsibility for the supply of ordnance matériel, exclusive of ammunition, and for the inspection and maintenance of arms and equipment. Within the division, and subject to his control as to their technical functions, were the mobile ordnance repair shop, an ordnance detachment for the maintenance of motor vehicles of the ammunition train, and ordnance detachment for the maintenance of matériel of each motorized artillery regiment, and usually an ordnance detachment for the physical handling of general supplies. To each regiment, to each machine gun battalion and to headquarters of the trains and military police, there was assigned a small detachment of ordnance enlisted personnel. The division ordnance officer in most instances operated a divisional supply dump. He was not, however, as a rule, concerned with ammunition supply, this duty being charged to the division munitions officer.

2. SOURCE FROM WHICH THE MAIN TYPES OF SUPPLY WERE MAINTAINED.

The normal source of supply was the United States, through the office of the Chief of Ordnance, U. S. Army. Lack of transportation and of production, however, necessitated overseas purchases

of many articles. Chief among these was artillery and its ammunition, obtained chiefly from and through the French and British Governments, 8-inch and 9.2-inch howitzers being the chief British artillery purchases. Purchases of other articles were also made in Italy, Switzerland, and Spain; manufacturers, wholesalers, and retailers were all drawn upon. Material purchased in England came almost exclusively from or through the Government; the same was true, though to a somewhat small extent, in France; in the other countries, however, purchases were usually made direct from commercial sources. The principle articles obtained by purchase were classified in the office of the Chief Purchasing Officer as follows:

1. Arms and ammunition.
2. Hardware and small tools.
3. Machinery and machine shop equipment and fixtures.
4. Metals and manufactured articles.
5. Textiles, leather goods, rubber goods, and cordage.
6. Paper and printing, office supplies, engineering drafting room supplies, etc.

Nearly a thousand different kinds of articles were purchased overseas on 5,829 purchase orders.

3. SYSTEM OF STORAGE EMPLOYED FOR THE BASE DEPOTS, ADVANCED DEPOTS, ETC.

Base, intermediate, and advance depots usually handled more than one class of supplies, except those where ammunition was stored. In each general supply depot, the British storage system, with some slight modifications, was put into effect. Under this system, ordnance matériel was divided into eight homogeneous groups, with a special organization, office, and record system for each group. Incoming requisitions were broken up into group issue orders, each of which covered matériel pertaining to one group only. After these orders were filled, the items were assembled into cars or trains bound for similar destinations. The main office transcribed all transactions for general reports to headquarters, and from its inventory records made up the requisitions for the materials necessary to keep the stocks up to the supply prescribed. This prescribed supply was intended to be, in a base section, enough for 45 days, in the intermediate section enough for 30 days, and in the advance section enough for 15 days.

In the storage of ordnance material, a sharp division had to be made between general ordnance stores which required only the ordinary conditions of warehousing and access to transportation, and the storage of ammunition, which on account of its dangerous char-

acter, must be handled far from centers of population and in warehouses specially constructed and widely distributed in small units to minimize the dangers of, or loss from, explosion.

The principal general ordnance storage depots were as follows: in the base section at Montoir, serving the ports of St. Nazaire and Nantes, with 480,000 sq. ft. completed; at St. Sulpice, serving the port at Bordeaux, with 125,000 sq. ft. completed and 200,000 sq. ft. authorized; at Aigrefeuille, serving the ports of La Rochelle, La Pallice, and Rochefort, with 62,400 sq. ft. authorized; at Brest, with 25,000 sq. ft. authorized; and at Miramas, serving the port of Marseille, with 30,000 sq. ft. completed.

General intermediate depots were at Gièvres, with 320,200 sq. ft. completed and 59,800 sq. ft. authorized; at Montierchaume, with 362,000 sq. ft. authorized; at Mehun with 120,000 sq. ft. completed and 120,000 sq. ft. authorized.

Ammunition storage depots were located as follows: in the base section at Usine Brulée, with 45,000 sq. ft. completed; at Donges, with 405,000 sq. ft. under construction; at Montoir, with 110,000 sq. ft. completed and 25,000 sq. ft. under construction. All these served the ports of St. Nazaire and Nantes. In addition the ammunition storage depot at St. Loubes, serving the port of Bordeaux, had 300,000 sq. ft. completed and 240,000 sq. ft. under construction.

The advanced depots were at Is-sur-Tille, with 120,000 sq. ft. completed and at Liffol-le-Grand with 12,000 sq. ft. completed after the Armistice.

Intermediate ammunition storage depots were at Foecy, with 410,000 sq. ft. completed and 210,000 sq. ft. under construction; at Issoudun, with 420,000 sq. ft. completed and 45,000 sq. ft. under construction; and at Le Cors with 124,000 sq. ft. under construction. The advanced ammunition storage depot was at Jonchéry, with 300,000 sq. ft. completed and 175,000 sq. ft. under construction.

In addition to these, a number of army depots were operated at points convenient to rail heads and sufficiently near the battle area to permit direct delivery of supplies to troops engaged therein. These depots were situated at Dongermain, Toul, Vaubécourt, Parois, Void, Souhesmes-le-Grand, Blénod-les-Toul, Saizerais, Nixéville, Brabant-en-Argonne, Les Islettes, Châtelchehéry, Eclisfontaine, and Chattancourt.

4. SYSTEM OF DISTRIBUTION.

Organizations arriving in France were, so far as possible, brought up to a given individual equipment by issues made to them automatically at the direction of the C. O. O., American E. F., his basis for action being their reports of property on hand. Replacement

troops were equipped from depots maintained by the depot division through which they passed.

By G. O. 44, G. H. Q., American E. F., 1918, the system of distribution of supplies to troops which had passed through the initial and automatic stage was prescribed. Ordnance supplies came under two of the four classes established by that general order, Class 3 and Class 4. Articles needed by organizations were requisitioned through divisional and army headquarters (or in a similar manner in the case of organizations not belonging to an army). The army commander had the power to order the issue of Class 3 articles from ordnance depots; Class 4 articles (which included ammunition and articles in which there were serious shortages) required the approval of G. H. Q. (G–4). Approved requisitions were usually sent to, and filled by, Advance Ordnance Depot No. 1, at Is-sur-Tille; though at times issues were made to troops direct from other depots, notably Intermediate Ordnance Depot No. 2, at Gièvres. This method, because of transportation difficulties, etc., was modified at times by the procedure in which army depots, under the control of the Chief Ordnance Officer of an army, requisitioned stocks in trainload lots from the S. O. S. depots, and made issues direct to troops, without requisition, in cases of emergency.

The foregoing statement of the systems of distribution applies to general ordnance supplies. It is subject to modification in the matter of artillery and small and automatic arms, and is inapplicable to ammunition and aircraft armament supplies. Artillery used by Americans was almost wholly of French and British manufacture. That furnished by the British, together with its spare and replacement parts, was ordinarily supplied through the same channels as general supplies; but that from the French, and especially spares and replacements, had frequently to be obtained direct from French establishments by the organizations in need. Small and automatic arms replacements were made, as a general thing, by the mobile ordnance repair shops, which issued serviceable arms in exchange for unserviceable ones. Stocks were maintained to some extent by cleaning and repairing salvaged weapons. Ammunition was apportioned by G–4, G. H. Q. to armies and was shipped forward from the S. O. S. to army dumps. Army headquarters then made allocations to corps and to the army artillery who, in turn, reallocated the ammunition going to the batteries, either direct or through corps or army artillery dumps.

The responsibility for operation of the army dumps and compliance with army allocation was placed on the army ordnance officer. Aircraft armament supplies were issued direct to the Air Service, which made the distribution.

5. SHORT STATEMENT ON THE FUNCTIONING OF SUPPLY DURING THE WORLD WAR.

The automatic initial equipment system gave excellent satisfaction, except that certain supplies were at various times not available, or available in limited numbers only,—such as pistols, trench mortars and fire control equipment; in respect to such supplies as could be obtained, however, the system worked well. The mobile repair shops maintained advance posts from which they made prompt issues and repairs during action. This system gave satisfaction. The ammunition supply was hampered by lack of trained personnel but, as the batteries invariably had ample ammunition to carry out their part of the program, it may be said that the supply system functioned with efficiency.

The original sources of information to which reference may be made for more detailed study of the foregoing, are collated in the office of the Chief Ordnance Officer, American E. F. The most important of the original sources are included in the "History of the Ordnance Department, American Expeditionary Forces."

Notes from the Report of G-4-A to the A. C. of S., G-4

Inasmuch as time was necessary for the manufacture of both ammunition and ordnance material in the U. S., it was decided to take advantage of the pooled facilities of the French and English in Europe, and to adopt, where possible, calibers of ammunition used by our Allies, so that interchangeability of ammunition could be had. Accordingly, we adopted the 75 mm. gun in place of our 3″ gun, and provided for the manufacture of 75 mm. guns and ammunition in the States. Artillery organizations therefore came to France without artillery material, and were supplied with it in our training camps after their arrival.

The reserve supply was as indicated in G. O. 44, and included automatic supplies based on units of 25,000 men every month from the States. The Ordnance Department supplied, or made provisions for the supply of artillery matériel, trucks and other motor vehicles, small arms, automatic arms, machine guns, personal equipment, and ammunition.

The Artillery matériel consisted of railroad artillery, of which we obtained from the French: two 340 mm. guns, four 400 mm. howitzers, twelve 32 mm. guns, thirty-two 19 mm. guns, twenty-four 23 cm. guns. In addition there were a number of 14 inch, 50 caliber, Navy guns which were mounted on railway mounts. There were eight of these, five manned by the Navy, and three by the Artillery. At the time of the signing of the Armistice, we had in France 212

8-inch howitzers, 88 of which had been shipped from the United States and 124 of which were received from England.

To equip our corps artillery regiments a number of 155 mm. guns were obtained from the French and manufacture of these commenced in the United States. At the time of the signing of the Armistice, 16 had been received from the States and 232 received from the French. Of these 232, ninety-six had been in active operation at the front.

Field Artillery.—Consisted chiefly of 75 mm. field guns and 155 mm. howitzers. At the time of the signing of the Armistice, 1,862 75-mm. guns had been delivered by the French to our troops and 32 had been received from the States. The 155-mm. howitzers (numbers not here given) were received from the French.

Anti-Aircraft Artillery.—Fifty mounts manufactured in the States were delivered in France for which the French provided 75 mm. guns.

Trench Artillery.—The trench artillery utilized was the 3-inch trench mortar, the 58 mm. trench mortar, the 6 inch trench mortar and the 240 mm. trench mortar. Of these, the 3 inch "Stokes" and the 6 inch "Newton" were received from the English. The great mass of our troops were equipped with the English type.

Tractors and Other Motor Vehicles.—The tractors and other motor vehicles provided by the Ordnance Department were those designed for technical organizations of the Artillery. For these, a separate depot and repair shop was established at Doulaincourt.

Small Arms, Automatic Arms and Machine Guns.—At the beginning of the war, our Army was equipped with the Springfield Rifle, model of 1903. It was decided to utilize the manufacturing capacity already developed by the Allied governments in the U. S. and therefore the model 1917 rifle, changed to caliber .30, was adopted. The change of the British rifle to caliber .30, enabled the use of the already existing large capacity for the manufacturing of caliber .30 ammunition. Our forces were equipped with the caliber .45 automatic pistol and caliber .45 revolvers, both adapted to fire the same ammunition.

Automatic Rifle.—At the time of our entry into the war, our troops were armed with the automatic machine gun, caliber .30. However, the "Vickers" machine gun had just been adopted, and a number were under manufacture. Inasmuch, as the manufacturing capacity was quite limited, it was necessary to obtain a large number of machine guns from the French. Our troops were therefore armed with the "Hotchkiss" 8 mm. and the "Chauchat" rifle. A caliber .30 "Chauchat" was also developed and several divisions were armed with them. In the meanwhile, a number of caliber .30 "Vickers"

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machine guns were manufactured in the United States and divisions armed. It is believed, however, that the new machine gun and new automatic rifle developed in the United States, namely, the "Browning,' was of the best type developed, and a number of divisions were equipped with these. A special type of fire control equipment had been developed to be used in action with these "Browning" machine guns.

Personal Equipment.—In addition to the articles usually supplied by the Ordnance Department in this line, there were provided special trench helmets and trench knives.

Ammunition.—Most of the artillery ammunition was obtained from the French. We had, however, been able to supply all the caliber 30 ammunition required by our forces for their rifles and such caliber 30 ammunition for the automatic rifles and machine guns in use. All the necessary ammunition for pistols and revolvers was received from the French.

CHAPTER X.

SECTION I.

PRELIMINARY SUPPLY ARRANGEMENTS (BRITISH).[1]

(Chart 1, Chap. XI, Vol. I.)

Some years before the war, a scheme was evolved for supplying an expeditionary force. Estimates were made of the quantities of forage, men's rations, and other commodities required. Methods of shipment, the reserves to be maintained in depots at overseas ports, the situation of, and arrangements at, regulating stations, and other necessary questions duly considered.[2]

Arrangements were made for a scheme of which the following were the chief features:

(*a*) Supply bases, and ports for the embarkation of troops were selected in the British Isles.

(*b*) Supply bases and ports, with rest camps, were allotted in France for the reception of supplies and troops.

(*c*) Concentration areas were fixed for the British Expeditionary Force, with lines of communication between bases and railheads.

Home Bases.—Certain home base supply depots were selected when stores were to be despatched to overseas ports.

Method of Feeding Troops up to Time of Arrival in Concentration Areas.—Troops were to mobilize in certain districts of Great Britain and Ireland, and proceed to ports of embarkation. Rations were to be carried for men and horses, calculated to last up to the day of arrival at rest camps at oversea bases, and still leave intact one complete ration in the train transport. All subsequent supplies required by troops in the rest camps were to be drawn from supply dumps, at that time called " expense depots," stationed at the port of disembarkation.

Field units were to remain at least twenty-four hours at the port of landing and, when entraining for the areas of concentration, were to take with them three days' rations for men and horses, regimental supplies in the train vehicles, and the unexpended portions of the rations issued on the previous day. After their arrival at destinations, all troops were to be fed from railheads, and from supplies purchased locally.

Base Ports in France.—The ports originally allotted to the use of the British services by the French were: Boulogne, Havre, Rouen.

[1] Prepared for the M. B. A. S. by Major G. E. Pitt, A. Q. M. G., Historian to the Quartermaster General to the Forces.

[2] See also Chart 1, Chapter VI, Vol. I.

Later, as the necessity arose, the following ports were also used: Calais (with Dunkerque), Dieppe, Marseille, St. Valéry, Cherbourg, Le Tréport.

Depots in France.—Three base supply depots, at Boulogne, Havre and Rouen, and one advanced supply depot at Amiens, were to be established in France.

No. 1 depot unit of supply was to proceed to Havre and No. 14 to Boulogne.

The chief functions of these depots were arranged and decided upon, as follows:

Boulogne was to receive three days' reserves for the whole expeditionary force, and a three days' supply of petrol and lubricants. These were to be forwarded to the advanced depot at Amiens as soon as possible after their arrival, for the following purposes:

(*a*) To feed the 4th, 5th and 6th Divisions, the Royal Flying Corps, the Cavalry Corps, General Headquarters and Army Troops, and to supply three reserve parks in the area of concentration, from the 9th to the 16th day of mobilization.

(*b*) To ration from "expense depots" near the rest camps all troops landing at Boulogne, and staying at the port (up to the 13th day) before proceeding to the area of concentration.

(*c*) To hold preserved supplies, and oats sufficient to fill two reserve parks, and to maintain a station for one frozen meat ship until the 16th day, on which it was proposed to close the base supply depot at Boulogne.

Boulogne was also to receive 19,000 gallons of petrol, and certain lubricants, for the Royal Flying Corps. These stores were to be despatched, as directed, to the field of operations.

Havre was to feed troops landing at the port, to hold supplies and oats to fill two reserve parks, to feed the personnel and horses of three reserve parks, the 1st, 2nd and 3rd Divisions, the headquarters of the First and Second Armies, and Army Troops, under the same conditions as Boulogne. An eight days' reserve of preserved meat, groceries, oats, hay, hospital supplies and disinfectants, for the whole expeditionary force, was also to be maintained at Havre.

This base was to keep a ten days' reserve of flour, and other bread-making material, and five days' petrol supply for transport and other motor cars, as well as fifteen days' petrol for the Royal Flying Corps.

A frozen meat ship was to be stationed there, and used as a cold store, to be replaced when emptied, by another vessel.

Rouen was to supply troops in rest camps up to the 16th day of mobilization, to hold sufficient supplies and oats to fill two reserve parks, and to establish a ten days' reserve for the whole ex-

peditionary force, including ten days' flour and other bread making materials and to hold seven days' petrol.

Amiens was to receive supplies, through Boulogne, to be dealt with in the following manner:

(*a*) One day's preserved supplies, and hay and oats for the whole expeditionary force, were to be loaded on trucks as soon as possible after arrival at Boulogne. These supplies were to be forwarded at once to Amiens, and there kept on trucks, for despatch as required. One day's petrol and lubricants, for the use of motor transport vehicles passing through Amiens on the way to areas of concentration, were also to be sent at the earliest opportunity from Boulogne.

(*b*) On completion of concentration, two days' preserved supplies, with hay and oats, flour, etc., and two days' petrol and lubricants, were to be forwarded from Boulogne to Amiens, to be held in reserve. Amiens was to be the headquarters of the I. G. C., and to form the main regulating station for supply trains, as well as to serve the purpose of an advanced depot.

General Instructions Concerning Bases in France.—The subsequent reserves to be maintained in these depots were: 30 days' supplies at Havre; 5 days' supplies at Rouen; 3 days' (one in trucks) supplies at Amiens. These quantities were to be inclusive of those mentioned above.

All sites chosen for supply depots and field bakeries in France were to be handed over to the officers taking command on their arrival.

Expense depots were to be formed in the vicinity of rest camps at each of the oversea ports, to provision troops arriving from the British Isles, and temporarily detained at the bases.

Trains were to be made up daily at Boulogne and Havre in accordance with orders of the Director of Supplies or the Deputy Assistant Director of Supplies. These orders were to reach the bases two days previously.

At the ports the work was to be carried out by local dock hands, but it was realized that those men would not be available in sufficient numbers to undertake stacking, the loading of trucks, and other labor duties.

The French agreed to provide military labor from the 4th to the 12th day of mobilization. Two hundred local laborers were to be available at Havre, 150 at Boulogne, and 100 at Rouen, on the evening of the 1st day.

Troops were to be railed up to the areas of concentration, billeted in divisional areas, and supplied from railheads, one of which was allotted to each division or two divisions.

It was intended that supplies should arrive at railheads the evening of the same day on which they were despatched from the bases. To prevent confusion at railheads, supplies had to be offloaded within twelve hours, and placed, if necessary, in small temporary supply depots established for the purpose.

The personnel at each railhead was fixed, and, pending the arrival of the railway supply detachment, a depot unit of supply, one of which was to be sent to each railhead on the 7th day of mobilization, was to supervise the unloading, storage and issue of supplies received by rail, and to assist the Supply Officer of divisional trains.

A peace-strength half-company of one of the lines of communication battalions was to proceed to each railhead with the first supply train leaving the ports on the 7th day, and, until further orders were received, to remain and unload the daily train.

Arrangements and Control of Railways.—The Railway Service was to be controlled and manned entirely by the French, but the British were to be responsible for the loading and unloading of all railway vehicles placed at their disposal.

During the period of concentration, the movements of trains were to be controlled by a "Commission de Ligne", at Amiens, with subordinate "Délégations de l'Embarquement" at each port.

During operations the control of the railways was to be in the hands of the "Commission Régulatrice" at Amiens, which would have representatives at the ports, and inform the I. G. C. from time to time as to which stations would be used as railheads.

British Supplies Service as Functioning in 1918.—On the outbreak of war on August 4, 1914, base supply depots were established at Boulogne, Havre and Rouen, a regulating station being located at Amiens. These arrangements were, however, upset before the end of the month owing to the turn of events, and it became necessary to transfer the base depots to St. Nazaire and Nantes, with an advanced supply depot at Le Mans.

The stopping of the German advance some three weeks later once more rendered the old bases possible, and they were reoccupied, but St. Nazaire and Nantes continued to supply local details, hospitals, and troops arriving there.

In December 1914, the British opened a new base supply depot at Dieppe, mainly as an entry and forwarding port for forage, and in April, 1915, another base supply depot was opened at Calais, which, together with Boulogne, fed the northern armies. In 1918, the base supply depot at Calais moved to Vendroux, outside the town.

The system of supplies worked along two lines of communication, the "Northern Line" and the "Southern Line." The northern line ports, Boulogne and Calais, sent supply trains direct to railheads, while the southern line ports, Dieppe, Rouen and Havre sent trains

to Abbeville regulating station for the armies. (Chart 2, Chapter XI, Vol. 1.) A year later another regulating station was opened at Romescamps, near Abancourt, and these two stations regulated for the southern line throughout the war, no further regulating stations being constructed.

At the end of September, 1914, a base supply depot was opened at Marseille for the supply of the Indian Expeditionary Force, which was then arriving. At the same time an Indian advanced supply depot was opened at Orléans, and continued to work until the middle of February, 1915, when all but the Indian cavalry left France.

The general scheme of supply worked from the base through the advanced supply depots and regulating stations to the railheads, and Abbeville was the first advanced supply depot and regulating station feeding the "Southern Line."

During April, 1915, a forage magasin was opened at Abancourt with a view to relieving the ports of large stocks of forage, and to centralizing the increasing issues of fodder. In 1916, Abancourt became an additional advanced supply depot for the southern line, with a regulating station at Romescamps close by. In March, 1917, the advanced supply depot at Abbeville was transferred to Mautort, about three kilometres distant. The Abbeville depot had not been in the fullest sense an advanced supply depot owing to lack of space, and at this period the necessity for still further relieving Rouen and Abancourt was the reason for the construction of the Mautort depot.

In May, 1917, a depot was opened at Cherbourg, whose purpose was to ration the troops stationed in the rest camp on their way to and from the Eastern theatre of war, and to make issues to mine sweepers. In November of the same year, in consequence of the Italian section being introduced, the area came under the control of Headquarters, Lines of Communication, and the depot was renamed No. 8 base supply depot.

A further small base supply depot had been opened at St. Valéry-sur-Somme in March, 1916. Its purpose was to act as a transit depot for supplies sent direct from Newhaven for Abbeville and Etaples.

In addition to the actual local supply depots situated wherever troops were stationed on the lines of communication, there were in the armies other depots called field supply depots. The function of these was to hold certain reserves which might be drawn in case of shortage in the supply trains from the bases, and on the other hand might receive surplus supplies from the railheads. There were two field supply depots officially recognized in each of the armies, and, in addition, several called "special field supply depots." Field supply depots, save in the case of the one at Doullens, were

all temporary depots, and changed their situations very frequently during the course of the war in accordance with the movements of the armies.

In addition, railheads maintained a reserve of from 2,000 to 5,000 complete rations for details entraining or detraining without rations.

Owing to the nearness of the home bases, the reserves held at each of the ports did not exceed twenty-two days for the number of troops based upon that port.

At the end of 1916, the Docks Directorate began to take over the hangars on the quays at the ports to act as transit hangars, and as a consequence the storage space for supplies was found insufficient in some places for the number of days to be carried. A reserve depot was opened at Outreau, about five kilometres from Boulogne, to take the overflow supplies, and Vendroux established, outside Calais.

The following notes indicate the method of supply of a division from the base to the trenches.[3]

As noted above, the system of supplies worked along two lines, the "Northern" and the "Southern" with two regulating stations for the southern line. In the case of each regulating station an advanced supply depot was situated within three kilometres distance. These depots received grocery trains in bulk from the bases, and established reserves from which the daily "section pack grocery train" was made up and shunted down to the regulating stations, where the complete "section pack trains" were formed and sent up to their respective railheads.

Each regulating station was served by three bases sending up different classes of supplies in trucks marked with the section number of the division to be fed. This section number always denoted the same division, wherever that division was stationed.

At the railhead the section pack train was handed over, together with the waybill, to the Railhead Supply Officer (R. S. O.) by the Railway Transport Officer (R. T. O.), and the issues were made to the division in accordance with the following control scheme:

The four Quartermasters of each brigade and divisional troops indented for their requirements and forwarded their indents to their Brigade Supply Officer (B. S. O.).

The four Supply Officers of the brigades and divisional troops each summarized the above indents and sent the summaries to the Senior Supply Officer of the division (S. S. O.), who, in turn, summarized these four documents and sent his summary over night by his representative, the Supply Officer, Divisional Supply Column (S. O., D. S. C.) to the R. S. O. All forms were in duplicate, one to be

[3] Chart 3, Chapter XI, Vol. I.

endorsed by the officer issuing the supplies, and the other by the officer receiving them. The Investigation Department eventually received all the forms through the Acounts Branch of the Deputy Director of Supply and Transport (D. D. of S. & T.).

From the S. S. O.'s summary the R. S. O. made out "chits" for his issuers, giving the quantities of each commodity to be issued when the division drew supplies from the railhead next morning.

Normally, the supplies were loaded on the motor transport of the divisional supply column, and the supply column proceeded to its "park," remaining there until next morning, when it moved off to a selected point, called "refilling point," and offloaded the supplies at four dumps.

The supplies at each dump were divided up in accordance with the requirements of the units drawing, and checked by the respective Brigade Supply Officers. They were then loaded on the divisional train horse transport vehicles, which took them up to the wagon lines (Quartermaster's stores).

At this point the Quartermaster received the supplies and issued them to the company Quartermaster Sergeants of the battalion, who subdivided them for the platoons, and sent them up in bags on the regimental first line transport to the trench dumps, convenient spots near the entrance to communication trenches. Thence, ration parties conveyed them by hand, trolley, etc., to the troops.

The general scheme was varied sometimes in the following ways:

(*a*) In the case of corps troops supplies were drawn at railhead by the supply column motor transport, and taken up to the corps dumps, where they were divided up, and the next morning delivered direct to the units.

(*b*) In the early days of the campaign the supplies were usually dealt with according to the scheme shown on Chart 3, Chapter XI, Vol. I, but later the practice grew up of using the divisional train horse transport from the railhead to refilling point and thence to the wagon lines, so freeing the motor lorries for other work. This method became possible owing to the comparatively short distances between the railheads and the wagon lines. "Decauville" lines from railheads were also used.

(*c*) When the railhead was right in the forward area a further simplification took place, the refilling point being situated either in the station yard, or near to it. In this case the supplies were loaded direct on to the train transport for the wagon lines.

(*d*) When forward operations were decided upon the troops drew "fortress" or "barrage" rations, which were dumped at convenient points in the rear, or in the trenches. They were intended to cover the possibility of supplies not coming up from the railhead.

DEVELOPMENTS LINES OF COMMUNICATIONS.

(Chart 2, Chap. XI, Vol. I.)

Administrative Control.—Until December, 1916, the lines of communication, which included the area from the base ports up to the armies, were controlled by the Inspector General of Communications. (I. G. C.)

The I. G. C. commanded lines of communication units, regulated the working of the administrative services on the lines of communication, and was responsible for selection and allotment of sites and buildings for depots of all kinds, offices, hospitals, plant, etc.

On the formation of the Directorate of Transportation, all transportation questions were exclusively in the Director General's hands, and the I. G. C.'s functions were in part fulfilled by a "General Officer commanding the Lines of Communication" (G. O. C., L. of C.), administrative functions of supply and transport falling to the Quartermaster General.

Railway Control.—The railway service was controlled and manned entirely by the French. During the concentration the movement of troops was arranged for by a "Commission de Ligne" at Amiens. Subordinate to this commission there was a "Délégation de l'Embarquement" at each port, with local control.

The British were responsible for the loading and unloading of all railway vehicles placed at their disposal.

The control of the railway system was in the hands of the "Commission Régulatrice," sitting at the "Gare Régulatrice," and the General Staff, Inspector General of Communications, was the sole channel of communication between the "Commission" and all representatives of services and departments. At the ports, the Base Commandants were the channels of communication between local heads of services or departments and the local railway authorities. (Commission de Gare.)

The "Commission Régulatrice" had at its disposal only a limited number of timings from the ports to the "Gare Régulatrice," but complete control over the railways from that point forward. From time to time the "Commission" informed the Inspector General of Communications which stations could be used as railheads.

Total imports for the years 1917 and 1918 were:

	Deadweight tons.
1917 (including 2,109,735 tons ammunition)	9,398,020
1918 (including 2,068,314 tons ammunition)	8,869,492

Total exports of salvaged material for the years 1917 and 1918:

	Deadweight tons.
1917	326,158
1918	410,686

Total tonnage carried to France by the Cross Channel Barge Service during the years 1917 and 1918 was:

	Tons.
1917	449,573
1918	963,608

Total British military personnel carried on broad and metre gauge lines during 1918 15,030,194

Total number of loaded trains run for the British E. F., France, during 1917 and 1918:

1917	63,304
1918	83,680

Location of Supply Depots.—Base supply depots were opened at the base ports allotted to the British in France, as follows:

Havre, Rouen, Boulogne	In August 1914.	Calais	In April 1915.
Marseille	In September 1914.	St. Valéry	In March 1916.
Dieppe	In December 1914	Cherbourg	In November 1917.
		Dunkerque (Bergues).	In December 1918

Owing to the shortness of the "Northern" line of communication, no advanced supply depot or regulating station was necessary, all supplies being sent direct from base to railhead. For the "Southern" line various intermediate stations were decided upon, from time to time, as follows:

Amiens	Proposed in the original scheme as an A. S. D. and R. S., but functioned as an R. S. only. Owing to the rapid enemy advance it was closed on August 26, 1914.
Le Mans, A. S. D. / Maroc, R. S.	Opened in August 1914 to replace Amiens. Closed in February, 1915.
Abbeville, A. S. D. & R. S.	Commenced to function in July 1916. Formerly supply depot advance base.
Abancourt, A. S. D. / Romescamp, R. S.	Opened March 1916.
Moutort, A. D. S	Replaced Abbeville A. S. D. in March 1917. The R. S. remained at Abbeville.
Outreau	Opened in January 1917. Intended as an A. S. D. and R. S., but actually functioned as a reserve depot only.

CHAPTER X.

SECTION II.

GENERAL ORGANIZATION OF THE SUPPLY OF FOOD AND MATERIALS BY THE "INTENDANCE" (QUARTERMASTER) SERVICE (FRENCH).[1]

I. *General.*

Chart 9, Chapter XI, Volume I, shows: (a) The general flow of food supplies from the time of their assembly until their delivery to the troops at the railheads (gares de ravitaillement); the principal agencies through which such supplies, destined for the armies, were obliged to pass.[2]

The greater part of the food supplies came, naturally, from the Zone of the Interior. At the beginning of the war the assembling of these supplies devolved upon the Minister of War, (V Direction), "Supply Service" (Service du ravitaillement).

During the latter part of the war, when the resources in the national territory became insufficient to supply the needs of both the Army and the civil population, a special administration: the "Under Secretary of State for Supply" (Sous-Secrétariat d'Etat du Ravitaillement) was created to:

Coordinate the requirements of the civil population and of the Army;

Distribute the resources of the national territory between the civil population and the Army;

Purchase additional food supplies from abroad.[3]

However, the system of supply was in no way modified. What actually occurred was that the agencies responsible for the assembly of the resources in the national territory, i. e. the "Departmental Supply Committees" (Commissions Départementales de Ravitaillement), found their task increasingly difficult, while the proportion of supplies coming from abroad was considerably increased.

The main supply agencies in the interior were the departmental supply committees. These committees functioned under the orders of the "Prefect" (Préfet) of the Department and were composed of a military "Deputy Quartermaster" (Sous-Intendant Militaire) and a number of capable civilian members.

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[1] Prepared for the Military Board of Allied Supply by the French Section of the Board (Commandant Poupinel, of the staff of General Payot, D. G. C. R. A.). Approved by General Payot.

[2] See Charts 8 and 9, Chapter VI, Volume I.

[3] Chart 10, Chapter XI, Volume I.

The departmental supply committees knew the resources existing in their respective Departments (from data prepared in peace time). They purchased or, whenever necessary, requisitioned the quantities of supplies requested by the Minister of War. They also assembled the supplies and forwarded them in due time to the particular "Intermediate depots" (Stations-magasins) which they were charged with supplying, either direct or through special "collecting centers or stations" (gares ou centres de groupement). The latter were used particularly in the case of bulky supplies (hay, straw, etc.), or for such supplies as could not be readily stored in the intermediate depots (livestock, etc.).[4]

Requests for shipments were made by the "Military commissioner" (Commissaire Militaire) of the intermediate depot concerned, according to needs.

Supplies were sometimes treated at the intermediate depots to obtain uniformity of quality (such was the case with wines, for example). Supplies were shipped from the intermediate depots to the regulating stations (Gares régulatrices) upon the request of the Regulating Officer (Commissaires Régulateurs) concerned, and only in compliance with such requests.[5]

As a matter of fact, great care had to be exercised to prevent congestion of the regulating stations by overloading them with quantities of supplies in excess of the amounts which could be absorbed by the troops at the front within a reasonable time.

The means by which such supplies were forwarded from the regulating stations to the troops is described in Section II, Chapter XIII.

II. *Organization of the bread supply.*

Despite large consumption, it was admittedly necessary (for the welfare of the troops), that the bread supply of the armies be as fresh as possible; moreover, this resulted in less scraps and waste.

The bread supply of the armies was furnished by:

1. Bakeries at the intermediate depots (stations-magasins).

These bakeries were organized and their ovens constructed in peace time; portable field ovens were added thereto whenever necessary.

The number of ovens, as well as the technical personnel required to operate them, were determined by the production desired; the latter, in turn, depended on the number of troops based upon the intermediate depot. (Effectif de base de la station-magasin).[6]

[4] Chart 11, Chapter XI, Volume I.
[5] Chart 12, Chapter XI, Volume I.
[6] "Effectif de base" (Base strength), i. e.: the number of men and animals which were to be supplied by a particular, designated, establishment.

For example, the intermediate depot at St. Cyr, with a "base strength" of 300,000 men and 100,000 horses, had a bread production capacity of 350,000 rations.

2. Bakeries at the front: "Army bakeries" (Boulangeries d'Armée—B. O. A.)

These bakeries were installed at or near the regulating stations. They were organized by combining units known as "Field bakeries" (Boulangeries de campagne), which had been formed during the mobilization. These field bakeries were equipped with 32 field or "Godelle" model, bake ovens. Two field bakeries, or 64 ovens, could produce 100,000 rations every 24 hours.

The army bakeries were connected with the railroads and their output arrived at the regulating station each day. Bread from the army bakeries was fresher than that of the intermediate depots and was included, as much as possible, in the shipments to units whose supplies took a longer time to reach their destination.

The army bakeries functioned at full capacity practically continuously, while the bakeries at the intermediate depots based their production upon the number of troops (effectifs) supplied by the regulating station to which they were attached, as their output only served to supplement that of the army bakeries.

The Regulating Officer controlled the production of each of the bakeries at the intermediate depots which were attached to his regulating station.

III. *Meat Supply.*

Either frozen or fresh meat (meat on the hoof) was supplied to the armies. Throughout the war the frozen meat available was insufficient to meet the total requirements of the troops, so that it was impossible to supply the armies entirely by this means.

However, the quantities of frozen meat delivered daily amounted, on an average, to 600 tons or one-half of the daily consumption and this enabled the Army to reduce its live-stock to a two-days' supply.

Frozen meat was delivered daily to the regulating station by direct shipments from the "cold storage warehouses" (Entrepôts frigorifiques), which were specially designated to supply that particular regulating station. Meat was sent to the cold storage warehouses immediately upon the arrival at the ports of the meat supply ships coming from abroad.[1]

Cars of frozen meat were attached to the "daily supply trains" (R. Q.) designated by the Regulating Officer. The latter made his decision after consulting the army to be supplied concerning the situation of the troops (combat or rest) and after ascertaining local

[1] There were six cold storage warehouses (Entrepôts frigorifiques) located at: Le Havre, Dijon, Marseille, Bordeaux, Dunkerque and Paris.

conditions in connection with facilities for maintaining cattle on the hoof (forage resources).

The maintenance of live stock at the front naturally entailed the transportation of forage (which is bulky and difficult to handle), whenever the region where the herds were to be stationed did not produce sufficient forage.

Meat on the hoof was generally delivered by the intermediate depots by complete trainloads and upon special request from the Regulating Officer. The cattle was herded in the neighborhood of the regulating station, in proximity to a station equipped with necessary loading facilities. (The "cattle park" (Parc de bétail) of a regulating station contained one day's meat requirements for the number of troops which were to be supplied by the regulating stationed concerned).

Forward of the regulating station, the personnel and cattle of the army corps "cattle herds" (Troupeaux de bétail) were assembled by groups of two or three army corps, near one of the two army slaughtering centers (Centres d'abats).

The shipment of cattle from the regulating station to the front was an exceptional supply and formed the subject of a special request from the headquarters of the army concerned to the regulating station.

IV. *Supply of Straw and Hay.*

The supply of these commodities presented the following peculiarities.

Daily, the Direction of the Rear (D. A.) ordered the shipment of a uniform total amount of forage from the intermediate depots toward the front, at a rate slightly below the ration authorized by Army Regulations.

The Direction of the Rear then caused the regulating stations to ship a smaller quantity of forage to the armies than the total amount which had been received at the regulating stations from the intermediate depots. The result was that the Direction of the Rear was enabled to create reserve stocks of forage, which it could use to make supplementary shipments to armies located in territory which contained no forage resources and for the purpose of making up the difference between the regulation ration and the shipments made by the regulating stations.

In order to secure the better utilization of local resources, the Director of the Rear caused the preparation, in each army zone and in each zone of the lines of communication (Direction d'Etapes), of a statement as to the total amounts of forage existing in the zone concerned, as well as of the total forage requirements for the needs of the civil population. The difference between these

two figures gave the amount of forage which was available in that particular zone for the use of the armies. The available forage was then purchased or requisitioned for the armies and stored if necessary.

With a view to utilizing these reserve stocks on another part of the front, a careful study was made and detailed plans prepared which provided for the possible removal of the forage and its loading upon railway cars; these plans also estimated the necessary labor and time which would be required. At the proper time, and at suitable stations, the "Directions of the lines of communications" (Directions d'Etapes) furnished the necessary loading personnel and means of transportation.

The Regulating Officers assured the movement of these supplies to destination by complete trainloads, in accordance with the orders of the Direction of the Rear.

V. *Supply of Oats.*

Similar methods for the utilization of local resources were employed for the supply of oats. Actually, the small resources existing in the Zone of the Armies, as compared with the requirements, made it necessary to ship nearly all of the oat supplies from the intermediate depots.

Oat supplies were incorporated in the "daily supply trains" at the regulating stations, as were other supplies coming from the intermediate depots.

VI. *Supply of Coal.*

This supply was assured by the direct shipment of complete trainloads of fuel to the regulating stations from the mineralogical districts (Arrondissements) of Bruay and Chalon-sur-Saône. Shipments from the regulating stations toward the front were made by the addition of complete trainloads of coal to the "daily supply trains."

VII. *Supply of Clothing.*

1. Supplies were assembled in the interior by the Minister of War and he made the necessary contracts with industrial firms or contractors for the purpose.

Ready-made clothing, after inspection by the "Receiving committees" (Commissions de réception) was distributed by the Minister to the "clothing warehouses" (Entrepôts d'habillement). The clothing warehouses were, (as were all warehouses), under the authority of the Minister, but their entire stocks of supplies were at the disposal of the Commander in Chief.

There were five clothing warehouses at the beginning of the war. This number was increased to nine in 1918, located as follows: Lyon,

Dijon, Troyes, La Plaine St. Denis (near Paris), Orléans, Vierzon, Le Mans, Mézidon and Dunkerque.

Requests from the armies were generally sent direct to the clothing warehouses. Theoretically, these requests were made periodically but, after every important operation, certain unexpected needs arose which had to be filled immediately. Whenever these requirements attained the importance of periodical requests they were also filled by the clothing warehouses.

Shipments of clothing were made direct from the warehouses to the units for which they were destined. The bales containing clothing were handled at the regulating stations in the same manner as were the various parcels, known as "Corps parcels" (Colis des corps), coming from the interior and destined for the troops at the front.

2. At each regulating station there was a clothing depot (Magasin d'habillement) which was a branch (annexe) of a certain, designated, clothing warehouse.

The clothing depots at the regulating stations were established to meet the particularly urgent needs of the armies; however, their stocks were not large.

In addition, these clothing depots assured the distribution of clothing of all kinds to isolated men or to small detachments passing through the regulating station. Convalescents, upon leaving the hospitals in the Zone of the Armies, were thus re-equipped and clothed immediately upon arrival at the regulating station, before their return to the front.

3. Laundries. The laundering of the clothes of the troops at the front was done in special establishments known as "Army laundries" (Blanchisseries d'Armée). The clothes were sent to these laundries in wagon-loads and requests for the necessary quantities of clean clothes to enable the men to make a change were sent by the units concerned to army headquarters within a specified limit of time. A change of clothes was effected as often as possible and was obligatory whenever a unit left the vicinity of the combat zone, either to go into the second lines or into rest billets.

VIII. *Difficulties of Supply.*

Supply conditions, as described above, changed greatly during the latter part of the war (end of 1917 and beginning of 1918) on account of the shortage of certain essential supplies in the French Army. This shortage was due to the submarine warfare, the railroad transportation crisis, the increase in the number of men and horses (consumers of cereals on French soil) and, particularly, the almost total exhaustion of the resources of the country as a result of over three years of war.

IX. *Oats Crisis.*

At the end of 1917 the oat supplies in the intermediate depots (Stations-magasins) had fallen to three days' reserves and the Army stocks were exhausted.

The Commanding General was obliged to request the Government to take radical steps to provide the necessary supply of oats for the 700,000 animals of the French Army and he requested, particularly, that the importation of oats be given priority in the program of the "Shipping committee" (Commission du frêt).

In compliance with the request of the Commanding General, the requisitioning of oats throughout the national territory was decreed but, in spite of this measure (which provided new resources), the necessary shipments of oats to the armies failed to materialize on account of the great congestion on the railroad systems, caused by the arrival of the personnel and matériel of the American Army.

The Commanding General then requested that shipments of imported cereals be sent direct from the ports to a number of intermediate depots, chosen by himself, which were directly connected with the maritime ports. This measure improved matters temporarily, but the supply situation always remained precarious and resulted in important restrictions being imposed upon consumption.

The armies were therefore directed:

To carry to the maximum the exploitation of the local resources, and to assist the "Departmental committees" operating in the Zone of the Armies as much as possible in gathering the stocks which the latter had discovered. For this purpose the armies placed motor trucks and personnel at the disposal of these committees.

It was only after the month of August 1918, on account of the larger shipments arriving at the ports, important cessions granted by the Allied Armies, and as the result of the new harvests, that the oats crisis abated; consequently, the above mentioned restrictions on consumption, which had an undesirable effect upon the Army in the field, were partly revoked.

X, *Flour Crisis.*

In a lesser degree than for oats, the supply of flour had already become difficult during the first three months of 1918, and, for the purpose of conserving available resources, certain proportions of rice and dwarf-pea flour had to be added to the wheat flour used in the food for the troops.

However, on the 1st of June the situation became really critical and the flour in the intermediate depots had been reduced to a four days' supply. Moreover, the inefficient operation of railway transportation further complicated existing conditions and the result was that, on several occasions, certain bread producing establish-

ments had to cease operations, in spite of all efforts made to supply them and the cession of stocks of flour by the American Army.

On the 26th of May, the bread producing center at Elbeuf shut down. June 15th., the same occurred at Pithiviers. The 15th of July, the First Army advised that the bread reserve in its regulating stations was exhausted and that only one day's supplies remained in the supply wagons (équipages).

XI. *Hay Crisis.*

The period July–August was particularly serious. The already threatening situation was further aggravated by a labor and transportation crisis, which made it impossible to gather the crops or to press or transport the available hay. Certain units were obliged, for quite a number of days, to consume only one kilog of hay per horse, per day, at the maximum.

One must place one's self in a similar situation to realize the efforts made by the personnel of the staffs and services which were charged with the supply. June–July were the most critical months of the military situation and they were also the most critical of the supply situation.

He who knows the difficulties encountered in supplying armies during operations when resources are abundant and reserve stocks are full, will be able to appreciate the enormous additional obstacles which had to be overcome to provide the armies, along the whole front, with all of their supply requirements at a time when the grouping of the forces varied constantly and when the reserves of supplies at the disposal of the Commander in Chief had been reduced to heretofore unforeseen proportions.

ANNEX—CHAPTER X—SECTION II.

FRENCH ARMY.

Lists of stocks existing at the date of November 31, 1918.

(Rations.)

	Daily requirements.	Existing in the "intermediate depots" (stations magasins.)
Flour.....quintaux..	16,000	137,000 quintaux, or about 8½ days.
Oats.....do....	35,000	322,542 quintaux, or about 9 days.
Hay.....do....	25,000	25,415 quintaux, or about 1 day.
Straw.....do....	9,000	35,530 quintaux, or about 4 days.
Potatoes.....do....	9,000	38,492 quintaux, or about 4 days.
Wine.....hectoliters..	26,000	108,422 hectoliters, or about 4½ days.
Beans.....quintaux..	2,100	4,973 quintaux, or about 2 days.
Peas.....do....		2,596 quintaux, or about 1 day.
Rice.....do....		23,772 quintaux, or about 10 days.
Lentils.....do....		3,567 quintaux, or about 1½ days.
Sugar.....do....	1,400	29,952 quintaux, or about 15 days.

CHAPTER X.

SECTION III.

GENERAL STATEMENT OF THE BELGIAN "SERVICE DE L'INTENDANCE."[1]

During the course of the campaign 1914–1918, the function of the "Intendance" service was to supply the Army with food, forage, clothing, equipment and bedding; it also operated the laundries and disinfecting establishments. At the head of the service was the "Inspector General of the Intendance Service" (Inspecteur Général du Service de l'Intendance—I. G. S. I.).

The functions of the "Intendance" were not limited to the requisition and distribution of supplies; it also handled raw materials and supervised the factories and establishments located in the zone of the rear.

Operations of the "Intendance" at the Base of Antwerp.—During the mobilization, in 1914, the supplies of the Belgian Army were assembled in the storehouses of the fortress of Antwerp (Place Fortifiée d'Anvers—P. F. A.), which constituted the Army's base.

At that time the "Intendance" establishments at Antwerp consisted of a flour-mill, bakery, biscuit factory (biscuiterie) for army hard-bread, a box factory, forage, and bedding stores. During the mobilization there was also added thereto stock-yards (cattle park), and storehouses for wheat, coal, gasoline and automobile spare parts.

Flour-mill and Bakeries.—The output of the Antwerp establishments was supplemented, until August 1914, by the production of mills and bakeries in the interior of the country.

Military Abattoir.—The military abattoir only supplied the troops stationed within the fortress of Antwerp. The large units in the field had their own slaughtering establishments.

Stock-yards (Cattle Park).—Supplied the Antwerp military abattoir and also the slaughtering establishments of the field army, whenever the latter were unable to obtain their requirements in live-stock locally. The stock-yards had a capacity of 600 head of cattle, corresponding to three days' fresh meat rations. The total number of live-stock maintained for the use of the Army in the "Zone of

[1] Prepared for the M. B. A. S. from data furnished by the Inspector General of the "Intendance" Service of the Belgian Army.

Antwerp" was estimated at 50,000 head. The stock-yards functioned perfectly as long as Antwerp remained the Army base.

Canning Factory.—The field army consumed large quantities of canned meats. The output of this factory was supplemented by stocks from the interior of Belgium and by importations from England.

Stores of Groceries (Petit Vivres).—Large stocks of coffee, sugar, peas, beans, rice, etc., were stored in Antwerp at the beginning of the siege.

Stores of Forage.—Through the exploitation of local resources in the vicinity of and within the fortified region of Antwerp, large stores of straw and hay had been accumulated. The field army supplied itself through local requisitioning. Considerable difficulty was experienced in obtaining oats; however the troops were always regularly supplied.

Stores of Bedding Material.—These stores supplied the bedding material for the troops in the fortress of Antwerp (P. F. A.). The bedding material came from the storehouses in the interior of the country.

The Depot for Automobile Oils and Gasoline.—This depot was established with stocks found in Antwerp and in the vicinity. The daily average consumption was 150,000 liters per day.

Stores of Coal.—These were created for the purpose of providing the winter's supply of coal which, it was estimated, would require half a million tons. The quantity of coal found in Antwerp itself made it possible to organize a part of this stockage. It had been decided that the fortress of Antwerp was to receive sufficient stocks to enable it to withstand one year's siege. On October 1st, when the Belgian Army began its retreat towards the Yser, the reserve stocks of coal then accumulated were estimated as sufficient to supply the Army during six months.

The "Intendance" Service during the retreat from Antwerp to the Yser.—October 1, 1914, it was decided to organize a secondary base at Ostende, which was formed in part from supplies which had been evacuated from Antwerp.

For the supply of bread, flour was furnished by England, flour-mills were requisitioned in the region of Ostende, and field bakeries were organized; it was also found necessary to requisition civil bakeries. During the period of time Ostende served as a base, a daily production of about 50,000 bread rations was required to meet demands. Stores of groceries, canned meats, forage, gasoline and bedding material were also established there for the use of the field army. A large part of the forage was obtained locally.

The "Central Clothing Depot" (dépôt central d'habillement) was transferred from Antwerp to Ostende at the same time as the

other organizations of the "Intendance" service. Ostende, which had been organized as a secondary base, became the main base within a few days. It was rapidly organized and was immediately enabled to meet all demands made upon it.

The base at Ostende had hardly begun to function normally when, due to the retirement of the Belgian Army to the Yser, the "Intendance" received orders (on October 14, 1914) to evacuate Ostende and establish a new base in France. This rapid change could not be made without abandoning large quantities of equipment and matériel, nor without placing the supply services in a very difficult situation. It was only thanks to the active assistance of the French "Intendance" that it became possible to overcome the difficulties which arose.

From the beginning of the battle of the Yser, the Belgian troops were urgently in need of clothing and equipment and, particularly, of shoes. Great Britain and France sent various stocks of these indispensable articles.

The new Belgian base established itself at Calais and the French did their utmost to facilitate its organization.

The stocks of food, equipment, and clothing which had been evacuated from Belgium, or which had been furnished by England and France, were kept on board the ships on account of the uncertainty of the military situation. Rations and forage for two or three days only were sheltered in sheds on the docks.

The work of organizing the "Intendance" service at Calais was accomplished gradually. The service was subdivided, for administrative purposes, into five sections:

1. Flour-mill and bakery.
2. Abattoir and stock-yards.
3. Groceries, canned meats, and forage.
4. Gasoline, fuels, oils and greases.
5. Clothing.

These various organizations were partly supplied by means of stocks which had been salvaged from Antwerp and Ostende; however, certain other classes of supplies were either insufficient or absolutely lacking. The "Intendance" had to procure the latter through purchases in England or in America, or through agreements with the Allied Armies. It was thus, for example, that the French "Intendance" agreed to furnish daily a part of the requirements for the bread rations of the Belgian Army and that Great Britain furnished supplies of oil and gasoline. The stocks of commodities which had been salvaged from Ostende and from Antwerp (groceries, oats), had to be immediately completed, while others had to be acquired with least possible delay (potatoes, hay, straw, etc.). (Chart 5, Chapter XI, Vol. I.)

The stocks of supplies were progressively increased until a reserve of from 20 to 40 days was obtained.

Calais was exposed to both aerial and naval bombardment, moreover, a second retirement of the Belgian Army would have brought the latter so close to the base that the reserves of supplies would have been seriously endangered. It was therefore decided to organize a supply base (base d'approvisionements) at Le Havre for rations, clothing, equipment and bedding material, which would be sufficient for a two months' period. Land and sea transport between Le Havre and Calais made it possible to maintain the Calais stocks. Numerous overseas shipments continued to arrive at Calais.

When the German thrust was decisively broken on the Yser, it became possible to unload the supplies which, until then, had been kept aboard ships and to organize the base. The base establishments were divided between Calais and the small towns in its vicinity: Gravelines, Bourbourg, Adinkerke, La Panne and Elsendamme.

A "quartermaster" (intendant) was placed at the head of these establishments, while the various subdivisions of the base were under the orders of "assistant quartermasters" (sous-intendants).

BASE ESTABLISHMENTS AT CALAIS.

Forage Stores.—From the beginning of the base at Calais nearly all of the oats needed had been purchased in America. From 1917 on, oats were furnished by England in order to economize tonnage.

The forage supply service exploited the hay and straw resources in the vicinity of Calais and in the "Département du Nord", which had been assigned by the French to supply the Belgian "Intendance" service, as well as local resources in rear of the Belgian front. The French were obliged to furnish an additional 84,000 kilogs of hay and 50,000 kilogs of straw daily.

Flour Stores.—The bakeries at Bourbourg and Adinkerke received 80,000 kilogs of flour daily. As the Belgian flour mills had ceased to function, all the flour used was supplied by the French. This flour was received at Calais, either by direct shipment from America or from the big flour mills at Corbeil and at Le Havre.

Stores of Bedding Material.—This establishment was charged with the storage, upkeep and distribution of mattresses, blankets, etc., needed by the hospitals and troops and Services of the Rear.

BASE ESTABLISHMENTS AT BOURBOURG.

Bakeries.—After the battle of the Yser, a portion of the daily bread supply had been furnished by the French. It therefore became necessary for the Belgian "Intendance" service to provide its

own means for supplying bread to the Belgian troops and, consequently, two large bakeries were established. A permanent bakery was constructed at Adinkerke and a large field bakery was installed at Bourbourg.

Military Abattoir.—It distributed an average of 4,200 kilogs of meat daily to the troops at the base. It received the hides of animals from the slaughtering establishments at the front, as well as from civil abattoirs, and turned them over to the French "Intendance".

Stock-yards.—All the cattle for the use of the field army and the base were furnished by the French. The stock-yards received the cattle and forwarded them to the establishments at the front according to needs. The "stock-yards" really consisted of twenty large farms in the vicinity of Bourbourg. They generally contained about 600 heads of live-stock.

BASE ESTABLISHMENTS AT GRAVELINES.

Stores of Groceries.—These establishments received, stored, and forwarded to the various troops in the field and at the base, supplies of groceries, biscuits (hard bread), canned meats, cheese, coffee, chicory, pepper, salt, sugar, rice, peas, beans, tobacco, cigarettes, wines and spirits. These establishments also helped to supply the field army and the base troops with potatoes and vegetables by exploitating the resources of the "Département du Nord." In 1917, several million kilogs of potatoes were purchased in Ireland.

Gasoline.—The British supply service furnished the gasoline to the base at Calais, from whence it was shipped in tank cars to Gravelines; there it was put into containers (bidons) for shipment to the front. The field army received 40,000 liters of gasoline daily. The gasoline depots also handled automobile oils and lubricants, as well as the coal-oil needed by the Army. The supply of gasoline for the Aviation was likewise furnished by the depots at Gravelines.

Cooper Shops.—They manufactured barrels for the shipment of gasoline, for the transport of water, for the use of the canning establishment at Eu, and for the breweries organized by the "Intendance."

Drinking Water.—It was shipped daily from Gravelines to the front by means of tank cars.

BASE ESTABLISHMENTS AT FURNES.

Brewery.—In January 1917, the Medical Service (Service de Santé) gave warning that the beer issued to the troops was infected and that its use by the sick was dangerous. To remedy this situa-

tion, the "Intendance" service organized a brewery at Furnes for the supply of the hospitals at the front. The surplus production was sold in the canteens and in the messes.

In March 1918, on account of bombardments, this brewery had to be abandoned. The "Intendance" service then rented a brewery at Dunkerque. At the time of the Armistice, the "Intendance" service was organizing a new brewery at Gravelines.

BATHS, LAUNDRIES, AND SALVAGE SERVICES.

At Calais: A plant was established at Calais to launder the clothing of the troops of certain hospitals at the base and of certain units at the front. In connection with this laundry, a service was organized for the salvage of unserviceable clothing, equipment and bedding material. Later a second laundry was established at Calais to supplement the first.

At La Panne: To keep the troops in good health, it was indispensable that they be provided with clean linen every 8 or 10 days; it was also necessary that their clothing be disinfected regularly and that the men bathe frequently.

In 1915, Her Majesty, the Queen, established laundries and hot baths at La Panne for the use of the troops.

In 1916, these establishments were placed under the "Intendance" service. They were progressively enlarged and, in 1917, they employed 1,450 persons, of whom 900 were women, for the repair of clothing.

At Elsendamme: Bathing and disinfecting establishments similar to those at La Panne were installed at Elsendamme, on the southern portion of the front.

Kortewilde, Oerenburg, St. Ricquiers and Wulpen: In 1915, shower-baths for the troops were installed in these four towns.

At Furnes: A service for recuperating animal and organic materials was organized at Furnes in August 1916, by the "Intendance" service.

SALES-COMMISSARIES AND "INTENDANCE" DEPOTS.

Sales Commissaries.—In 1915, the "Intendance" service established sales commissaries at the front where offiers and men could obtain supplies for cash.

To supply these commissaries, the "Intendance" organized a large establishment at Calais which was known as the "Central Sales Commissary for officers and men" (Magasin central pour officiers et troupes). It carried more than 600 different kinds of articles and commodities.

In August 1917, the Central Sales Commissary operated nine branch commissaries.

In August 1918, there were fourteen branch stores.

Retail sales at the front were made through officers' sales commissaries and troop sales commissaries.

The officers' commissaries were located at Adinkerke and at Isenberghe; there were retail commissaries for the troops in the cantonments of each Army Division (D. A.) and in the towns of La Panne, Bray Dunes and Hondschoote.

"*Intendance*" *Depots* (Chart 4, Chapter XI, Vol. I.)—Theoretically, troops were to obtain hay, straw, potatoes, vegetables, and materials for heating and lighting by local requisition, but these supplies were soon exhausted or were insufficient and additional requirements therefore had to be brought up from the rear. To facilitate the transport, handling and distribution of these supplies, the latter were stored in depots distributed along the front, which were known as "Intendance" depots (Dépôts de l'Intendance). The units received the supplies which they could not procure on the spot from these depots.

In 1917, there were eight of these depots. They held from 8 to 10 days' supplies of hay, straw, potatoes, vegetables, coal, fuel, wood, coal oil, lubricants, etc. These depots received the supplies of potatoes purchased abroad. The "Intendance" depots exploited local resources in hay, straw, potatoes, and chicory by means of a permanent service.

Supply of Clothing and Equipment (Chart 6, Chapter XI, Vol. I.)—A branch of the "Central Clothing Depot" at Le Havre was established at Gravelines. It was known as the "Auxiliary Clothing Depot" (Magasin auxilaire d'habillement) and contained, at all times, sufficient stocks to supply the field army and the troops at the base of Calais for one month.

BASE AT LE HAVRE.

The reasons for the establishment of this base have already been given. It included the following establishments:

Ration stores and coffee roasting plant.
Special storehouse for gifts.
Sales commissary for officers.
General stores of bedding material.
Central clothing depot, which maintained various shops in connection therewith, as well as a manufacturing service at Paris.

Ration Stores.—These stores were to contain a two months' supply of groceries for the Army. They were to supply the troops at the

front, a depot for groceries at Gravelines, and all Belgian troops stationed in France. A coffee roasting plant was attached to this establishment.

Special Storehouse for gifts.—This was organized in 1915 to receive donations of all kinds for troops at the front and for Belgian prisoners in Germany.

Special Sales Commissary for officers.—For the sale of clothing, shoes, and equipment of all kinds.

General stores of bedding material.—These stores were organized in 1915, and contained the reserve bedding material for the entire Army.

Central Clothing Depot (Chart 6, Chapter XI, Vol. I.)—The central clothing depot at Le Havre supplied the following establishments, etc.:

The auxiliary clothing depot at Gravelines.
The clothing depot at Rouen, for the men in the training areas (C. I.)
The depot at Le Havre for officers.
The special storehouse for gifts for prisoners of war.
Belgians interned in Switzerland.
Isolated Belgian troops in France and England.
The laundries at Calais, the establishments along the front for the sorting of linens, and the Belgian Clothing Service at Paris.

The central clothing depot contained sufficient supplies for the requirements of from six to twelve months.

Clothing Service at Paris.—In 1915, the "Intendance" organized a service for the manufacture of woolen and cotton clothing, and shoes. It included large stores of materials for the manufacture of clothing and shoes and maintained a receiving service, composed of experts, which inspected and assorted the stocks of shoes and clothing.

Some fifteen large custom-tailoring establishments in Paris worked almost constantly for the Belgian "Intendance" service. Similar establishments functioned at Rouen and at Le Havre.

During the four years of war, the supply of shoes for the Belgian Army was assured by four large factories in Paris.

Supply of Belgian units stationed in France.—The troops at the base were supplied according to the system which applied to the field army. The troops under the "Inspector General of the Army" (I. G. A.), and who were located in the "training areas" (C. I.), in the interior of France, supplied themselves by local purchases upon arrival in France.

A clothing and equipment depot was organized for the latter at Rouen. In 1917, the scarcity of food made it necessary for the

Belgian "Intendance" service to assist the Belgian troops stationed in France in obtaining certain supplies.

An "Intendance" depot was established at Eu to supply the Belgian troops stationed at Eu, Dieppe, Fécamp, and Creil, and another "Intendance" depot was established at the Camp D'Auvours for the Belgian troops stationed there and in the vicinity of Le Mans.

A large number of isolated Belgian units and detachments were stationed throughout France and they encountered great difficulties in obtaining their supplies. In order to supply these isolated troops the Belgian "Intendance" organized the "Supply Depot for Troops of the Rear" (M. A. T. A.) at Le Havre. The latter maintained more than 60 branch establishments in France, wherever the presence of Belgian military personnel warranted one.

Isolated Belgian soldiers and their families could purchase their provisions at these stores in conformity with the French Government's system of rationing.

Supply of the civil population.—At the end of 1914, the Belgian Government had provided means for supplying the civil population of the Belgian communities which were not invaded by the enemy. A civil "Supply Commission" (Commission de Ravitaillement), directed by superior officers, was established at Calais and functioned under the orders of the Minister of the Interior.

Organization of the "Intendance" Service.—All the services and establishments of the "Intendance" were under the technical direction of the "Inspector General of the Intendance Services" (Inspecteur Général des Services de l'Intendance). He was the chief of the administrative and technical officers and troops of the "Intendance" service.

Transfer of the "Intendance" establishments at the end of 1918.—After the Germans were driven out of Belgium, the necessity for moving the "Intendance" establishments became apparent. It had been planned to establish a new Belgian base at Bruges, but the rapid liberation of the whole country made it possible to transfer the base to Antwerp and, within a few weeks, the "Intendance" service had transferred all of the base establishments to that city. Antwerp supplied the Belgian troops of occupation in Germany, as well as those which remained in garrison in Belgium.

CHAPTER X.

SECTION IV.

FOOD AND FORAGE SUPPLY SERVICES (ITALIAN).[1]

The supply of food, forage, clothing and equipment for the Army and the handling of the Army's finances devolved upon the Commissariat service. This service was subdivided into three distinct branches:

a) Food and forage.
b) Clothing and equipment.
c) Finance Department.

These three branches were organized in accordance with the pre-war Army Regulations, but underwent many modifications during the war on account of the special conditions which arose as a result of trench warfare (guerra di posizione). The functions of the Commissariat service were directed by administrative organizations common to all three branches and by executive organizations peculiar to each branch. (Chart 13, Chapter XI, Volume I.)

ADMINISTRATIVE ORGANIZATIONS.

a) The Commissariat Section of the Intendenza Generale: Coordinated the Commissariat service of the whole Army and controlled the supply of the central depots.

b) Army Commissariat Direction: In the zones assigned to it, the Army Commissariat Direction submitted plans to the "Intendente" (supply officers) of the armies for the delimitation, among the various army corps belonging to each army, of the food zones assigned to each army. It provided for the evacuation of the advanced supply establishments and for the organization of new supply installations. It assured a regular flow of supplies to the first line establishments and advised the General Commissariat and the Ministry of War of the locations of the central depots, so that the latter might see to it that supplies from the bases were delivered in time. (Chart 16, Chapter XI, Volume I.)

c) Army Corps Commissariat Direction: Directed the work of the army corps Commissariat services and fulfilled the same duties, insofar as divisions were concerned, that the Army Commissariat Direction performed in connection with the army corps.

d) Divisional Commissariat Office: Provided food and forage for the divisional troops with the means placed at its disposal by the Army Corps Commissariat and by the utilization of the local resources in the food zones assigned to the respective divisions.

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[1] See Chart 10, Chapter VI, Volume I.

EXECUTIVE ORGANIZATIONS.

The executive organizations consisted of various establishments or services whose denomination varied according to the nature of the work which they performed.

The Food and Forage Service assigned the following organizations to each of the large units:

1. Each army had:

a) A central subsistence depot, consisting of a central storehouse for food supplies, a central bakery and a central cattle park.

b) Advanced subsistence depots, consisting of an advanced storehouse for food supplies, an advanced bakery and an advanced cattle park.

c) A Commissariat section, which issued rations to the troops and various services of the army. These sections were suppressed during the war, on account of the permanent character assumed by the services, and replaced by special "ration distributing" storehouses.

2. Each army corps had:

a) A subsistence park.

b) A Commissariat section, for the distribution of food supplies to the army corps troops. These sections were also suppressed during the war and special storehouses created in their stead.

3. Each infantry and cavalry division had: A Commissariat section and a cattle park.

4. Each "Alpine" group disposed of:

a) A subsistence column.

b) A reserve subsistence park.

c) A bakery section, equipped with mule-drawn ovens.

The Clothing and Equipment Branch of the Commissariat service maintained only second line establishments.

Each army was assigned:

a) A central clothing and equipment depot.

b) An advanced clothing and equipment depot.

Each army corps could also dispose of a limited reserve supply of boots, which was carried by the subsistence parks.

Similar establishments were not assigned to divisions. The units and detachments were allowed limited supplies of each article of clothing and were provided with means for the repair of clothing and boots.

The Military Finance Department maintained a finance office with each Army Administration and Army Corps Commissariat. In addition, there was a military finance office at the General Commissariat; the latter was the main finance office of the Army.

FUNCTIONING OF THE SERVICE.

A. *Food and Forage.* (Chart 15, Chapter XI, Volume I.)

As a result of the special conditions arising from trench warfare, local resources in the zone of operations were soon exhausted and the operation of this branch of the service was dependent upon the bringing up of supplies from the rear (da tergo).

(*a*) Food and oats. The central depots contained stocks of food composing the food ration and stores of oats. These supplies were held for the use of the advanced depots and were forwarded daily by means of special supply trains, (one or more for each army according to needs) in accordance with the schedules prepared by the Transportation Administration (Direzione Trasporti). The stocks of foods and oats which were contained in the advanced depots were generally smaller than those stored in the central depots.

The advanced food depots established one or more sub-depots in proximity to the troops to provide the supplies for one or more army corps. The small depots which were located in towns were generally supplied by the central depots.

The supply from the advanced depots and their sub-depots (aliquots) functioned as follows:

The administration of the army corps Commissariat sent motor transport sections, composed of army corps motor transport units, to the advanced food depots or to their sub-depots. The motor transport sections received the rations and oats at these points and transported them to the Commissariat sections.

At the beginning of the war each army corps had its own subsistence park. The subsistence parks carried two ordinary food rations (bread and other components of the food ration), two rations of oats, and one reserve ration. They supplied the Commissariat sections daily and, in turn, were supplied by the advanced depots. A few months after the outbreak of the war, it was deemed advisable to supply the Commissariat sections direct from the advanced depots. The subsistence parks no longer carried ordinary rations and, finally, owing to the permanent character assumed by the services, the parks themselves were suppressed; however, it was considered necessary to maintain stocks of reserve rations with the troops.

Rations were distributed by the Commissariat sections to the Commissariat (supply) officers of the various detachments and troop units, and the latter fetched their supplies by means of the regimental transportation assigned to them.

(*b*) Meat. The meat supply of the Army included both fresh and frozen meat (home or foreign production) but, after the first year of the war, frozen meat was more generally used.

Livestock was purchased by special commissions and sent to the central cattle parks, from where it was shipped by rail to the advanced cattle parks. Some of the cattle, however, was sent to the packing establishments.

Cattle was sent by road or by rail from the advanced cattle parks to the Commissariat sections, where it was slaughtered. In certain cases units were provided with the necessary equipment and slaughtered the cattle themselves.

Frozen meat was sent direct by rail in refrigerator cars from the ports of debarkation, or from the packing houses in Italy, to the advanced subsistence depots. From these advanced depots it was sent in motor trucks or refrigerator cars to the Commissariat sections, which were provided with facilities for the preservation of the meat.

(*c*) Bread. Most of the bread was made in the advanced bakeries; in a great many cases, however, the central bakeries were obliged to furnish additional bread.

The advanced bakeries assigned to each army were composed of "bakery sections" which were equipped with "Weiss" (1893 or 1897 model) ovens or with stationary ovens. The equipment varied according to the number of army corps composing the army, and was based on the fact that one bakery section could supply one army corps at a maximum. The type of equipment generally used was the "Weiss" oven, on account of its advantage over other models and, particularly, because it could be readily transported. To provide better facilities, many of the "Weiss" bakery sections were equipped with motor transportation instead of their original animal transportation. Bakery sections equipped with "Weiss" ovens were composed of as many "squadrons" as there were divisions in the army corps; ten ovens were assigned to each "squadron" and the latter could produce sufficient bread for a division.

Bakery sections which were equipped with other types of equipment were assigned a varying number of ovens, according to the capacity of the latter. Sections which were not equipped with mobile ovens only carried the necessary bakers' implements to enable them to operate the permanent bake-ovens.

The central bakeries assigned to each army consisted of permanent brick bake-ovens. Numerous brick bake-ovens were constructed during the war, on account of the stability of position arising from trench warfare and in order to preserve the mobile field bakery equipment as much as possible. The mobile ovens were easily damaged and it was necessary to reserve these for possible use in case of a change from trench to open warfare.

At the beginning of the war only wheat flour was used in making bread; later, various mixtures were employed. These were principally composed of wheat flour to which certain percentages of

rice, bran, corn or other flour substitutes had been added, according to the material most available. Flour was supplied by the central subsistence depots, by the advanced subsistence depots, or, was sent direct to the field baking establishments. Bread was generally sent from the bakeries to the Commissariat sections by motor transport and the sections then distributed the bread to the troops.

(*d*) Wine. Wine was generally furnished by the Army Commissariat Administration and was obtained through direct purchase from the producers. The Army Commissariat Administration and the divisional Commissariat offices were also authorized to purchase wine direct from the producers located in their respective food zones and, in certain cases, even outside of their zones.

During the latter part of the war, the wine supply services at the Ministry of War (General Administration of the Supply (Logistic) and Administrative services) organized special commissions to purchase or requisition wines. Ordinary wine, which was fit for immediate consumption, was sent direct to the advanced subsistence depots. Other wines were sent to laboratories where they were treated and their alcoholic strength reduced to meet the prescribed requirements.

(*e*) Hay. Hay was purchased by commissions and forwarded to the central subsistence depots from whence it was sent, by means of daily forage supply trains, to the advanced subsistence depots. The Commissariat sections fetched the hay from the advanced depots by motor transport and then distributed it to the troops. Hay purchased in the provinces which were located in the Zone of the Armies was generally sent direct to the advanced subsistence depots.

(*f*) Straw. Each month the General Commissariat advised the Central Mixed Purchasing Commission as to where available supplies of straw were to be sent and the central depots, therefore, contained no reserves of straw.

(*g*) Wood. Wood for the construction of mess-shacks (rancio) was procured on the spot by the troops themselves or by the Commissariat sections. The latter, in case of necessity, organized forestry operations. Towards the end of the war, when the local resources began to diminish, a service was organized to supply wood from the interior (da tergo).

Food and forage rations.

The ordinary food ration prescribed by prewar Army Regulations underwent many changes during the war. These changes were generally dictated by the availability of certain foodstuffs. The rations for the troops were generally better and more varied than those prescribed for the civilian population.

There were three kinds of military rations:

a. The normal field ration, for the officers and troops of the commands, corps, offices and services who were entitled to what were known as "war allowances."

b. The winter field ration for the troops in the zone of operations. This ration was only used during the winter season and in accordance with the instructions of the General Commissariat.

c. The "modified" territorial or garrison ration, for troops designated by the General Commissariat.

The composition of the above named rations is shown in the following table. (The ration prescribed in Army Regulations is also indicated.)

Article	Regulation ration	Normal field ration	Winter field ration	Modified territorial or garrison ration
Bread	750 grams	700 grams	700 grams	700 grams.
Fresh beef	375 grams	250 grams	260 grams	200 grams.
or				
Frozen beef		240 grams	240 grams	190 grams. (Five times per week.)
Macaroni	150 grams	150 grams	200 grams	150 grams.
or				
Rice	150 grams	150 grams	150 grams	150 grams.
Cheese		50 grams	50 grams	
Potatoes	350 grams	150 grams	150 grams	150 grams.
or				
Dried vegetables	250 grams	80 grams	80 grams	80 grams.
or				
Fresh vegetables	(When available on the spot.)	200 grams	200 grams	200 grams.
Roasted coffee	15 grams	15 grams	15 grams	15 grams.
Sugar	20 grams	20 grams	20 grams	20 grams.
Wine	25 centiliter (When available on the spot.)	25 centiliter (Three times per week.)	25 centiliter (Three times per week.)	25 centiliter. (Once per week.)
Condiments (boxes)	1 ration	1 ration	1 ration	1 ration.
or				
Lard	15 grams	15 grams	20 grams	15 grams.
or				
Oil		15 grams	20 grams	15 grams.
Salt	20 grams	20 grams	25 grams	20 grams.
Pepper	0.5 grams	0.5 grams	0.5 grams	0.5 grams.
Salads	When lard was issued in lieu of condiments.	5 centigrams (With lard.)	5 centigrams (With lard.)	5 centigrams. (With lard.)
		2 centigrams (With condiments.)	2 centigrams (With condiments.)	2 centigrams. (With condiments.)
Maize flour (corn meal.)		200 grams (When considered advisable by the Commands and upon the days designated by them.)	200 grams (Same remarks as for previous column.)	
Salt		4 grams	4 grams	
Apples			200 grams	
or				
Oranges			One (One issue per week.)	
Fresh chestnuts			100 grams	
or				
Dried chestnuts			60 grams (One issue per week.)	
Dried figs			100 grams (One issue per week.)	

The quantities and components of the ration, as indicated above, were modified according to availability of same. Throughout the war it can be said that there was no standard ration, as the latter varied according to circumstances.

Troops operating in mountain districts received an additional allowance of bread and various special issues, such as condensed milk, dried fruits, lard or bacon. In addition to their ordinary rations troops in the trenches also received special allowances, such as: 15 centiliters of Marsala wine; 4 centiliters of rum or brandy, "Elixir of Quinine" or "Liqueur of Aniseed," several times per month.

To reduce the consumption of fresh and frozen meat, these articles were substituted by issues of salt cod, salmon, canned meats, etc.

The reserve ration was composed of 400 grams of hard bread (galetta) and 200 grams of canned meat (beef).

The regulation forage ration consisted of 5 kilogs of oats and 5 kilogs of hay. During the war special rations were adopted for horses, mules, donkeys and oxen:

1. There were four types of rations for horses and mules:

Type A.—4.5 kilogs of oats and 4.5 kilogs of hay.
Type B.—4.0 kilogs of oats and 4.0 kilogs of hay.
Type C.—3.5 kilogs of oats and 3.5 kilogs of hay.
Type D.—3.0 kilogs of oats and 3.0 kilogs of hay.

The ration was determined by the size of the animals and the work which they performed.

2. For small mules: 1.5 kilogs of oats and 2.5 kilogs of hay, with the addition whenever possible of chopped straw, corn husks and stalks.

3. For oxen: 8 kilogs of hay; 4 kilogs of straw and 4 kilogs of fine or coarse bran (or 3 kilogs of rice husks instead of bran). The pulp of beet roots was also used in lieu of bran.

The rations for light cattle were reduced, while those for draught animals were increased.

Food and forage for the Alpine troops: At the beginning of the war, the Alpine troops were formed into groups and each group had its own supply services, subsistence columns, and bakery sections. The supply services of the Alpine troops were provided with animal drawn transportation (horses and mules).

The reserve subsistence parks were supplied by the advanced subsistence depots. The reserve parks supplied the subsistence columns which, in turn, furnished the rations to the supply wagons (salmerie) of the units included in the group. The bakery sections also received their supplies of flour from the advanced subsistence depots.

This organization was modified during the war. The subsistence columns and the reserve subsistence parks were suppressed and replaced by a subsistence park for each Alpine group. The latter contained much smaller stocks of supplies than those which had been maintained in the supply organizations which they replaced. The Alpine troops were finally organized into divisions and special supply services were no longer assigned to them; however, they were assigned Commissariat sections similar to those of the infantry divisions.

B. *Clothing and Equipment.*[1] (Chart 14, Chapter XI, Volume I).

Normally these supplies were transported by rail. The reserve establishments, in accordance with the orders of the Ministry of War, sent various supplies direct to the central clothing and equipment depots, or, through the Commissariat organizations of the large units. The stocks of these establishments were not replenished automatically but had to be obtained by requisition (saltuario). The central clothing and equipment depots received the requests from the various army Commissariat administrations and transmitted them to the Ministry of War; the latter supplied the central depots with new stocks of supplies. When certain stocks in the central depots were insufficient to meet the requirements of the Commissariat administrations, the central depots telegraphed the list of articles required to the Ministry of War, and the latter forwarded the necessary supplies direct from the reserve establishments.

War conditions necessitated the organization of special depots for each class of supplies. These depots were under the direct control of the General Commissariat and, whenever urgently needed supplies could not be obtained from the central clothing and equipment depots or whenever shipments of supplies from the reserve establishments were delayed, they supplied the armies direct.

C. *Military Finance Offices* (Casse).

The Military Finance Office of the General Commissariat and the finance offices of the army and army corps Commissariat administrations, were charged with the administration of the funds of the commands, corps, administrations, and army establishments, making all disbursements and securing recoveries of funds. These offices constituted the " Service of the Exchequer " (finance service) of the mobilized Army. The service was operated by civil personnel from the Ministry of the Exchequer and consisted of cashiers and controllers, working under the supervision of bank inspectors and assistant inspectors.

[1] Under the heading of equipment are included: field kitchens and kitchen equipment, office furniture, safes, lanterns, clothing bags, tents, pumps, barrels, etc.

However, the finance services of the commands, corps, detachments and other army services, as well as the finance offices, functioned under officers acting as paymasters.

The Ministry of the Exchequer supplied the military finance offices with funds in accordance with the fortnightly requests of the General Commissariat. These requests covered the needs of the various army and army corps finance officers, as well as those of the General Commissariat. Requests were based on the lists of requirements which were submitted to the General Commissariat by the various army and army corps finance offices every fifteen days.

The units, detachments, and services, in turn, advised the finance offices to which they had been assigned as to their own requirements. The various units could draw funds from the finance offices as soon as they had been notified that the funds asked for had been placed at the disposal of the latter.

CHAPTER X.

SECTION V.

QUARTERMASTER CORPS, A. E. F.[1]

The chief duties of the Quartermaster Corps (Q. M. C.), in the A. E. F., were to feed, clothe and pay the Army, although it was charged with many others, including the supply of fuel and forage, salvage, grave registration and, at one time, dock operation and motor transportation. It had to perform these varied functions for an army of 2,000,000 men and at the same time prepare for an army twice that size.[2]

Maximum strength (on December 15, 1918):			
Officers			4,229
Men			96,451
Field clerks			42
Strength at Armistice:			
Officers			4,027
Men			96,006
Field clerks			38
Forage received, tons			824,410
Animals received, all sources			243,560
Remount depots			35
Mechanical bakeries			4
Field bakeries			61
Coffee roasting plants			3
Ice making plants			7
Cold storage plants			21
Main gasoline storage depots			6
Gasoline storage and distributing stations			28
Motor gasoline consumed	gallons		87,663,056
Aviation gasoline consumed	do		5,627,572
Coal receipts to May 1, 1919	tons		1,953,777
Salvage depots			4
Salvage shops			17
Degreasing and rendering plants			4
Clothing received:			
From United States	tons	107,429	
From Europe	do	12,032	
			119,461

[1] Prepared by Col. J. W. Wright, Historical Branch, War Plans Division, with the assistance of Major J. W. Melvin and approved by General H. L. Rogers, Quartermaster General, A. E. F.

[2] Chart 7, Chapter XI, Vol. I.

Food:		
From United States	tons	1,313,525
From Europe	do	248,150
Total (in the following commodities)		1,561,675

Meat	tons	421,322	Fruits	tons	88,300
Sugar	do	74,455	Vinegar	do	15,961
Tobacco	do	24,986	Rice	do	29,974
Butter	do	21,907	Coffee	do	40,972
Flour	do	412,050	Cinnamon	do	424
Beans	do	58,767	Salt	do	21,249
Milk	do	39,756	Potatoes	do	309,478
Pepper	do	871	Tea	do	203

Reserve of above on hand Nov. 11th, 1918: 93.75 days.[3]

Food consumption (pounds per man per day):[4]	
Potatoes	1.1770
Meat	1.0729
Flour	.8527
Sugar	.2409
Fruit	.2302
Beans	.1793
Milk	.0976
Coffee	.0794
Rice and hominy	.0734
Butter	.0686

Food consumption (pounds per man per day)—Continued.	
Tobacco	0.0576
Salt	.0477
Vinegar	.0332
Candy	.0228
Baking powder	.0051
Pepper	.0019
Flavoring	.0013
Cinnamon	.0009
Total	4.2387

ORGANIZATION.

Under G. O. No. 8, July 5, 1917, the Quartermaster Corps in the A. E. F. was charged with "the transportation of personnel and supplies; the supply of Quartermaster transportation; repairs to all vehicles of all services except artillery vehicles; clothing, Quartermaster equipment; subsistence; fuel; forage; lights; water; camp sites; quarters and offices and equipment therefor; pay of personnel and general disbursements; laundries and baths; remounts; claims; salvage; Quartermaster workshops and storehouses; burials; cemeteries; labor; Quartermaster personnel; and coal storage and refrigerating plants.

The same order that established the Transportation Department of the A. E. F., determined the duties of the Quartermaster Corps.[5] This order charged each with the transportation of supplies and personnel but the function of the Quartermaster Corps was confined to the issue of transportation requests for the A. E. F., by practice

[3] "Some achievements of the S. O. S." See Table "Subsistence in Depots Nov. 11, 1918."

[4] "Some achievements of the S. O. S." See Table, "Food—Total Issues and Rate of Consumption."

[5] G. O. No. 8, G. H. O., July 5, 1917.

and not by order. Later this function also passed to the Transportation Corps. By G. O. No. 20, G. H. Q., August 13, 1917, the Service of Military Railways was established and it was charged with the transportation of personnel and supplies in the place of the Quartermaster Corps, but the latter continued operating the transports through its Army Transport Service. On September 14, 1917, the Service of Military Railways became the Transportation Service and on December 18, 1917, by G. O. No. 78, G. H. Q., the Army Transport Service was transferred to the Transportation Service with its equipment and personnel. On February 16, 1918, there was a re-organization, under G. O. No. 31, G. H. Q., whereby the Q. M.C. became one of the services of the Service of the Rear, later the Services of Supply. In this order the Corps was charged with pay of personnel and general disbursements; Quartermaster matériel, including clothing, subsistence, fuel and forage; transportation of water beyond the water point; remount service; laundries and baths; disinfection of clothing; salvage service; Quartermaster (Q. M.) shops, depots and storehouses; cold storage and refrigeration; grave registration and inspection of Q. M. activities. To these later were added sales stores and rolling sales stores, effects depots and garden service. In addition it had those functions which fell under Par. 1,000 A. R., which provides that the Q. M. C., "attends to all matters connected with military operations which are not expressly assigned to some other bureau of the War Department."

The initial work of the Chief Quartermaster (C. Q. M.), A. E. F., was to take care of the troops already in France and those coming with the first convoy, which arrived at St. Nazaire, June 26, 1917, before the Chief Quartermaster had had time to organize his office on anything like a permanent basis. St. Nazaire had been selected beforehand as one of the French ports for American use and, by the time the first convoy reached there, officers and men were on hand to take care of it. Unloading the first convoy was done by French labor. It was at this port that the Army Transport Service began operations. It branched out to the other ports, as they became available, and its work was not interrupted by the transfer to the Transportation Department. The Chief Quartermaster moved from Paris to Chaumont with the Commanding General, A. E. F., and then removed to Tours on March 11, 1918. The Office of the Chief Quartermaster, Lines of Communication, was absorbed by the office of Chief Quartermaster, A. E. F., when the latter moved to Tours. In the final plan of organization the Chief Quartermaster, A. E. F., was assisted by a Deputy C. Q. M. and assistants to the Chief Quartermaster and the following divisions:[6]

[6] See Q. M. Sec. Part II, App. "A" Rpt. Bd. Convd. by Par. 79, S. O. No. 141, 1919.

Administrative Division, which handled all records, mail, telegrams and cablegrams, messenger service, precedent and research and administrative action on contracts.

Supplies Division, the work of which was distributed among fifteen branches, viz: clothing, subsistence, bakeries, animal drawn transportation, traffic, traveling officers, supplies and stationery, fuel, forage, cold storage and refrigeration, administration, storage and warehousing, garden service, gasoline and oil, and miscellaneous.

Personnel Division, handled all Quartermaster personnel in the A. E. F., preparation of priority schedules of Quartermaster troops in the U. S. for shipment overseas, organization of new units in the A. E. F., and distribution of all Quartermaster personnel including labor organizations.

Finance Division, handled supply of disbursing officers and funds for their disbursements, instruction of finance officers and adjustment of certain classes of claims.

Inspection Division, through traveling officers, inspected and reported on the several activities of the Quartermaster Corps.

Accounting Division, examined and analyzed the accounts, both property and funds, and audited subsistence returns of all Quartermasters in the A. E. F.

Salvage Service, operated salvage depots and shops, rendering plants for the recovery of fats, kitchen economic activities, laundries and disinfectors, and policed the battlefields.

Remount Division acquired by purchase in Europe and shipment from U. S. all animals of the A. E. F. and cared for them.

Construction and Repair Division designed equipment, chevrons and other insignia, made maps and organization charts and did Quartermaster illustrating. This division was incorrectly named because it had no construction or repair function.

Graves Registration Service acquired, maintained and controlled cemeteries, identified the dead, registered burials and corresponded with relatives of deceased soldiers.

The Quartermaster personnel accompanying the C. G., A. E. F., consisted of 16 officers, 10 enlisted men and 12 field clerks.

PERSONNEL.

By November 11, 1918, there were 4,027 officers, 96,006 enlisted men and 38 field clerks. The maximum was 4,229 officers, 96,451 enlisted men and 42 field clerks. Besides these, the Quartermaster Corps had transferred 600 officers and 18,000 enlisted men to the Motor Transport Corps and 300 officers and 13,000 enlisted men to the Transportation Corps. The commissioned personnel was drawn

from the line of the regular Army, from former Quartermaster noncommissioned personnel of the Army, and from men with wide experience in commercial life. The enlisted men came from the usual sources, the selective draft and voluntary enlistments. Quartermaster personnel was slow in arriving and there was always a shortage. Although troops began to arrive in the latter part of May 1917, there were less than 2,500 Quartermaster officers and men in France by October 6th, of the same year. Labor organizations did not appear in any appreciable amount until the middle of December 1917, despite repeated representations of the Commanding General, A. E. F., and for many months Q. M. C. troops worked especially long hours, seven days in the week. The storage depots were unable to keep up because not enough labor was on hand to take care of the calls made upon them. During January and February, 1918, the Corps began to catch up with its quota but, in March and April, the demand for combat troops became pressing and priority schedules were changed so radically that Q. M. arrivals fell off seriously and the shortage began to grow again. By the middle of April, General Headquarters had to take up this question and numerous cablegrams were sent urging an increase in the shipment of Q. M. C. troops. In May, June and July, these shipments increased and the shortage became less serious, although it never did disappear.

MATÉRIEL.

As pointed out many times, the aim of the A. E. F. was to have always 90 days' reserve of supplies based upon the entire number of American troops in Europe. This decision was arrived at after a series of conferences with the chiefs of several services and the War Department was notified by cable September 7, 1917. It was told that this reserve was to be based on authorized issues where such issues were regular, and on actual periodic consumption of other articles based on British and French experience. It was the aim of the Quartermaster Corps to keep the reserve at that figure but it was able to do so only in the matter of subsistence. Other articles fell short just as in other services. The flow of tonnage was always worked out as nearly as possible so as not to interfere with the flow of troops. At no time was there as much ship tonnage available as was needed. This forced the purchase of many Q. M. supplies in Europe as it did in the other services.

The principal base storage depots were at Montoir (Loire-Inférieure), St. Sulpice (Gironde) and Miramas (Bouches-du-Rhône). The intermediate depots were at Gièvres (Loir-et-Cher) and Montierchaume (Indre), with an auxiliary depot at Paris. The advance depots were Is-sur-Tille (Côte d'Or) and Liffol-le-Grand

(Vosges). Gièvres had the largest depot in the A. E. F. and one of the largest storage places in the world.

Each American soldier in France consumed on an average 4.2887 pounds of food a day. The Quartermaster Corps managed to keep ahead of him all the time in subsistence, but was often behind in clothing. The daily production of bread increased from the first baking of 11,378 pounds on August 3, 1917, to 1,830,000 pounds on November 30, 1918. At the time of the Armistice bakeries were being operated in practically every section of France. The largest bakery was at Is-sur-Tille, which was put into operation on December 1, 1918. This bakery had a capacity of 550,000 pounds a day, which could be increased to 750,000 in case of emergency. When hostilities ended plans were under way for two additional mechanical bakeries there.

The Garden Service was started in the spring of 1918, and during the period of its operation it produced 75,000,000 pounds of vegetables at a cost, not including the pay and subsistence of enlisted men, about one-third the prices prevailing in the open markets.

Four cold storage plants were added after the Armistice. On November 11, there were 17 in operation with a capacity of 10,374 tons and 15 more were projected with an additional capacity of 15,065 tons. The largest plant was at Gièvres. It had a capacity of 5,200 tons.[1]

Forage was always a serious problem in France because of the scarcity of ship tonnage. In all, the receipts were 824,410 tons the bulk of which came from the United States. At one time the French refused to permit the A. E. F. to buy in the open market, but offered to turn over certain monthly credits of hay from their reserve on condition that it was replaced, pound for pound, from America. At the signing of the Armistice, the French had delivered only about 30 per cent of their contract but, in spite of this the A. E. F. had built up a 21-day reserve.

FACILITIES.

A. E. F. coal came from England and gasoline, oils and other greases from the United States. Wood was procured from French forests and cut by American forestry troops. The facilities of the Quartermaster Corps were found in nearly every section of France. They were located always with a view to the needs of the troops they were to serve or the sources of supply they were to draw from.

The storehouse locations were governed by the lines of communication and those of other activities depended upon climatic, geo-

[1] See Q. M. Sec. Part II, App. "A" as above noted.

graphical or agricultural conditions. The locations of these facilities were as follows (Chart 8, Chapter XI, Vol. I):

Coffee roasting plants:
- Le Havre (Seine-Inférieure).
- Bordeaux (Gironde).
- Corbeil (Seine-et-Oise).

Mechanical bakeries:
- Bordeaux (Gironde).
- St. Nazaire (Loire-Inférieure).
- Is-sur-Tille (Côte-d'Or).

Field bakeries:
- Brest (Finistère).
- St. Nazaire (Loire-Inférieure).
- Savenay (Loire-Inférieure).
- Nantes (Loire-Inférieure).
- Montierchaume (Indre).
- Issoudun (Indre).
- Gièvres (Loir-et-Cher).
- St. Aignan (Cher).
- Orléans (Loiret).
- St. Maixent (Dordogne).
- Montmorillon (Vienne).
- Angoulême (Charente).
- Pons (Charente-Inférieure).
- Genicart (Gironde).
- Beautiran (Gironde).
- Le Corneau (Gironde).
- Marseille (Bouches-du-Rhône).
- Clermont-Ferrand (Puy-de-Dôme).
- St. Amand (Cher).
- Verneuil (Nièvre).
- Bourges (Cher).
- St. Florent (Cher).
- Beaune (Côte-d'Or).
- Dijon (Côte-d'Or).
- Châtillon (Côte d'Or).
- Paris (Seine).
- Mailly (Saône-et-Loire).
- Vittel (Vosges).
- Neufchâteau (Vosges).
- Gondrecourt (Meuse).
- Meucon (Morbihan).
- Coetquidan (Morbihan).
- Angers (Maine-et-Loire).
- Saumur (Maine-et-Loire).
- Le Mans (Sarthe).
- Château-du-Loir (Sarthe).
- Tours (Indre-et-Loire).
- Blois (Loir-et-Cher).
- Cour Cheverny (Loir-et-Cher).
- La Pallice (Charente-Inférieure).
- Limoges (Haute-Vienne).
- La Courtine (Creuse).

Field bakeries—Continued.
- Neuvic (Dordogne).
- Souge (Gironde).
- St. Sulpice (Gironde).
- Pontenx (Landes).
- Valbonne (Isère).
- Vichy (Allier).
- Mars (Nièvre).
- Nevers (Nièvre).
- Mesves (Nièvre).
- Mehun (Cher).
- Allerey (Côte-d'Or).
- Is-sur-Tille (Côte-d'Or).
- Langres (Haute-Marne).
- Chaumont (Haute-Marne).
- Montigny-le-Roi (Haute-Marne).
- Rimaucourt (Vosges).
- Liffol-le-Grand (Vosges).
- Toul (Meurthe-et-Moselle).

Cold storage plants:
- Brest (Finistère).
- Grand Blottereau (Loire-Inférieure).
- La Pallice (Charente-Inférieure).
- Arcachon (Gironde).
- Tours (Indre-et-Loire).
- Orléans (Loiret).
- Vichy (Allier).
- Rimaucourt (Vosges).
- Bazoilles-sur-Meuse (Vosges).
- Toul (Meurthe-et-Moselle).
- Bendorf (Germany).
- Savenay (Loire-Inférieure).
- Angers (Maine-et-Loire)
- Bassens (Gironde)
- Le Havre (Seine-Inférieure).
- Blois (Loir-et-Cher).
- Gièvres (Loir-et-Cher).
- Beaune (Côte-d'Or)
- Vittel (Vosges).
- Hook of Holland (Holland).

Ice-making plants:
- Savenay (Loire-Inférieure).
- Allerey (Saône-et-Loire).
- Bazoilles-sur-Meuse (Vosges).
- Gièvres (Loir-et-Cher).
- Rimaucourt (Vosges)
- Grand Blottereau (Loire-Inférieure).
- Beaune (Côte-d'Or).

Main gasoline storage depots:
- La Pallice (Charente-Inférieure).
- Furt (Gironde).
- Gièvres (Loir-et-Cher).
- Blaye (Gironde).
- St. Loubes (Gironde).

Gasoline and oil distributing stations:
- St. Nazaire (Loire-Inférieure).
- Angers (Maine-et-Loire).
- Tours (Indre-et-Loire)
- Limoges (Haute-Vienne)
- St. Aignan (Loir-et-Cher).
- Romorantin (Loir-et-Cher).
- Orly Field (Seine).
- Sens (Yonne).
- Châtenay (Loire-Inférieure).
- Le Mans (Sarthe).
- Bordeaux (Gironde).
- Châteauroux (Indre).

Gasoline and oil, etc.—Continued.
- Issoudun (Indre).
- St. Amand (Cher).
- Silly-le-Poterie (Aisne).
- Coincy (Aisne).
- Nevers (Nièvre).
- Clermont-Ferrand (Puy-de-Dôme).
- Toul (Meurthe-et-Moselle).
- Neufchâteau (Vosges).
- Langres (Haute-Marne).
- Is-sur-Tille (Côte-d'Or).
- Miramas (Bouches-du-Rhône).
- Verneuil (Nièvre).
- Clermont-en-Argonne (Meuse).
- Gondrecourt (Meuse).
- Rimaucourt (Vosges).
- Chavelot (Vosges).
- Marseille (Bouches-du-Rhône).

NOTE.—See also Charts 2 to 7, Chapter VI, Volume I.

CHAPTER XI.

SECTION I.

ENGINEER ORGANIZATION IN THE BRITISH ARMIES IN FRANCE AND FLANDERS.[1]

At General Headquarters there was a Major General of Royal Engineers called the "Engineer in Chief." He was the technical adviser to the Commander in Chief for military engineering matters (with certain exceptions mentioned hereafter). As such, he issued technical instructions to the Chief Engineers of formations and to the Director of Works, Lines of Communication; he could not issue orders involving the use and movements of units, but made recommendations as to the best distribution of the Engineer units with which he was concerned. (Chart 1, Chapter XII, Vol. I.)

Such units were divisional engineers, army troops companies, tunnelling companies, electrical and mechanical companies, well-boring sections, army workshop companies, advanced engineer parks, pontoon parks, camouflage parks, searchlight sections, artisan works companies, base park companies.

Certain schools of instruction were controlled by him, e. g., Engineer and pioneer and heavy bridging schools.

The work of these units included defences, mining, demolitions tunnelled dug-outs, concrete dug-outs and pill-boxes, bridges of all kinds (except railway bridges), hutting and buildings, water supply, electrical power, workshops, depots, hospitals, roads in the shelled zone, hand operated tramline, handling and manufacture of Engineer stores.

The Engineer in Chief was not concerned with transportation engineering or transportation units, which were dealt with by a Director General of Transportation. Certain other engineer units were also not under his control, such were signal units, gas units, and survey units, which worked under the General Staff, and forestry units under a Director of Forestry.

[1] Prepared for the M. B. A. S. by the Director of Engineer Stores, British Forces in France and Flanders.

The Engineer in Chief caused to be prepared monthly and periodically forecasts of engineering stores and plant, the supply of which was arranged by the Director of Works (Stores Branch), and latterly by the Director of Engineer Stores, by importation from overseas or by local purchase and manufacture.

He advised on the allocation of stores and plant between the Chief Engineers of armies and Director of Works, Lines of Communication, who were empowered to deal direct with the base stores organizations in regard to details of despatch, destination, etc. of their allotments.

The following table of engineer material and stores issued from Rouen during 1914–1918 to armies is of interest. (Table I.)

The following table of engineer material and stores issued during June, July, August 1918, indicates the amounts required. (Table II.)

Four months before the Armistice, the Director of Works, Lines of Communication, and the newly created Director of Engineer Stores were transferred from the Engineer in Chief's to the Quartermaster General's department.

TABLE I.—*Record of Issues, R. E. Stores, Rouen*

Description	1914[1]	1915	1916	1917	1918	Total
Cement.....tons..	.....	589	2,345	2,002	2,812	7,748
Iron, corrugated (all sizes).....sheets..	.....	30,227	30,155	115,415	167,854	343,651
Roofing felt.....rolls..	.....	3,328	1,264	11,421	10,338	26,351
Decauville track.....f. r..	.....	Nil.	16,451	18,351	23,716	58,518
Firebricks.....No..	.....	Nil.	22,447	63,622	85,618	171,687
Fireclay.....lbs..	.....	8,425	59,140	91,015	77,140	235,720
Glass.....f. s..	.....	6,041	29,682	53,421	97,477	167,321
Ridging.....f. r..	.....	Nil.	2,639	14,318	30,048	47,205
Windows.....No..	.....	5	1,520	4,867	3,205	9,607
Stoves (all sizes).....No..	.....	2,298	2,215	2,410	2,976	9,899
Ranges (all sizes).....No..	.....	468	165	270	209	1,112
Asbestos sheets.....No..	.....	679	1,235	2,503	1,847	6,264
Baths.....No..	.....	125	20	57	113	255
Bolts and nuts (all sizes).....No..	.....	8,613	52,073	278,686	253,043	592,415
Cisterns (all sizes).....No..	.....	335	384	469	282	1,470
Piping W. I. (all sizes).....f. r..	.....	43,980	71,904	98,363	125,275	339,524
Bricks, common.....No..	.....	213,173	490,596	424,216	262,715	1,390,701
Pipes, drain (all sizes).....No..	.....	7,145	11,613	19,610	13,666	52,034
Lamps, E. L. (all c. ps.).....No..	.....	7,959	25,000	42,911	67,816	143,686
Cleats.....	.....	21,310	77,432	104,927	130,958	354,625
Switches.....No..	.....	1,701	5,096	9,044	7,592	23,533

[1] No record.

Timber: During the period July, 1917, to December, 1917, 450 standards sawn timber. During the period March, 1918, to August, 1918, 661 standards sawn timber, 1,194 tons poles. During the period September, 1918, to March, 1919, 862 standards sawn timber, 1,156 tons poles. Quantities as shown were used.

TABLE II.—*Engineering Stores, Issues to Armies During June, July, August, 1918*

Description		North. (II, II, V Armies)	South. (III, IV Armies)	Total
Trench boards	No.	266, 501	155, 846	422, 347
Trench frames, small	No.	87, 051	6, 745	93, 796
Revetting hurdles	No.	90, 111	25, 152	115, 263
Sausage hutting	f. r.	16, 380	16, 944	33, 324
Box latrines:				
1-seat	No.	1, 760	2, 451	4, 211
2-seat	No.	1, 782	2, 113	3, 895
5-seat	No.	1, 394	2, 583	3, 977
Squatter latrines	No.	----------	186	186
Water troughs	No.	514	379	893
Notice boards:				
Tin	No.	19, 658	20, 295	39, 953
Wood, 18x12 inches	No.	8, 730	4, 652	13, 382
Wood, 24x18 inches	No.	6, 314	4, 987	11, 301
Wood, 24x9 inches	No.	7, 128	3, 492	10, 620
Tables, 6-foot	No.	1, 379	554	1, 933
Forms, 6-foot	No.	2, 743	789	3, 532
Artillery bridges	No.	686	754	1, 440
Infantry bridges	No.	1, 699	491	2, 190
Anti-gas frames:				
Type A	No.	498	4, 082	4, 580
Type B	No.	334	876	1, 210
Type C	No.	414	1, 136	1, 550
Frames for 2,300 gallon tanks	No.	84	174	258
Machine gun tables	No.	127	621	748
Ablution benches	No.	825	2, 052	2, 877
Nissen ovens	No.	165	79	244
Water bottle fillers	No.	138	100	238
Mining frames	No.	69, 145	119, 764	188, 909
Trucks, Van Ness	No.	202	----------	202
Trucks, Calais, push	No.	589	----------	589

1. At the commencement of the campaign there was no organized system of supply of engineering stores. There was at first little demand for articles of Engineer (R. E.) supply by the armies, and entrenching tools, barbed wire, sandbags, and explosives were held in small quantities on rail by the Ordnance Department at ammunition railheads.

2. As regards engineering stores not of Ordnance supply required on the lines of communication, they were obtained principally by local purchase, when not supplied by the contractors by whom at that time most of the work was carried out, and were supplemented by demands sent by responsible Works Officers to the Director of Fortifications and Works (D. F. W.) at the War Office.[2]

In October 1914, a special purchase office was opened in Paris and continued to operate throughout the war, although towards the end the stores available for purchase lessened very much.

3. On the 26th December 1914 an advanced R. E. park was opened at Strazeele for the Second Army which was administered by the Director of Works, the staff consisting of 1 lieutenant and quartermaster in charge, 1 warrant officer (W. O.), 1 ledger-keeper and 1 storeman, checkers being furnished from a detachment of the 29th Advanced Park Company (A. P. Coy.), R. E., at St. Omer.

[2] Chart 2, Chapter XII, Vol. I.

In March 1915 a second Royal Engineers (R. E.) park was formed at Berguette for the First Army, and the administration of both the advanced R. E. Parks was transferred from the L. of C. to armies on 20th March 1915.

The Director of Works (D. of W.) collected information as to stores required, indented on the War Office, and arranged for their shipment to Boulogne, where an officer and small staff were placed to receive and transit forward the stores.

The 32nd A. P. Coy, R. E., was sent out to France in April 1915, and was stationed by the Director of Works at Havre, with instructions to construct and organize a base workshop.

Bridges for the Army were sent out from England and stored at Havre in charge of this company and tested by them.

As the war went on a great deal of new bridge work was constructed in the Havre workshop.

4. By July 1915, it became obvious that further development was necessary in the system of the provision of engineering stores.

The Director of Works therefore formed base depots and shops at Havre and Calais and appointed certain officers whose specific duty it was to deal with the questions arising concerning the supply, transportation, and custody of stores, under the title of "Works Stores Officers," subsequently styled "R. E. Stores Officers."

The "Stores" staff at Boulogne continued to deal with the receipt and forwarding of R. E. stores arriving at that port.

In general, the Engineer in Chief's office, under Colonel Liddell, forecasted the requirements of armies monthly and sent this forecast to the Director of Works. The latter, after adding the stores estimated as required by works on L. of C., arranged for the provision of the stores, either by purchase in Paris or local purchase by R. E. Stores Officers, by manufacture at base workshops, or by indent on the War Office through "F. W. 5."

Apart from timber, the bulk of stores were obtained through the I. I. S. (subsequently styled C. M. E.), and shipped by him in shipping under his control to the various French ports.

5. At the end of 1915, it became apparent that large quantities of R. E. stores of all kinds (including timber) must be kept in stock in order that stores required for a serious operation could be "rushed" to armies concerned within the period of time between the date at which preliminary preparation became permissible and the date on which concentration of ammunition and troops began, after which R. E. stores could not be handled by railways, etc. Also stores for winter hutting had to be accumulated on an average monthly tonnage to steady manufacture and shipping, although such stores were not required until autumn.

Formation of Base Depots.

6. For this reason, early in 1916, two base depots were opened: One at Les Attaques, 3 miles south east of Calais; one at Abancourt, on the Rouen-Amiens railway.

The depot at Les Attaques was situated between the Calais-St. Omer canal and the railway and branches from the railway were brought into the depot.

Wharves were constructed along the canal for the barges and they discharged by Decauville light railway track direct to the appropriate stacks.

The requirements of the canal traffic, however, restricted very greatly the length of wharf permissible. To obtain this it would have been of great advantage to widen the canal on the depot side, so that barges could lie alongside the wharves without restricting the canal traffic.

This depot consisted originally of 50 acres but was enlarged subsequently by 15 acres, as the accumulation of R. E. stores increased, and eventually spread to the other side of this railway, where a large timber depot was formed, 150 acres in extent.

At Abancourt there was no canal, but it was situated close to an important railway junction, suitable for concentrating trainloads from Le Havre, Rouen and Dieppe.

It consisted in April, 1917, of 32½ acres, and was expanded in May, 1918, to 163 acres.

Le Havre and Rouen became subsidiary stores depots. That at Le Havre was necessary owing to the railways being unable to remove sufficiently quickly stores which arrived at that port, and which had to be sent there owing to the congestion of other ports.

Rouen had been established by the D. of W. as his principal port for the reception and storage of timber from overseas. In November 1915 a wharf for R. E. stores was constructed by contract, and a local depot established for general R. E. stores with a brouettage service.

In general these depots were fed: Les Attaques, from the ports of Calais and Dunkirk and to a small extent from Boulogne. Abancourt, from Havre and Rouen, and occasionally from Dieppe and Fécamp.

In turn, they normally supplied: Les Attaques to three northern armies and Lines of Communication (North). Abancourt to two southern armies and Lines of Communication (South).

Base Workshops.

7. The base workshops developed concurrently with the development of the base depots.

It has already been stated (par. 3) that a base workshop was created at Havre in 1915.

8. In July 1918, the Stores Branch of the Director of Works was made into a separate Directorate of Engineering Stores, Lieutenant-Colonel J. W. S. Sewell, C. M. G., Chief R. E. Stores Officer (North) being appointed Director of Engineering Stores, with the rank of Brigadier General, reporting direct to the Q. M. G.

The whole of the personnel of the Stores Branch of the Works Directorate was transferred to this new Directorate of Engineering Stores, consisting of: 108 officers, 3 base park companies R. E. (1st, 24th, and 32nd), 8 stores sections, 4 area employment artisan corps.

CHAPTER XI.

SECTION II.

THE SUPPLY OF ENGINEER MATERIAL (FRENCH).[1]

The provisions which had been made in peace time to assure the supply of Engineer material for the armies, were totally inadequate to meet the requirements of stabilized warfare. (Chart 8, Chapter XII, Volume I.)

At the beginning of the war each army and each army corps was assigned an "Engineer Park" (Parc du Génie), comprising relatively minimum and current supplies, carried on wagons, and consisting for the most part of portable tools of the special model for Engineer troops, small quantities of defense accessories (barbed wire, iron wire, iron stakes, etc.) and very small supplies of explosives for the demolition work usually required in open warfare.

Stores of Engineer materials were maintained at the regulating stations to supply the army and army corps Engineer parks. These stocks were known as "First reserves of supplies" (Premiéres réserves de ravitaillements) and naturally comprised the same kinds of materials as were carried by the army and army corps Engineer parks.

In the interior, supplies of Engineer materials were stored in establishments which were similar to the "Intermediate depots" (Stations-Magasins) and these stores were known as "Second reserves" (Deuxièmes réserves).

A main supply establishment, the "Central Establishment for Engineer Material" (Etablissement Central du matériel du Génie), under the Minister of War, supplied the armies' requirements in special technical engineering materials (lighting, pumping and bridging materials, etc.), upon special request.

The above mentioned supplies, both as to quantity and kind, were found to be insufficient from the start, even during the period of open warfare which occurred at the beginning of the war. With the stabilization of the fronts, the requirements of the armies attained such unforeseen proportions that a complete revision of the system of supplying Engineer material had to be undertaken and

[1] Prepared for the Military Board of Allied Supply by the D. G. C. R. A. (Headquarters of Marshal Foch), by the French Section of the Board.

this resulted in the echelonment described below. This reorganization was effected during 1916.

1. *Establishments and Resources of the Armies (Front).*

The army and army corps Engineer parks were supplied with such engineering materials as were in general use for the current construction of defense works and ordinary installations, including tools and lumber. It was impossible, naturally, to maintain all of these supplies on wheels. Each of the above mentioned parks therefore comprised a main stockage of engineering material and several advanced depots (annexes), of varying importance; the latter were located near the front, in the most suitable positions and those best concealed from the enemy.

2. *At the Regulating Stations.*

The "First reserves of supplies" at the regulating stations were maintained and developed. In connection therewith, in addition to the sheds containing Engineer tools and materials which had to be sheltered from the elements, a number of railway sidings were specially designated and along these tracks were established stockages of such engineering materials as could withstand open air storage (lumber, wire, stakes, etc.).

3. *Outside of the Regulating Stations.*

Outside of the regulating stations, but still within the Zone of the Armies, were established what were known as "Annex reserves of Engineer material" (Réserves annexes de matériel du Génie). Five Engineer "Annex reserves" (R. A.) were created in 1916, namely: Barbery, La Baraque, Le Plessis-Belleville, Nangis and Valentigny.

These establishments, in addition to "current supplies,"[2] received cumbersome, bulky, engineering materials which were not in general use among the troops at the front, but which were used in the large construction projects in the rear, such as: Covering and revetting material, lumber for defensive works and for construction purposes, etc.

4. *In the interior.*

Five large general reserve depots (Entrepôts de Réserve générale—E. R. G.) were established in the interior, as follows:

Cercy-la-Tour, created in March 1916.

Auneau, created in March 1916.

[2] The following materials were designated "materials in current use" (matériaux d'usage courant): Iron beams; ordinary barbed wire; "Iroquoise" barbed wire; binding wire; 2 mm. iron wire; 2.4 mm. iron wire; 3.9 mm. iron wire; 4.9 mm. iron wire; "Brun" entanglements; ordinary metallic wirework; sections of reinforced corrugated iron plates; chevaux-de-frise; pickets for entanglements; tools for road-menders (terrassiers); tools for navvies (cantonniers); shelters for watchmen (guetteurs).

Ponthierry-Pringy, created in March 1916.
Le Havre, created in December 1916.
Mignières-Gondreville, created at the beginning of 1917.

The Engineer "Annex reserves" were entirely at the disposal of the Commander in Chief.

The general reserve depots were under the control of the Minister of War (4th Direction), but their contents were exclusively at the disposal of the Commander in Chief and the latter gave direct orders for their removal and shipment. The restocking of these depots was assured by the Minister and, theoretically, the Commander in Chief did not concern himself with this matter.

The general reserve depots contained only certain classes of materials and these were determined by agreement between representatives of the Minister and of the Commander in Chief. (These materials were practically similar to those named in the list of "current materials.")[3]

Finally, mention must be made of the following special supply installations which were at the disposal of the Commander in Chief:

A large sawmill at Nettancourt (Meuse) for cutting wood of special dimensions.

Five forestry exploitations.

An Engineer Direction (Chefferie du Génie), at Villers-Cotterêts for the manufacture of cantonment equipment (tables, benches, bunks, etc.)

System of Supply.[4]

The allowances were determined by the Direction of the Rear (Direction de l'Arrière—D. A.) in accordance with the requests made by the armies and by the "Directions of the lines of communication" (Directions d'Etapes—D. E.) and taking into consideration the amount of supplies available, as well as the plans of the High Command (contemplated operations, possible emergencies, etc.)

The Direction of the Rear was informed as to available resources:

a) By the general reserve depots (E. R. G.) and by the Engineer "Annex reserves" (R. A.), by means of statements issued every five days (états bidécadaires);

b) by the Minister of War, through weekly statements concerning the supplies of covering and revetting materials, etc.;

c) by the Minister of the Armament, through the "General Wood Inspectorate" (Inspection générale des Bois—I. G. B.), by means of bi-monthly statements concerning available lumber for defense works and construction purposes;

d) by the various forestry exploitations and by the "Wood Center" (Centre de Bois) at Dunkerque, by means of bi-monthly statements.

[3] Chart 9, Chapter XII, Volume I.
[4] Chart 10, Chapter XII, Volume I.

The transportation of engineering materials was assured by:

(*a*) the Regulating Commissions (Commissions régulatrices—C. R.), for such materials as came from the general reserve depots or from the Engineer "Annex reserves";

(*b*) the "Central Establishment for Engineer Material" (Etablissement Central du matériel du Génie), under the control of the Minister, for other engineering material;

(*c*) the forestry exploitations, for such supplies as concerned them.

However, this system of supply underwent important modifications during 1918. On account of the slowness and irregularity of transports by rail, it became necessary to send Engineer materials which came from the interior to "Collecting Centers" (Centres de Groupement), before forwarding them to the front. There were three of these "Collecting centers", located at: Le Mans, Châtres and Troyes.

The railway cars (rames) containing supplies were rehandled and made up in these centers so that only complete carloads of engineering materials were sent to the armies.

NOTE.—In the French Army, Engineer supplies came under two headings: wood and iron. Wood was furnished by the Director of Forestry. Iron material obtained from abroad was unloaded at the ports and shipped direct to the various general reserve depots (E. R. G.) in the interior. Iron material manufactured in France, was also sent direct to the general reserve depots.

From these establishments, the material was shipped to the depots of the Engineer "First reserves of supplies", the contents of which were at the entire disposal of the Commander in Chief. Such shipments never had priority; on the contrary, during active operations shipments of Engineer supplies were always subordinate to others.

CHAPTER XI.

SECTION III.

THE COMMANDANT OF ENGINEERS OF THE ARMY (BELGIAN)

The staff of the Commandant of the Engineers of the Belgian Army consisted of the chief of the service and five officers. The Chief of Engineers was the technical advisor of the Chief of the General Staff in all matters pertaining to engineering (with the exception of special branches such as telegraphy and railroading). From a technical point of view, he controlled all engineering operations through the preparation of orders for engineering work (which he submitted for the signature of the Chief of Staff), and by supervising the technical execution of such work. (Chart 3, Chapter XII, Volume I.)

The principal questions which the Chief of Engineers was called upon to study and for the proper execution of which he was responsible were:

The construction of positions in rear of the first line.

Inundations and the drainage of the ground.

The upkeep and construction of roads.

The water supply.

The procurement of Engineer tools and material.

Camouflage.

The Commanding General of Engineers of the Army (Général du Génie de l'Armée—G. Gn. A.) had a number of organizations at his disposal for the accomplishment of these duties.

1. The preparation of withdrawal positions was executed under the direction of a number of Engineer officers who formed the "Engineer Service of the Army" (S. G. A.) and by labor, varying according to circumstances, placed under their technical control. This personnel consisted of Auxiliary Engineer troops (T. A. G.) composed of soldiers from the oldest military classes, or, of infantry or engineer units belonging to army divisions (Divisions d'Armée—D. A.) which were in reserve.

2. The "service of inundations" was assured by a company of the "Pontonier Battalion". This unit was known as the company of "Sapper-Pontoniers" and was charged with the operation of the canal locks at Nieuport and the constant upkeep and repair of the dikes and locks in the region of Nieuport.

3. The Roads Service (S. R.), which was directed by engineers and by officials of the "Bridges and Highways" administration (Ponts et Chaussées). The work was carried out by means of auxiliary Engineer companies, assisted by civilian labor which had been drafted. The pontonier battalion (consisting of three companies, including the company of sapper-pontoniers) constructed bridges for heavy traffic; these bridges were metallic or constructed upon piles.

4. The "Technical Direction of the Water Supply Service" (D. T. S. E.) and several platoons of troops known as "fontainiers" (well diggers). There was one water supply service platoon for each of the army divisions and one platoon at General Headquarters; charged with supplying drinking water to the troops.

5. The Command of the Engineers of the Army received the requests for engineer tools and supplies from the army divisions and transmitted them to the Director of the Army Engineer Park (Directeur du P. G. A.) for compliance. The latter controlled the army depots established at the front, as well as the zone depots. (Charts 4 and 5, Chapter XII, Volume I.)

6. The Engineer shops at the front. Each of these shops was under the orders of an engineer officer and consisted of:

(*a*) A carpenter shop (furniture, doors and windows, coffins, etc.).

(*b*) A shop for the repair of light railway matériel (Decauville).

(*c*) A shop for the repair of tools and equipment.

(*d*) An establishment for the manufacture of cement articles (flagstones, bricks, cradles, etc.).

7. Following the example of the French and British Armies, a small camouflage section was created to carry out special works in the sectors occupied by the army divisions.

In addition to the duties enumerated above, the Commandant of Engineers of the Army issued regulations and technical instructions for the guidance of the Engineers of the army divisions in the construction of fortifications and communications.

The Engineer Command also acted as the liaison agency between the Chief of the General Staff and the "Military Construction Service" (Service des bâtiments militaires) which constructed and maintained the barracks in the rest areas. In the forward areas this work was under the orders of the Engineer officers of the army divisions concerned.

CHAPTER XI.

SECTION IV.

THE SUPPLY OF ENGINEERING MATERIAL (ITALIAN).

According to Army Regulations, the Engineers were charged with the supply, repair, and evacuation of all material used by the Engineer troops and by the various specialized Engineer units (sappers, miners, telegraphists, pontoon builders and railway engineers), as well as of the engineering material supplied to the armies in the field.

This material included the tools and equipment of the various specialized Engineer units with the armies, the heavy mining equipment which was distributed among the infantry and cavalry detachments, the material used by the telephone and telegraph sections, the material used for reinforcements and revetments, the equipment for the electrical and hydraulic plants, the materials and machinery used in boring operations and construction work, as well as the material for the aerial railways. In addition, the Engineers were charged with the upkeep of the equipment and material in current use by the troops.

ADMINISTRATIVE ORGANS.

(Chart 11, Chapter XII, Volume I.)

The administrative organs of the Engineer service in the Zone of the Armies (Zona di guerra) were:

The Commanding General (Commandante) of Engineers, with the Supreme Command (Comando Supremo). He was at the disposal of the Chief of the General Staff for the technical direction of the Engineer service.

The Engineer Section of the General Commissariat (Intendenza Generale), under the direct control of the Chief of Staff of the General Commissariat. He provided for the expeditious supply of engineering material and, particularly, for the shipment of supplies from the base to the armies, as well as for the removal of Engineer material toward the rear in case of necessity.

The Administration of Military Engineers, which provided and maintained all the material supplied to the advanced storehouses under its control; it also moved this material in accordance with the

progress of operations so as to assure the supply of the first line establishments.

The army corps Engineer Commands, which directed and controlled the Engineer supply services and provided for the distribution of engineer material to the labor troops operating in their respective zones.

ENGINEER ESTABLISHMENTS AT THE FRONT.

The following Engineer establishments were in existence at the beginning of the war:

The army corps Engineer parks, under the commander of the army corps Engineers. The army corps Engineer parks were equipped with animal transportation and carried Engineer tools and equipment for the sappers, miners and various other Engineer units. In addition they also contained explosives for demolitions, etc., telegraph, telephone, and bridge materials, pumps and "Morthon" wells, sand bags, wire for entanglements, and lighting equipment. Each army corps Engineer park maintained a mobile repair shop.

The army corps Engineer parks were charged with supplying the parks of the Engineer units which were assigned to the Army Corps and to its divisions.

Advanced Engineer storehouses. These were under the Administration of Military Engineers and were charged with replenishing the army corps Engineer parks and the supply parks of the Engineers attached to the various army corps.

Central Engineer depots. The central depots were under the control of the Administration of Military Engineers and were responsible for the supply of the advanced Engineer storehouses. (Chart 12, Chapter XII, Volume I.)

ENGINEER SUPPLY ORGANIZATIONS AT THE BASE.

The following territorial establishments were organized before the war for the supply of engineering materials:

The Engineer Administrations;
Engineer supply offices;
Regimental Engineer supply depots;
Military Engineer construction establishments.

These organizations maintained depots containing stores of Engineer material and equipment. In time of peace, however, the stocks of Engineer supplies in these depots were limited.

At first, these organizations were coordinated by the Engineer Division of the General Artillery and Engineer Administration at the Ministry of War. Later, when the Ministry of Arms and Muni-

tions was created, the General Artillery and Engineer Administration became the "General Engineer Administration".

To preserve and control the existing resources of Engineer supplies, each organization (ente) was allocated only such quantities of Engineer equipment and materials as were available, from month to month, within its own territory. In this manner the storehouses were supplied almost automatically.

OPERATION OF THE SERVICE.

Troops requiring Engineer material sent their requests to the army corps Engineer commands (Commandi) or, in the case of troops not assigned to an army corps, to the Administration of Military Engineers and these furnished the supplies which had been requested, either through the establishments at their disposal (Engineer parks, advanced storehouses, etc.), or by the utilization of local resources.

The central Engineer depots were supplied by the Ministry of War through the General Commissariat, from the military reserve establishments or by the purchase of necessary supplies from commercial sources. This system had to be modified when the war broke out in order to meet the ever increasing and varying requirements.

MODIFICATIONS CARRIED OUT IN THE ENGINEER SUPPLY SERVICE DURING THE WAR.

The principal modifications were:

(a) *For the supply of the first line (field) establishments (Stabilimenti di Campagna).*

In order to accelerate the supply of Engineer material and to avoid unnecessary handling it was decided, at the beginning of hostilities, that the engineering material should be sent direct from the producing establishments to the armies, or to the Engineer depots and advanced storehouses which had been created during the war and which were under the control of the Engineer Commands of the various army corps.

As a result of these measures the functions of the central depots were greatly changed. These depots thereafter cooperated with the other territorial Engineer supply agencies in the procurement and purchase of available materials and, whenever necessary, assured the shipment of such materials to destination. The latter procedure was necessary, for example, in the case of an army which had not been assigned a central depot.

(b) *Special Engineer depots of the General Commissariat (Intendenza Generale).*

Subsequently, the Engineer supply service had to be further modified. The Austrian offensive of 1916, in the Trentino, made it absolutely necessary to establish larger reserves of Engineer material at conveniently located points, under the control of the General Commissariat.

Special depots were therefore established much nearer the front and in more central localities, such as Padua, Treviso (Sancenigo) and Castelfranco Veneto. This enabled the General Commissariat to supply the needs of the various armies, especially during the preparation and development of important operations.

The necessary materials for the stocking of these depots was assembled during the calm periods and particularly after the withdrawal of the troops in 1917. During the second phase of the war, new depots were also created in localities further to the rear (arretrato). These depots were operated along the same lines and were also controlled by the General Commissariat. They were similar to the earlier establishments.

(c) *Organization of an Engineer Construction establishment at the disposal of the General Commissariat.*

To satisfy urgent requests for various Engineer materials required during operations, an Engineer construction plant was built at Castenaso (Bologna) and placed under the direct control of the General Commissariat. This establishment rendered important services and assembled (arontementi) a great deal of the Engineer equipment and material required for the operations of 1918, and, notably for the victorious offense of October of that year. It will suffice here to state that this establishment furnished all of the pontoon material used during the above named offensive for the passage of rivers (i. e., ten kilometers of pontoon bridges).

(d) *Abolition of the Army Corps Engineer Parks and the substitution of Depots for Engineer Material.*

ENGINEER SUPPLIES.

(Chart 13, Chapter XII, Volume I.)

a) *Field Material*, (barbed wire, sand bags, iron stakes for entanglements, special accessories for defensive works, etc.).—On account of the deficiency in the initial national production, barbed wire and iron stakes for entanglements were obtained from America. Subsequently, as the national industries succeeded in increasing their production and were enabled to furnish the tremendous quantities of

engineering material required, the importation of manufactured products was discontinued and only raw materials were obtained from abroad.

Sand bags were produced in sufficient quantities at the beginning of the war. Later, however, the supply of jute having become almost exhausted, it became necessary to import ready made bags. These importations continued until the Ministry of Arms and Munitions was able to procure jute from the Indies and these supplies were then distributed to the Italian establishments for the manufacture of sand-bags. The number of sand bags supplied to the armies amounted to more than 270 millions.

b) *Material for the Engineer parks and services*, (regulation equipment, engineering tools, explosives, etc.)—Tools for sapping and mining operations and bridge material were practically all manufactured in Italy. The great demand for gelatine, dynamite, and black powder exceeded the capacity of the national production, hence a substitute: "Cordite," had to be imported; the latter was obtained mostly from France. (This explosive is less powerful, and therefore not as efficient, but it was very useful and less costly than the other explosives mentioned.)

c) *Bicycles.*—The large number of bicycles required for the armies was produced by the Army Engineer Works at Padua and by various private manufacturing establishments in northern Italy.

d) *Photo-electric stations.*—This equipment was manufactured by private firms, particularly "F.I.A.T.", Salmoiraghi and Gallileo. Altogether, these establishments sent 1,300 pieces of apparatus to the Zone of the Armies.

e) *Special material for mountain warfare.*—(Aerial railways (transporting cables or "teleferiche") and mechanical boring apparatus). The subject of aerial railways has been fully treated in Chapter XV, so that only the mechanical boring equipment will be mentioned here.

In Italy, a very satisfactory equipment was obtained by the adoption of high speed, motor driven, compression boring machines of the "F.I.A.T." and "Romeo" types and this equipment rendered invaluable services on the Italian front. These machines were also in great demand by the other Allied Armies, particularly for the troops operating along the Macedonian front. Italy, which previous to this time depended entirely upon importations from foreign countries, thus became an exporter of machinery also.

From February 1916 until November 1918, 3,925 groups of boring machines, of from 5 to 45 HP., were supplied, with a total of more than 60,000 horse-power. In addition, twenty permanent boring machines of varying capacity were installed.

The boring machinery used by the Italian Army was operated under very difficult conditions, nevertheless it was kept in working order practically continuously through the provision of large quantities of spare parts. The supply of these spare parts, which was a very important matter, was entrusted to the "Military Commission for mechanical boring machinery", which was organized in February 1916. This commission formed part of the Fifth Regiment of Engineers and was located at Turin.

f) *Building material.*—This consisted for the most part of: Huts in sections, tarred roofing material, linoleum, insulating material (felt, straw, etc.), bricks and tiles, window panes, door and window frames, cement and lime.

Most of these supplies were furnished by the national industries and recourse was had to foreign markets only in case of absolute necessity as, for example, for the procurement of American tarred felt.

Cement and lime were readily obtainable in Italy. In 1917 and 1918, about 100,000 tons of these materials were sent into the Zone of the Armies each month. Canvas, tarred cardboard and felt were obtained through purchases at prices fixed by the Government. Canvas had been obtained in excess of the requirements of the Army and this surplus stock enabled the Italian Government to cede 1,500,000 meters of this material to the French.

Altogether, the importation of Engineer material from abroad represented but a small proportion of the total needs of the Army and from this fact it will be seen that, spurred on by necessity, Italy succeeded in organizing her industries so that she was enabled to supply the tremendous requirements in Engineer material almost entirely from her own resources.

CHAPTER XI.

SECTION V.

REPORT OF THE CHIEF ENGINEER A. E. F.[1]

The activities of the Chief Engineer, A. E. F., properly came under two heads:

First: Those of a more or less purely military character, relating to the organization, personnel, equipment, training and distribution and operations of Engineer combat units.

Second: Those relating to construction and supply. Construction included wharves, warehouses, depots, shelters for troops, hospitals, rail facilities, etc. Supply included not only the securing, storage and distribution of technical engineer supplies for combat troops, wherever located, but also the provision of everything needed in the way of tools, materials and machinery for the construction program above referred to.

ORGANIZATION OF THE ENGINEER DEPARTMENT.

From a total of six men, three officers, and three civilians on May 28, 1917, the Engineer strength of the American Expeditionary Forces increased until, on November 1, 1918, there were under the direct command or technical supervision of the Chief Engineer, A. E. F., 174,000 officers and men. The organization of the Engineer Department, as of date of the Armistice, consisted essentially of the four main divisions of the Office of the Chief Engineer:

1. Assistant to the Chief Engineer, A. E. F., G. H. Q.
2. Division of Construction and Forestry.
3. Division of Military Engineering and Engineer Supplies.
4. Division of Light Railway and Roads.

The duties charged to the Chief Engineer, A. E. F., during the last four months of hostilities had, previous to July 11, 1918, been discharged through the medium of three distinct organizations which, with the Engineer Department as it was at the Armistice, made a total of four different organizations.

These were:

Engineer Department, May 18, 1917, to July 11, 1918.

Office of Chief Engineer, Lines of Communication, August 13, 1917, to March 12, 1918.

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[1] Reduced from the report of the activities of the Engineer Department and prepared for the M. B. A. S. by the Chief Engineer, A. E. F.

Service of Utilities (two of its four departments) March 12, 1918, to July 11, 1918.

Engineer Department, July 11, 1918, to withdrawal from Europe.

The Engineer Department, May 18, 1917–July 11, 1918.

The Engineer Department at first was engaged in making various reports needed in determining the ports best suited for the use of the A. E. F., and also in making investigation of the transportation facilities and requirements in the western theater of operations, as well as a general study of requirements affecting engineer operations. Until August 31, 1917, the office of the Chief Engineer continued in Paris. During this perod it was the seat of great activity and far reaching labor. Investigations and surveys were made, large construction projects were formulated, estimates embracing the needed materials were prepared, labor requirements were calculated, necessary quantities of construction equipment were determined, and, in addition, after consultation with the French, important recommendations, including the organization of the Transportation Department and Gas Service, were made to the Commander in Chief. Requisitions for Engineer troops, equipment, supplies and materials were cabled, and the plans and specifications for constructions and wharves, railway and shop equipment were mailed.

On the 31st of August 1917, the Office of the Chief Engineer moved to Chaumont. Until March 12, 1918, the Chief Engineer (C. E.), except for technical supervision of the operations of all Engineer units, was principally concerned with matters of military engineering, training of troops, and procurement of supplies.

In November 1917, the office of the Chief Engineer at G. H. Q., had become more or less definitely organized.

On March 19, 1918, the office of the Chief Engineer A. E. F., was transferred from G. H. Q. to Headquarters, S. O. S., at Tours and somewhat reorganized to care for certain changes in its functional and geographical relations. It became necessary for the Chief Engineer to maintain an assistant in charge of the office that was retained at G. H. Q., as well as an assistant in charge of the main office at Tours, so that he would be free to visit any point where his immediate presence might be needed.

The G. H. Q. office of the Chief Engineer was concerned entirely with matters pertaining to Engineer service in the Zone of the Armies and it was organized accordingly. In May, 1918, what had previously been the Operations Division was abolished and the Geologic, Camouflage and Searchlight Sections were placed directly under the assistant to the Chief Engineer in charge of that office.

An Engineering Intelligence Section and a Bridge Section were organized and placed in similar positions. A Board of Military Engineers was organized on March 30, 1918, and became a component of the G. H. Q., office of the C. E.

The Office of the Chief Engineer was constituted with three divisions.[2]

Office of the Chief Engineer, L. of C., August 13, 1917 to March 12, 1918.

The main functions of the Chief Engineer, Lines of Communication, were general construction, less railway and dock construction, (then assigned to the Transportation Department) and the supply of Engineer materials. The office was organized in two divisions: Administration and Construction Division and the Supply Division. The former division dealt with matters of office routine, etc. The latter with lumber production and the receipt, storage and issue of Engineer material; it also had a forestry section and a depot section. The operations of the forestry troops in the forests and mills were directed, through the District and Operation commanders, by the chief of the Forestry Section who, at the same time, was commanding officer of all the forestry troops; he also had charge of the acquisition of stumpage.

Service of Utilities, March 12, 1918–August 11, 1918.

The scope of the duties of the Service of Utilities, as a staff department at the headquarters of the S. O. S., were specified as follows in orders:

"* * Service of Utilities * * will include the Transportation Department, the Motor Transport Service, Forestry Service and lumber and tie production, and all construction under the Commanding General, S. O. S. * * co-ordinated by the Chief of Utilities * * *"

It was under the Service of Utilities that the Department of Construction and Forestry took form. It had five sections, (A) Forestry Section, (B) Plant Construction Section, (C) Hospitalization Section, (D) Warehouse and Barrack Construction Section, (E) Water Supply Section. Later, the last four of these sections were consolidated as a sub-section of the General Construction Section and the Forestry Section continued as a department section, with two additional department sections, the Administration Section and the Railroads and Docks Sections.

Under the Services of Utilities, the Department of Light Railways and Roads also was organized. The functions of construction,

[2] For detailed working of this office, see report of C. E., A. E. F., dated March 10, 1919.

operation, and maintenance of light railway, and that of construction, repair, and maintenance of light railways were taken from the Transportation Department in March 1918, and placed under the Department of Light Railways and Roads. This department was originally responsible for the construction, equipment, maintenance, and operation of all narrow gauge railways in advance of normal gauge railheads and, for the construction and maintenance of all roads in American occupied territory, together with the quarrying of material therefor. However, it was later relieved of much of this work and, except for technical supervision in the Advance Section, S. O. S., and the Army Zone, the functions of the Department of Light Railways and Roads, after May 7, 1918, became primarily that of an agency to estimate light railway and road requirements including amount of trained personnel, construction and operation equipment, etc., and to make provisions for their delivery to the construction and operation forces.

Engineer Department from July 11, 1918.

On July 11, 1918, the Services of Utilities was abolished. The Engineer Department was reorganized to include the former office of the C. E., and the two former Utilities departments previously described. These were to form three divisions and they continued as such until the Armistice.[8]

It was divided into four divisions:

Division of Military Engineering and Engineer Supplies.
Division of Construction and Forestry.
Division of Light Railways and Roads.
Office of the Assistant at G. H. Q.

The Chief Engineer, A. E. F., supervised the work of the following organizations:

Light Railways and Roads; Quarry Section; Searchlights: Camouflage Section; Water Supply Section; Geologic Investigation and Electro-Mechanical Section; Sound and Flash-Ranging Service; Surveying and Printing, Bridging, Engineer Supplies, Cement Supply, Construction and Forestry.

THE SUPPLY OF ENGINEERING MATERIAL IN THE A. E. F.

The supply of engineering material for the A. E. F. in France was one of the most serious problems with which the Corps of Engineers had to deal. The methods adopted for the accomplishment of this task are briefly indicated below.

The supply of engineering material required by the A. E. F. was accomplished by requisition from the United States and by purchase

[8] See Chart 6, Chapter XII, Vol. I.

in Europe. This work was handled by the Engineer Purchasing Office, under the direction of the Chief Engineer, established August 1917. It was partially reorganized in March 1918, when the Chief Engineer moved to Tours. The Engineer Purchasing Officer was stationed in Paris. The procurement department of the Engineer Supply Office was at Tours. The Engineer Supply Office was at G. H. Q. The latter was charged with the distribution of all engineer supplies and the procurement of these supplies for front line troops only. The duties of the Deputy Engineer Supply Officer at G. H. Q. were as follows:

The equipping of all combatants units with engineer supplies and the distribution of engineer supplies to the combatant forces. (Monthly credits and special requisitions approved by G-4, G. H. Q.) Procurement of engineer material required by the Army. The inspection of Army uses in anticipation of Army needs (ordering the material forward before the armies realized they would require it), and supervision of the transportation from the depots to the Army front (obtaining cars through G-4, G. H. Q., and advancing their deliveries through Engineer officers attached to regulating stations).

Engineer troops were equipped upon their arrival in the training area. An officer of the Deputy Engineer's supply office would visit the troops, ascertain the shortage in their equipment and arrange for furnishing all authorized equipment without requisition.

The responsibility for the preparation of the Engineer portion of "priority cables" rested upon the Procurement Section of the Engineer Supply Office. The D. E. S. O., under this arrangement, was charged with the preparation of the priority lists of engineer supplies required by the Army and for special material.

Two priority lists were required: Priority cables sent the Chief Engineer each month showing the complete lists of supplies to be shipped from the U. S. the following month, and the preliminary priority cable advising the Chief Engineer of the supplies likely to be needed four months in advance.

The Engineer Purchasing Office, established in August 1918, was divided into three departments: European Purchases, Requisition and Depot. European purchases were handled by the E. P. O. under approval of the G. P. B. and were made in France, England, Switzerland and Spain. These purchases were as large as possible to conserve the tonnage from the United States.

Supplies from the United States: Handled by the Requisition Department and consisted of those things that were not susceptible to purchase on the Continent or England. The duties rested with the Paris and London Purchasing Officers in advising the articles not obtainable in Europe and through our Allies and making up of the requisitions.

DEPOT DEPARTMENT

The Depot Department had charge of the storage and distribution of the supplies after they had been secured. The Engineer storage, open and covered, actually occupied in the various depots on November 11, 1918, amounted to over 15,000,000 square feet, divided in varying amounts between, Gievres, Is-sur-Tille, Montier, St. Suplice, Montoir, La Pallice and Marseilles.

METHODS OF DISTRIBUTION.

Reception at Base Depots: Upon the arrival of ships with engineer supplies, the depot engineer officers at the ports secured copies of the manifest and extracted the engineer items therefrom. This information was telegraphed to Tours, including the order number. At Tours the items were checked off against the orders specified and the material was assigned to points where the shortages were most acute; this information was wired back to the depot engineer officer at the port who made shipments of the material accordingly. Every effort was made to prevent unnecessary shipments to inland depots and, whenever possible, direct shipment was effected from the primary depots at the base ports to the point of utilization, which prevented rehandling of supplies and the saving of thousands of ton miles of transportation.

Requisitions: Were standardized per G. O. 44, 1918. The two systems being: First, the credit system; second, the requisitioning of material by officers in charge of projects to the Chief of the Department.

Transportation: Throughout the history of the Engineer depots in France, the lack of rail transportation continually prevented the rapid shipment of Engineer supplies. In forwarding supplies from depots, three classes of shipments were provided for:

First: Small shipments which could be delivered by trucks.

Second: Less than carload shipments.

Third: Carload shipments

For points in the immediate vicinity of the depots, trucks were used when available. Shipments of less than carload lots of material were first taken care of and shipments were made by rail by what the French called "Petits Colis" or "Grande Vitesse." Transportation authorities soon discovered, however, that facilities were not available to handle a vast number of these shipments so that an embargo was placed on them and instructions were issued that cars must be fully loaded to one destination. This delayed these less than carload shipments as long as a month, holding up jobs that needed only a few essential items for completion, and the situation was finally relieved by the assignment to each base section of one or more distri-

COL. A. CUMONT

Belgian Member of the Board; Belgian Member of the Editing Committee

bution centers where material, destined for the towns in the neighborhood of these centers, could be shipped in carload lots and then delivered by motor trucks. The value of this system was readily apparent and the only restriction being the lack of motor trucks.

Carload-lots: Shipment of carload lots of material depended on the number of cars available. The Engineer depots were not permitted to use American box cars. When sufficient cars were available, shipments depended of course, on the rapidity of loading at depots.

ENGINEER SUPPLY DEPOTS.

(Chart 7, Chapter XII, Vol. I.)

Langres (Haute-Marne).
Neufchâteau (Vosges).
Liffol-le-Grand (Vosges).
Pacy-sur-Armançon (Yonne).
Châtillon-sur-Seine (Côte-d'Or).
Demange-aux-Eaux (Meuse).
Barizey-la-Côte (Meurthe-et-Moselle).
Nevers (Nièvre).
Etais (Côte-d'Or).
Clermont-Ferrand (Puy-de-Dôme).
La Guerche (Cher).
St. Amand (Cher).
Le Mans (Sarther).
Orly (Seine).
Gièvres (Loir-et-Cher).
Saumur (Maine-et-Loire).
Nantes (Loire-Inférieure).
St. Nazaire (Loire-Inférieure).
Bordeaux (Gironde).
Le Havre (Seine-Inférieure).
Rouen (Seine-Inférieure).
Brest (Finistère).
Landerneau (Finistère).
Marseille (Bouches-du-Rhône).
Aigrefeuille (Charente-Inférieure).

CHAPTER XII.

SECTION I.

THE MEDICAL SERVICE (BRITISH).[1]

The Medical Service did its work as a branch of the Adjutant General's Department, but the successive Commanders in Chief made it clear that for practical purposes the service was to be treated as an independent department whose requirements must always be met, if this was in any way possible.

DUTIES AND RESPONSIBILITIES.

Its duties covered everything connected with the treatment and disposal of medical and surgical casualties, and the prevention of disease in a force which at first consisted only of five divisions, and latterly of upwards of two millon individuals.

Its responsibilities were equally extensive except for the fact that in formations not solely medical, the representative of the Medical Department (whether a Director of Medical Services (D. M. S.) of an army, or a battalion Medical Officer (M. O.)) could only advise certain courses, not order their adoption.

CONSTITUTION.

The personnel of the original service, namely, that which came out with the first Expeditionary Force, consisted entirely of other ranks belonging to the regular service and duly trained. The officers consisted of regulars, with a few civilians holding commissions in the special reserve and partly trained for their work, and a small proportion of young civilian medical men engaged on a contract for a year and for employment chiefly in ward work.

Later on when the service grew it included a considerable number of Territorial Medical Officers, a certain number of senior civilians holding commissions for the duration of the war and so large a number of contract medical officers that the proportion of regular officers to the whole fell to about 1 in 10.

The change in the subordinate personnel was of a corresponding kind and degree, but in their case all non-regulars were serving for the duration of the war.

[1] Prepared for the M. B. A. S. by the Director General of Medical Services British Armies in France and Flanders.

As a rule throughout the war the higher administrative posts were held by the regular officers they alone having previously been trained for such work, but otherwise executive and professional duties were performed by both.

SYSTEM.

The original service was under a Director of Medical Services (D. M. S.) but when towards the end of 1914 the force began to multiply into several armies each much bigger than the original one, the full control of the medical services of all of them was placed in charge of an officer entitled a Director General (D. G. M. S.).

The Director General's principal staff officers were the D. M. S. of the armies consecutively raised, and the D. M. S. of the Lines of Communication. In the performance of his own duties he had as assistants, a Deputy Director General, an Assistant Director General, an Assistant Director (A. D.), and a varying number of Deputy Assistant Directors (D. A. D.), Medical Service (M. S.).

In addition he had an advisor in pathology, and an A. D. M. S. He also had a counsel drawn from the civilian medical officers appointed to the Army as consultants in medicine and surgery, and the other specialities.

The original work of these consultants was to act as do consultants in civil life, but it soon became their duty to supervise the strictly professional work of any hospital units existing in the area or formation to which they were appointed, and to act as advisers to the Senior Medical Officer of such area or formation in respect of all professional questions including the choice of officers for special clinical appointments.

SYSTEM IN THE ARMIES.

The officer responsible for the medical work of each army was its D. M. S., whose principal subordinates were the Deputy Directors in charge of corps. His personal assistants consisted of an Assistant Director (A. D. M. S.), one or more D. A. D. M. S., an expert in sanitation, and one or two consultants.

The number of Deputy Directors varied with the number of corps allotted to the army, such number varying with the extent and character of the work that such army was performing or about to perform.

The personal assistant of the Senior Medical Officer (D. D. M. S.) of a corps was a D. A. D. M. S., and his principal subordinates were the Assistant Directors of Medical Services in medical charge of the divisions forming that corps. The number of such divisions varied even more greatly than the number of corps.

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Its responsibilities were equally extensive except for the fact that in formations not solely medical, the representative of the Medical Department (whether a Director of Medical Services (D. M. S.) of an army, or a battalion Medical Officer (M. O.)) could only advise certain courses, not order their adoption.

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Unlike a corps, a division always formed a definite and independent medical entity, the A. D. M. S. was commanding officer (O. C.) of the R. A. M. O. in his formation in addition to his administrative duties. He was assisted by a D. A. D. M. S. (and eventually by a sanitary expert) and his principal subordinates were the M. O. S. of the combatant units forming the division, and the C. O.'s of the three Field Ambulances invariably allotted to it.

SYSTEM OF THE LINES OF COMMUNICATION.

The D. M. S., L. of C., was responsible for all medical work done in L. of C. and base areas. This was regarded as including the hospital train services, the maintenance of base depots for the supply of drugs and appliances wherever required, the sanitation, the upkeep of laboratories, hospitals, convalescent depots, and centres for the grading of reinforcements of men discharged from convalescent depots, and the supply of medical attendance to troops not possessing a medical officer of their own. His personal assistants consisted of a Deputy for general work, of an A. D. M. S. in charge of hospital ship and train work, and a D. A. D. M. S. and other officers in charge of medical statistics and medical supplies and personnel. (Chart 1, Chapter XIII, Vol. I.)

His principal subordinates were the Deputy Directors of the Medical Services of the various areas which from time to time constituted the base and L. of C.

The personal assistants of the D. D. M. S. of a base area usually consisted of a D. A. D. M. S., and Embarkation Medical Officer, a sanitary expert, and two or more consultants in medicine and surgery, and other specialities; also a Principal Matron who received her orders in respect of administrative nursing questions from the Matron in Chief.

The principal subordinates of the D. D. M. S. of an area were the commanding officers of the hospital and other medical units within its confines.

In regard to numbers the service always lacked a considerable number of the medical officer personnel to which it was entitled according to War Establishment Regulations. The deficit was met partly by economies of staff at the base hospitals.

It was found that the latter could be worked with entire efficiency with a smaller ratio of medical officers to beds than was prescribed by regulations, as also by a much smaller number of officers of field rank. The relative shortness of medical officers did not, in fact, cause any real drawback otherwise than in an occasional period of stress and interference with the regularity of the granting of leave. In this connection it is to be remembered that war, from

a medical point of view, has been described as a "damnable monotony interrupted by periods of hell." In the former there are always too many officers, and in the latter there can never be enough.

GENERAL PRINCIPLES.

Every officer entitled to issue orders issued them in his own name and was responsible for the extent to which they met the circumstances in view, and the closeness with which they complied with either standing orders, or specific orders received by him from the officer to whom he himself was subordinate. The circumstances of all units and of all armies, divisions, and bases differed more or less extensively, and it was neither desired nor attempted to make them all do their work in precisely the same way; but when any particular method of carrying out an aim had been found to work well in a particular formation, and was esteemed likely to work well in all formations, it was frequently ordered to be adopted by all formations by a general order, emanating from the office of the D. G. M. S.

UNITS EMPLOYED.

On the L. of C., the units employed were General Hospitals, Stationary Hospitals, Convalescent Depots, Laboratories, Medical Inspection Rooms, Sanitary Sections, Dental, Ophthalmic, Delousing and Disinfecting Stations, Motor Ambulance Convoys, and depots of medical stores. At the beginning the number of these units was precisely that prescribed by regulations, and roughly the same proportion is believed to have been maintained right through the war as the total size of the force in France rose and fell, but in some cases and at some times the increased working capacity required was provided by increasing the accommodation of existing units instead of creating new units.

The units employed in the army zones were Mobile Laboratories, Dental, Ophthalmic and other like centres, Delousing and Disinfecting Stations, formed by field ambulances or casualty clearing stations, Sanitary Stations and Squads, Motor Ambulance Convoys, Advanced Depots of Medical Stores, Casualty Clearing Stations, Field Ambulances, and the formations run by the latter.

The Casualty Clearing Stations (C. C. S.) dealt with all men whose condition was not likely to necessitate their evacuation from an army area. The Field Ambulances, besides attending to the collection of casualties, undertook the treatment of men suffering from conditions deemed susceptible of effective treatment without evacuation from the divisional or corps area.

The other formations maintained by Field Ambulances for the purpose of supplying treatment were known as Advanced Dressing Stations and Main Dressing Stations. The former were transmitting centres and the other might either treat light cases themselves or transmit them to Casualty Clearing Stations.

Every army had allotted to it a certain number of C. C. S's, the proportion usually being one C. C. S. to every division on the strength of the army for the time being. Each division had allotted to it three Field Ambulances, each of which was capable of being subdivided into three sections, each of these in its turn could be subdivided again into a bearer or collecting subsection and tent or treatment subsection. During the periods of mobile warfare at the beginning and end of the war, these facilities were utilized. But during the intermediate period all the ambulances of a division or all those of a corps frequently combined to carry out their common work.

TRANSPORT.

(Chart 2, Chapter XIII, Vol. I.)

On the Lines of Communication, the transport of patients from trains to hospitals, from hospitals to convalescent depots, or from hospitals to ships was under the control of the Embarkation Medical Officer on the staff of the D. M. S., of the area concerned, the vehicles used being supplied by the British Red Cross Society.

In army areas patients unable to proceed on foot from regimental aid posts to Advanced Dressing Stations of Field Ambulances were transported either on hand carried or wheeled stretchers; occasionally by Ford cars.

From the A. D. S's to the Main Dressing Stations conveyance was by means of the vehicles belonging to the Field Ambulance concerned, and occasionally by light railway. Also during heavy offensives by vehicles, running in circuits along the roads likely to be reached by lightly wounded men.

From the Main Dressing Stations casualties were taken to C. C. S's or to Rest Camps, as the case might be, by cars belonging to the Motor Ambulance Convoys. Frequently, when there were heavy casualties, char-a-bancs, busses, and motor lorries were used for the conveyance of the lightly wounded and those capable of sitting up, in order to free the cars of the Motor Ambulance Convoy for the lying down cases.

CHIEF DEVELOPMENTS.

Among these were the following:

(1) The introduction of Motor Ambulance Convoys. At the beginning of the war the British Army, like all other Armies, depended largely for the conveyance of casualties to railheads or Casualty

Clearing Stations on supply wagons and the mechanical transport of the supply columns returning empty from the front.

(2) The transformation of the Casualty Clearing Stations into real hospitals. In the beginning they were equipped and intended to serve merely as railhead collecting posts but, within a few months, they were provided with female nursing staffs and otherwise so equipped as to be capable of performing rapidly a very large number of operations and then either retaining the patients until well on the road to recovery, or evacuating them forthwith, according to their condition and as the circumstances of the moment rendered most desirable.

(3) The introduction soon after the beginning of the war of Mobile Bacteriological and Hygiene Laboratories.

(4) The appointment of a Sanitary Section, under an officer who belonged to the Medical Service, to each division or divisional or other area. At the beginning of the war control of the sanitary work of a division was in charge of the D. A. D. M. S. of such division.

(5) The establishment in all army areas of mobile or fixed dental or ophthalmic centres, and of neuropathic centres.

(6) Annihiliation of any difference in point of equipment between a Stationary Hospital and a General Hospital. Soon after the war began Stationary Hospitals began to be equipped like General Hospitals as elaborately as are permanent civil hospitals in peace time. (Chart 3, Chapter XIII, Vol. I.)

(7) The equipment and staffing of Convalescent Depots in such fashion that they could effectively treat many cases which at first had to be evacuated from the hospitals to the United Kingdom, in order to release accommodation.

(8) The substitution for improvised ambulance trains, formed of covered goods vans with stretchers on frame, of corridor trains so built and equipped that the treatment of patients could be carried on therein for any period desired and operations performed if necessary.

(9) The establishment of arrangements of Regimental Aid Posts and Advanced Dressing Stations for the preventive treatment of shock.

(10) Recognition of the fact that nearly all wounds require mechanical cleansing by operations to secure their speedy recovery, and that such operations must, if possible, be performed at no further distance from their place of infliction than a Casualty Clearing Station.

(11) Recognition of the fact that very many cases of abdominal and chest wounds previously deemed inevitably fatal could be saved by early operation.

REFERENCES.

Detailed information as to the number and size of different units as projected before the war can be found in War Establishment Regulations published subsequent to 1914. Similar information as to how the Army Medical Service was expected to do its work, can be found in the Royal Army Medical Corps Training Manual published in 1911, and reprinted in 1917.

For details as to how they were actually run references may be made to an article entitled "The work of the Royal Army Medical Corps" which was written in 1917, by the order of the Ministry of Propaganda. It was first published in the British Medical Journal and then, together with a number of other articles bearing on the medical and surgical sides of the war, was made up into a book which was translated by the Ministry of Propaganda into several languages and distributed to various countries including the United States of America.

Much information as to the work of the Service, especially from the point of view of evacuation, will also be found in the fourth volume of the journal of the Royal United Services Institution for the year 1916, in an article entitled "The Via Dolorosa of the Soldier."

There are some points of principle which are thought worthy of note in any paper dealing with the British Medical Service. They have a very distinct bearing on its efficiency.

1. One is that the service is autonomous; it does everything itself. Its members not only "doctor" the patients, but are responsible for the organization and equipment of the hospitals, for the supply of drugs and dressings, for the dieting and interior economy of the patients and for their discipline, and for the recruiting, training, pay and discipline of the men of the Royal Army Medical Corps. In other armies many of these duties and responsibilities are performed by officers who are non-medical. In the British Army this is not so.

2. The officers of the Medical Service, who are qualified doctors in civil life, are given definite army rank on being commissioned—as regards seniority—precedence, etc., they are on the same footing as officers in any other branch. As regards Command, they are naturally restricted; not being trained as combatants, they are in common with other departmental officers, not eligible to hold command of mixed bodies of effective troops, but in every other respect they are on the same footing as anybody else.

3. As to Staff Duties. General Officers commanding formation have a Medical Officer on their staff graded as a Director, Deputy Director, or Assistant Director as the case may be, who is their re-

sponsible adviser in all matters affecting the health and physical efficiency of the troops. He is also responsible personally and directly for the working of the Medical Services—the collection of wounded, the disposition of the medical aid posts, the distribution of units and personnel, the disposal and care of the wounded and sick.

The movement and location of units naturally forms part of the tactical distribution of the formation of which they form part and so proposals must be submitted to the "G" branch for approval—but when approved, the onus of carrying them out lies with the head of the Medical branch. Similarly, in periods of "Peace"; the arrangements for medical inspections, sick parades, collection of sick, discharges from hospital and so on, inasmuch as they affect different branches of the service must be submitted to the "A" branch who co-ordinates such matters; but when approved by him the responsibility for the details of the performance of the duties lies with the head of the Medical Service, who is directly responsible to the General Officer commanding and not to any Staff Officer.

EVACUATIONS OUTSIDE ZONE OF THE ARMIES.

The chief method of evacuating sick and wounded outside the Zone of the Armies was by ambulance train, but ambulance barges were also used and in times of stress in order to relieve congestion on the ambulance trains, motor ambulance convoys were used.

AMBULANCE TRAINS.

The first eleven ambulance trains were improvised from rolling stock procured from the French, and earlier ones were composed of covered goods wagons arranged to accommodate 396 lying down on stretchers.

They consisted of a number of 1st, 2nd and 3rd class coaches and fourgons, arranged to take an average load of 400 cases each, of which about 200 were lying; or, in times of pressure a total of 500 to 600, reducing the lying cases to 120 and utilizing all available floor space.

More of these improvised French trains were added each month, and by December 1914, there were 11 in commission, which were converted into corridor trains with inter-communication.

The first properly fitted British ambulance train arrived from England in December 1914.

During 1915, 8 more British ambulance trains were added, making a total of 11 French and 9 British.

In 1916, there were 11 French and 19 British ambulance trains in commission, and 11 more French trains, composed of ordinary

3rd class coaches, were requisitioned as temporary trains, to carry sitting cases only. These latter trains were capable of taking care of from 800 to 1,000 cases.

In 1917, there were 11 French and 26 British ambulance trains in commission and 15 temporary ambulance trains.

In 1918, 11 French and 29 British ambulance trains and 16 temporary ambulance trains were used and 3 U. S. A. trains were also employed during June and July.

These temporary trains, however, were only employed during severe fighting and were broken up immediately after their need ceased to exist.

AMBULANCE BARGES.

Evacuations by this method were begun in April 1915, on the canal system between Merville, Aire and St. Omer, by one flotilla consisting of 6 barges.

At first the barges worked singly but subsequently they were worked in pairs, towed by small tugs, each barge having accommodation for 30 patients.

They were fitted with beds like an ordinary ward, and were extremely comfortable, but slow.

Many cases such as severe chest and head wounds were evacuated by this method, which would otherwise have had to be kept in the army areas.

In October 1915, a second flotilla was added and patients were evacuated to Calais as well as St. Omer.

In 1916, two flotillas were transferred to the Somme canals, working between Corbie and Abbeville, and another was added to those of the "Northern" system so eventually there were four flotillas of six barges each together.

In 1917, all four flotillas were in use at one time or another, two having been sent up to the Dunkirk area, but subsequently the number was reduced to two, which were employed until the end of the war in 1918.

MOTOR AMBULANCE CONVOYS.

Evacuation by Motor Ambulance Convoy was carefully organized for the fighting on the Somme in 1916, and at that time a very large number of wounded were transferred from the 4th Army Area to Hesdin and Etaples. Similarly, evacuation was carried out by Motor Ambulance Convoy from the 1st and 2nd Armies at all times to St. Omer, when it was necessary to relieve the congestion on the railway.

CHAPTER XII.

SECTION II.

ORGANIZATION OF THE MEDICAL SERVICE (FRENCH).

I. *General Organization of the Medical Service During Different Phases of the War.*

1. *With the Armies.* As a result of the regulations in force at the beginning of the war, the directors of the medical services (Service de Santé) of the large units, particularly in the echelons of the armies, were too far removed from the Command and their recommendations, which the Command was to transmit in the form of orders, often suffered from the ignorance of these medical officers concerning the military situation. The disadvantages arising from this situation were bound to become apparent, especially during the first months of the war and during the active operations of a period of open warfare containing much of the unexpected, but they were less marked during the period of stabilized warfare which followed. During the latter period, each service could work out its plans more calmly, in complete accord with the General Staff, and could submit its recommendations at a proper time.

During May 1917, orders were issued which placed the directors of the medical services with the commands of the units, and they were authorized to handle all questions concerning the interior administration of the medical services. Medical officers were attached to the 4th Section (4e Bureau) of the various army headquarters, so that the Medical Service could keep in touch with matters which concerned it, be enabled to make timely provisions and issue instructions (for inclusion in the general orders issued by the large units, for the proper functioning of the medical services; in other words, to secure efficient liaison and cooperation between the Medical Service and the other services (motor transport, roads, railways, etc.).

In order to successfully carry out evacuations by rail, a medical officer was detailed with each "Commissaire Régulateur" (regulating officer). From then on, all movements of hospital trains were regulated after agreement between the railway technical officials and the medical technical officers.

At the same time that closer relations were being established between the directors of the medical services and the Command, the technical authority of the medical directors in the armies and army corps was strengthened by the addition of consulting surgeons, who were charged with studying, conjointly with them, the best means of providing for the proper care of the wounded. The directors of the medical services were responsible for the accomplishment of these plans, in so far as military operations permitted and in agreement with the Command.

The organization of a Medical Service at G. H. Q. passed through various phases. This service did not exist at the beginning of hostilities and was organized in October 1914, following the appointment of a "Director General of the Medical Service" (Directeur Général du Service de Santé). His main duties were to coordinate and supervise, from a technical standpoint, the operation of the Medical Service. By an order dated October 31, 1914, Dr. Tuffier was attached to the staff of the Director General as consulting surgeon and given charge of missions with the armies.

More efficient operation of the Medical Service became evident in May 1917, because, from that date on, medical officers were regularly attached to G. H. Q. These medical officers furnished all necessary information and developed all plans concerning the Medical Service. They were required to prepare the orders pertaining to the operation of the Medical Service and these orders were sent by the Commander in Chief to the army commanders. The medical officers attached to the staff were at first under the direction of the "Assistant Chief of Staff for Supply" (Aide-Major Général, Directeur de l'Arrière) and, later, under that of a "Medical Inspector" (Médecin-Inspecteur) who ranked as assistant chief of staff.

The purpose of this central organization was to utilize the medical personnel and material to the best advantage. It was the duty of this organization to provide sufficient reserves to meet the requirements of contemplated operations by drawing upon the resources of armies less actively engaged, and to distribute these reserves according to needs. It allotted the hospitals in the Zone of the Armies, as well as those in the interior which had been placed at the disposal of the Commander in Chief. It was also charged with obtaining the necessary assistance from the various directions at G. H. Q. (Motor Transport Direction, etc.), to enable the Medical Service to function properly. Finally, through its own personnel and with the help of the Medical Inspector General in charge of this service, it supervised the evacuation and care of the wounded, as well as the execution of orders in connection therewith.

2. *In the Interior.* The "General Direction of the Medical Service" (Direction Générale du Service de Santé), as it was organized at the

beginning of the war, was at first under the "7th Direction" of the Ministry of War. In July 1915, it passed under the control of an Under Secretary of State (Sous-Secrétaire d'Etat), on account of the increasing importance of this service and because everything pertaining thereto particularly interested the country at large, At the beginning of 1917, a weekly liaison service was maintained between the Medical Service at G. H. Q. and the Under Secretary of State. This made it possible to coordinate the use of the resources in the interior with those in the Zone of the Armies and the determination, by agreement between the Commander in Chief and the Under Secretary of State, of general plans for the operation of the medical services of the armies.

II. *General Organization of the Medical Service at the Time of the Armistice.*

(Chart 12, Chapter XIII, Vol. I.)

Under the orders of the Minister of War, there was an Under Secretary of State (or department of the Government) for the Medical Service, who exercised technical control over the Medical Service in the Zone of the Interior and in the Zone of the Armies.

Under the Commander in Chief at G. H. Q., there was a Medical Inspector, designated as the Assistant Chief of Staff for the Medical Service. The latter, acting in the name of the Commander in Chief, directed the organization, training, and operation of the Medical Service and maintained liaison between the Commander in Chief and the Under Secretary of State for the Medical Service.

III. *Medical Units—Their Distribution.*

The regimental medical units were directed, technically, by the superior medical officer of the regiment (Médecin-Major), but the regimental commander had military control over these units.

A Camp Hospital and a dressing station were attached to each regiment.

A group of divisional litter-bearers and one Field Hospital (formerly there were two, but one became an army organization, that is, a hospital where surgical cases were treated) were attached to a division. A division also had a Motor Ambulance Section (Section Sanitaire Automobile) for evacuating lying cases.

A group of corps litter-bearers and two Field Hospitals (one surgical, the other medical; the latter especially equipped for gas cases and known as "Field Hospital Z") were attached to each army corps.

Mobile field hospitals (Ambulances d'Armées) and permanent hospitals (Ambulance D'Etapes) were assigned to each army, and these were destined to reinforce or supplement the army corps organizations. In addition, an army was assigned "Evacuation Hos-

pitals." These were located along the railway lines, near a railway station, and were designated as "Primary Evacuation Hospitals", while those located further in the rear were known as "Secondary Evacuation Hospitals." There were also "hospital centers", established in barracks or buildings (barracks, colleges, schools, etc.) at fixed points in the rear. Moreover a reserve of medical material (tents, beds, medical stores) was maintained at each regulating station. The necessary motor transportation was placed at the disposal of the army medical services (T. P. or T. M. and S. S. A. motor trucks) by the 4th Section (4e Bureau) at army headquarters, to which was attached an officer of the Medical Service.

The group of armies had the medical formations of the armies that constituted the "group of armies" in addition to the medical units of the Zone of the L. of C. (Zone des Etapes) and, in certain cases, even medical units of the areas adjacent to the Zone of the Armies.

The Medical Service at G. H. Q. directed the medical units of all the armies. The motorized surgical field hospitals (Types 1915 and 1917), which were very completely equipped, were also under the direction of G. H. Q. and were assigned to the armies according to their needs. G. H. Q. maintained a considerable reserve of medical material of all kinds, (temporary barracks, tents, medical stores and dressings, etc.). It also controlled the surgical personnel which normally formed part of the surgical field hospitals but which, in case of necessity, could be detached and sent wherever an overflow in wounded was expected.

IV. *General Functions of the Medical Service.*

The Medical Service was based entirely upon the "Plan of Hospitalization and Evacuation." The two general rules which follow governed this service at all times:

1. Treat extreme cases on the spot: the seriously wounded because it was impossible to transport them and the slightly wounded in order to hasten their recovery.

2. Evacuate toward the rear the seriously wounded who were able to travel, either by stages or by a continuous journey, as well as those who were not seriously wounded but whose condition required prolonged treatment; maintain near the front cases which were not serious and who would recover quickly.

V. *Echelons of the Medical Service Units from the Front to the Rear. Their Functions. Evacuation and Hospitalization.*

The regimental units were always very small (dressing stations when in combat, and camp infirmaries when at rest). There was a greater advantage in maintaining regimental medical organizations than by having battalion organizations, because the greater disper-

sion of the battalion units offered less possibilities for efficient work. The transportation of the sick and wounded was at first effected by hand or wheeled litters, then by animal drawn ambulances. Coordination was necessary between the divisional medical officers and the regimental medical officers, the former furnished the litter-bearers from their "groups of divisional litter-bearers" (Groupes Brancardiers Divisionnaires—G. B. D.) as well as the animal drawn and motor ambulances.

The G. B. D. established loading centers in accordance with the orders of the medical officers of the divisions, who coordinated the evacuation from the regiments to the "loading points" (point de triage) for the wounded. The divisional field hospitals received the most serious of the non-movable cases and classified and routed the others to the main hospitals, i. e.: to the "Army Corps Hospitals."

The corps litter-bearers were reenforced by the G. B. D. of the divisions whenever necessary. The division and corps groups of litter-bearers carried a mobile reserve of material for defense against gas which was used for replacement purposes in extreme necessity.

The army corps organized a divisional medical service for the reception of gas cases (Ambulance Z) and one for the wounded (field hospitals attached to the unassigned units of the corps,) (Hôpital E. N. E.) which were reenforced by the army surgical hospitals (A. D.) and others. Non-movable cases were cared for in hospitals on the spot, the very slightly wounded were sent to a convalescence center, while those who could be evacuated were disposed of in accordance with the technical instructions of the army and army corps medical services.

The army organized a hospital center in the proximity of a railway line for surgical operations and evacuations; the center generally consisted of one evacuation hospital (hôpital H. O. E.) per army corps. This hospital center received, treated, and evacuated cases in accordance with general principles, modified according to the circumstances. These hospitals were usually established in tents and temporary barracks which were easily dismantled and which permitted their removal whenever military operations required it.

These evacuation hospitals were filled chiefly by the medical motor transport service (S. S. A.) and were cleared, partly by the S. S. A., by removal to near-by hospital centers, and partly by hospital trains by removal to evacuation hospitals of the second line or to hospital centers of the interior.

The "Plan of Evacuation and Hospitalization" was subordinated to the movements of troops, etc., upon highways and railways. It was necessary to regulate these questions by agreement between the Medi- Service and the 1st Section of the army corps headquarters (1er

Bureau) or with the 4th Section of the army headquarters (4e Bureau), which had authoritative control over the matter.

Hospital centers and additional army hospitals were established in temporary barracks located near evacuation hospitals or in requisitioned buildings. These were readily reached by automobile or by train and served to clear the evacuation hospitals, where numerous beds were to remain available at all times in case of emergency.

In principle, a few large centers were established rather than numerous small centers in many localities.

The evacuation of army hospital centers or of base hospitals, was usually effected by hospital trains and cases were sent either to adjacent or distant areas.

Hospital train movements were controlled by the regulating officers, in conjunction with medical regulating officers. The general rules were: First—never to neglect the treatment of the sick and, above all, of the wounded before placing them on the trains. Second—to move the trains with the minimum delay and forward them to places where the sick and wounded were to receive the major part of their treatment.

The loading of hospital trains was preceded by a careful examination of the sick and wounded to avoid sending serious cases, which were unable to withstand a long journey, or those who would recover quickly. During the transit the medical officers in charge of the hospital trains carefully watched the sick and wounded and removed those whose condition was aggravated by travel. At certain selected points along the road, medical regulating officers were stationed in depots for the purpose of reexamining the sick and wounded transported in hospital trains.

Finally, at the entrance to the areas which were to receive and clear the trains, were so-called clearing stations (gares de déchargement), where the trains were routed in accordance with the number and location of available beds for sick and wounded in the areas concerned.

The sick and wounded were evacuated toward the interior under either the "normal" or the "exceptional" plan. The former, after being cured, rejoined their depots. The latter, consisting of rapidly curable cases, were granted sick leave (congé de convalescence) upon discharge from the hospital, after which they proceeded to the front, passing through the regulating station of their unit.

These were the rules which governed the medical services in the armies and they were always applied in a broad sense, following the spirit rather than the letter. This was feasible only through close cooperation between the Medical Service and the military command.

VI. *General Arrangements for the Evacuation of the Wounded.*[1]

It is necessary to consider the following evacuations separately:

A. Within the Zone of the Armies,

B. Outside of the Zone of the Armies.

A. *Evacuation in the Zone of the Armies.*

1. The main organizations for the clearing of the wounded were the evacuation hospitals, which were established partly under double tents containing thirty beds each, partly under hangars arranged for the reception of wounded and containing one hundred and twenty beds each and, partly in temporary wooden barracks, either double (type Santé) or single type (type Adrian).

The number of beds in an evacuation hospital ranged from two thousand to three thousand (maximum), divided into wards of five hundred beds, each forming a sort of small hospital within the large evacuation hospital. (H. O. E.)

It was necessary to figure on one advanced evacuation hospital (H. O. E. primaire) per army corps in line, supplemented by a rear evacuation hospital (H. O. E. secondaire); the former at fifteen to twenty kilometers from the lines and the latter from one hundred to two hundred kilometers away.

In addition to the evacuation hospitals, there were special army hospitals in varying numbers.

2. The method of transportation between the advanced field hospitals (which numbered one or two per division, and two for the unassigned units (E. N. E.) of an army corps) and the evacuation hospitals was by means of the medical motor transport service. One S. S. A. section (20 vehicles) was attached to each division and, in addition, there were available the corps, army and, if necessary, the G. H. Q. reserves, distributed according to needs. "Fords" were considered best for divisions; while "Berliets" and "Fiats" were preferable for evacuations in the rear zone.

3. The number of men evacuated in the Zone of the Armies was represented: (*a*) By a fairly regular number, namely, the usual, readily estimated, daily loss (2% to 3% of the strength); (*b*) by an irregular number, varying according to operations (wounded, gassed) or epidemics (dysentery, influenza). In battle, a division lost an average of five hundred men the first day, five hundred the second day, and one hundred men during each of the following days. Of one hundred wounded, 30% could be treated on the spot and 70% had to be evacuated.

4. The number of lying cases carried by the S. S. A. was, on the average, half of the total number of wounded. The remainder were transported in T. P. or T. M. motor trucks (personnel or material

[1] See chart 14, Chap. XIII, Vol. I.

motor transport sections) far enough away not to block or encumber the highways (even though the men were able to walk).

B. *Evacuation outside the Zone of the Armies.*

1. The number and class of hospitals varied according to their distance from the front. Near the Zone of the Armies, it was necessary to establish hospitals in temporary barracks (secondary or tertiary evacuation hospitals), in permanent barracks, or in schools transformed into hospitals. In the interior, ordinary hospitals, Red Cross hospitals, and welfare organization hospitals were used. Their number varied according to their capacity. Hospitals were to have a capacity of not less than one hundred nor more than one thousand beds; the best were those with five hundred beds.

2. The only means of transportation employed between the Zone of the Armies and the Zone of the Interior were the hospital trains. In addition, hospital trains were used between the primary and the secondary evacuation hospitals.

3. Waterways were occasionally used in the Zone of the Armies (Somme, Aisne, Oisne, Marne), but never in the Zone of the Interior.

VII. *Hospitalization and Evacuation of the Wounded and Sick During the War 1914–1918.*

Whether in warfare of position or movement, two rules applied:

1. Retain on the spot two divergent kinds of cases, i. e.: the very serious cases, which could not be moved without danger of death, and the very light cases which were quickly cured.

2. Evacuate the movable cases: By stages, if they were serious, or, far to the rear, if they were less serious but required a prolonged absence from their unit; finally, immediate removal, although only to nearby points, of slightly wounded who would recover rapidly.

VIII. *Statistical Information.*

The medical units of the interior were very numerous. There were 360,000 beds, of which 100,000 were at the disposal of the armies. Information as to their distribution could only be given by the Under Secretary of State for the Medical Service, at Paris. The armies had 200,000 beds in their own zone and 110,000 beds in the adjacent rear zone.

The armies had 583 field hospitals (of the 1910 type), with 212 hospitalization sections (of the 1910 type); 33 evacuation hospitals; 69 supplementary army hospitals; 34 surgical motor field hospitals, (of which 27 were of the 1915, and 7 of the 1917 type) and 3 light surgical groups (1918 type). In addition, there were 180 sterilization and X-ray trucks; 205 mobil or stationary laboratories; 1,300 temporary barracks (type Santé); 1,600 temporary barracks of various kinds; 1,100 Bessonneau tents; 200 Bessonneau hangars; 141,000 comfortable tents; 150,000 litters; 135 stationary disinfecting plants and 36 mobile disinfectors.

The depots for the convalescents and lame organized and directed by the Medical Service varied in number; there were, on an average, forty of these depots, two thirds of which were in the billeting and rear areas.

During the war, 3,303,847 sick or wounded were hospitalized in the Zone of the Armies, the sick and wounded being about equal in number.

During the war, 10,745,385 wounded or sick were transported by 195 medical motor transport sections.

There were 189 hospital trains in operation, of which six were "permanent" (standard hospital trains), 148 "semi-permanent" and thirty-five "improvised" (converted). The regular hospital trains carried, on an average, 120 lying cases and the semi-permanent trains 100 lying and 200 sitting cases, while ordinary passenger trains could transport 1,200 sitting cases.

During the war hospital trains evacuated 4,988,663 sick or wounded. Half of this number went to the Zone of the Armies and the other half to the interior; the ratio of sick to wounded was about equal.

About 80% of the sick or wounded evacuated returned to the front.

The medical personnel of the armies numbered 9,193 surgeons, 163 of whom came from colonial troops. Of this number 4,243 were with medical units, proper, 3,024 with the Infantry, 1,043 with the Artillery, etc. Moreover, 570 mobile or stationary surgical crews were organized.

There were 2,131 pharmacists, 1,194 administrative officers and approximately 60,000 male nurses in the medical units of the armies.

The number of female nurses varied. They were kept for a long time with rear units. (Information as to their number and distribution can be furnished by the Under Secretary—Medical Service.)

IX. *Statistics Concerning Wounded and Nature of Wounds.*

The proportion of killed in action as compared with the total number killed and wounded (deaths from disease not included), is 18.36% or about one killed to every four wounded, the missing not being considered.

This proportion is considerably increased and reaches about 23%, or one killed to every three wounded, if it is considered (and this is probably true) that many of the missing were blown to pieces, crushed or buried.

X. *Proportion of Killed on the Field of Battle During the Principal Engagements.*

In this calculation it is not possible, for each battle, to differentiate between the missing and the prisoners, hence partial figures concerning the number of missing reported for each battle have been disregarded. The proportion of killed who remained on the field of

battle is calculated by taking into account the total number of killed accounted for and the number of wounded who were picked up.

Starting with the 18.36% killed in action, as compared to the total number of killed remaining on the field and of wounded who were picked up, the comparative figures for each battle are as follows:

	Per cent killed on the field.
1st battle of the Woevre (April, 1915)	25.73
2nd battle of Artois (May–June, 1915)	20.39
2nd battle of Champagne (September, 1915)	20.24
3rd battle of Artois (September, 1915)	23.24
Battle of Verdun (February–December, 1916)	21.52
Battle of the Somme (July–November, 1916)	22.04
2nd battle of the Aisne (April–July, 1917)	21.61
2nd battle of Flanders (July–October, 1917)	17.63
2nd Verdun offensive (August–December, 1917)	16.00
Battle of la Malmaison (October, 1917)	22.52
2nd battle of Picardy (March–June, 1918)	15.34
3rd battle of Flanders (April–June, 1918)	15.73
3rd battle of the Aisne (May–June, 1918)	16.79
Battle of Matz (June, 1918)	14.50
2nd battle of the Marne (July, 1918)	14.47
Battle of the Ailette (August–September, 1918)	14.29
Battle of the Oise, of the Serre and of the Aisne (September–October, 1918)	11.59
Battle of Champagne and of the Argonne (September–October, 1918)	14.52

Stationary warfare: General average, 21 per cent.
War of movement: General average, 14.66 per cent.

As a general conclusion, the proportion of killed in action appears to be less in open warfare than in position warfare.

Roughly speaking, of the sick and wounded evacuated toward the interior, there were two sick for every three wounded. This excess of wounded should be compared with the data on European wars of the past.

For the year 1918, the general statistics were:

	Per cent.
Wounded	54.25
Sick	30.00
Gassed	15.75

XI. *Classification of Wounds According to Anatomical Location.*

By combining the statistics for 1917 and 1918, the following proportions are reached:

	Average per cent.
Head	15.50
Thorax	9.76
Spine	3.24
Abdomen	4.51
Arms	31.60
Legs	35.79

These figures do not permit of absolute deductions.

Since the killed in action are not included in this calculation by percentages, it can be understood why the proportion of thoracic and abdominal wounds, as given above, is relatively small; as a matter of fact this class of injuries, as well as wounds to the vascular trunks, frequently cause death on the battle field, while very serious cranio-encephalic lesions did not produce death so rapidly and permitted the wounded to be brought to a medical center.

XII. *Multiple Wounds.*

According to the statistics of the Army for 1917, the following proportion of men who had been wounded several times was observed:

In April 1917, 4th Army	per cent	21.03
In April 1917, 5th Army	do	20.00
In April 1917, 6th and 10th Armies	do	11.00
In October 1917, battle of La Malmaison	do	20.00

XIII. *Classification of Wounds According to Weapons.*

In the wars previous to 1914, bullets caused about 75% of the wounds.

At the end of 1914, and during the period 1916–1917 (stabilized warfare), the following figures obtained:

	Approximate per cent
Bullet wounds	16.
Shells, bombs and grenade fragments	76.
Other causes	8.

In 1918, during the war of movment (open warfare), the following obtained:

	Approximate per cent
Bullet	30.
Shells, bombs and grenadte fragments	58.
Other causes	12.

XIV. *Number of Wounded According to the Days of Battle.*

First, in a limited offensive.

Champagne, September 1915.
Somme, July 1916.
Soissons, April 1917.
Verdun, August 1917.
La Malmaison, October 1917.

On the day of the attack the most exposed divisions had an average of 560 wounded, with a maximum of 1,200 wounded for the most stricken one.

Less exposed divisions had an average of 384 wounded.

On the day before the attack the average number of wounded was 500 for the most exposed divisions, and about 300 for the less exposed divisions.

XV. *Proportion of Wounded According to the Possibilities of Evacuation.*

As a result of numerous observations, the proportion of wounded who could not be evacuated was found to be from 20 to 25 percent, while the proportion of wounded capable of being evacuated a long distance was 74 to 80 percent.

In considering the wounded who could not be evacuated (20–25%) two classes should be distinguished:

First, those who could not be transported or who could not go beyond the advanced groups of medical stations.

Second, those unable to be evacuated, properly speaking, and who came to the evacuation hospitals or to the army hospital centers for treatment.

The wounded capable of being evacuated (74 to 80%) can also be divided into two classes.

First, those with minor wounds (scratches, bruises, etc.) rapidly curable and who, for military reasons and to prevent shrinkage of man power, should be kept near the front; their proportion was from 18.5 to 23%.

Second, those with wounds of medium gravity, who could be evacuated to the zone of the lines of communication or to the interior, of which the proportion was about 60%.

In considering the assignment of means of transportation, sufficient transportation for the total number of wounded incapable of being evacuated (20 to 25%) and for at least 20% of the wounded capable of being evacuated (that is, from 35 to 42% of the total number of wounded), should be reserved for lying cases.

XVI. *Statistics Resulting from the Evolution of Wounded.*

A. *Mortality according to nature of wounds.*

First—Mortality in the Armies.

	Per cent of deaths of the wounded taken into the hospitals.		
	1916	1917	1918
Medical units in the zone of the advance	4.60	5.12	5.36
Medical units in the zone of the L. of C. (Etapes)	7.18	0.73	1.29

It should be noted that, as a matter of fact, during the battle of Verdun and the battle of the Somme the lines of communication medical units contributed more than at any other period of the campaign to the primary hospitalization of the seriously wounded.

Second—Mortality in the interior.

During the period August 1914–January 1916, statistics concerning the Zone of the Interior show a mortality of 2.25% out of the total number of wounded treated in the regional hospitals.

The total deaths from wounds should be compared with the total deaths from disease during the same period (August 1914–January 1916). It is to be noted that this phase of the war was marked by a relatively high percentage of deaths from disease due to the fact that an epidemic of typhoid fever occurred during the first part of this period.

During the period covered by the years 1916, 1917 and 1918, there was a proportion of 0.94% deaths from wounds, as compared with the total number of wounded treated in the regional hospitals.

The deaths from wounds should be compared with the total of deaths from disease during this same period. It should be noted that there were 34,819 deaths from disease in 1918 and these figures coincide with the influenza (grippe) epidemic which occurred in that year.

Summed up, the total deaths from wounds in the medical formations of the armies and in the regional hospitals may be stated as 250,000, to which should be added 674,700 killed in action, giving a total of 924,700 deaths from wounds. If the number of missing who are presumed to have been killed in action is added thereto, the total is approximately 1,150,000.

The difference between 1,150,000 deaths from wounds and 1,325,000 (i. e., the total number of dead and missing during the war) or 175,000, represents, approximately, the total number of deaths from disease during the war.

B. *Wounded cured and returned to service.*

From July 1, 1916 to December 31, 1916, the average monthly total number of men who recovered and were re-equipped by the regulating stations and returned to service amounted to 50,904.

In 1917, this monthly average was 46,477, while in 1918 it amounted to 60,003.

In deriving this monthly average no discrimination was made between those suffering from disease and those suffering from wounds. During the years 1916, 1917 and 1918, the percentage of wounded cured and sent back was 78.99%.

C. *Maimed.*

The number of amputations undertaken in the armies from August 1917 to November 1918, during the principal battles, amounted to 5,170 amputations out of 253,419 wounded who passed through the army medical stations, or one amputation for every 49 wounded.

Up to the 31st of December 1919, 40,824 artificial limbs were furnished as follows.

Amputations during the war (31 Dec. 1919).

	Total number.	Proportion per 1,000 men operated on.		Total number.	Proportion per 1,000 men operated on.
Partial amputations of the hand	449	11	Amputation of the legs	9,063	222
Amputation at the wrist	164	4	Amputation at the knee	367	9
Amputation of the forearm	3,796	93	Amputation at the thigh	15,922	390
Amputation at the elbow	367	9	Amputation at the hips	285	7
Amputation of the arm	6,532	160			
Amputation at the shoulder	1,307	32	Total	40,824	
Partial amputation of the foot	2,042	50			
Amputation of the tibio-tarsal part of the leg (lower)	530	13			

In addition to the number of surgical amputation cases, 54,156 maimed were supplied with artificial articulations.

XVII. *Supply of Medical Material.*

(Chart 13, Chapter XIII, Vol. I.)

At the beginning of the war, it was necessary to purchase medical supplies in neutral and allied countries. Later, however, French production about equaled the consumption.

A. *Current supplies and medicines.*

a. In France, the medical supplies for the armies were stored in intermediate depots (stations-magasins) which were designated to supply certain armies. The intermediate depots supplied the armies assigned to them by means of reserves of medical material held at the regulating stations.

During the war distribution stations for mattresses, filling stations for oxygen tanks, and repair shops for surgical instruments were established in the regulating stations.

b. At the same time, the armies often organized advanced reserves of medical material (R. A. M. S.) which were very useful, particularly during important operations. However, the maintenance of large advanced stores of medical supplies close to the front was very dangerous, on account of possible bombardments and the risk of capture in case of a sudden advance by the enemy.

There was a unit of supply, known as "Basic Supply" (ravitaillement de base) which was calculated to provide the necessary medical supplies for 50,000 men during a period of ten days and 5, 6 or 7 "basic supply" units, were permanently maintained in each advanced reserve of medical material (R. A. M. S.).

Requisitions for medical supplies and drugs for each unit, large or small, as well as for the medical services, were coordinated by the Army Medical Inspector (Medecin-Inspecteur de l'Armée) who filled them from his own advanced reserves (R. A. M. S.) or from the medical reserves of the regulating stations (R. M. S.).

Theoretically, requisitions for such supplies were filled at the regulating stations and shipped from there to the railheads by means of the daily supply trains (train journalier de ravitaillement).

At the railheads the motor transport of the "army corps litter-bearers" (G. B. C.) received the supplies and distributed them to the "groups of divisional litter-bearers" (G. B. D.).

The latter sent the supplies to the troops by means of animal drawn transportation.

In urgent cases, the motor transport of the "G. B. C." carried medical supplies for the troops in action right up to the first lines.

B. *Technical matériel.*

Technical medical formations (surgical ambulances, motorized sterilizing and radiological (X-ray) plants, mobile laundries, mobile bathing (shower) establishments and sanitary sections) were supplied by the main storehouses of the Medical Service. The latter were informed of changes in the location of the technical units and provided for the supply of personnel and matériel to these special units. The main establishments were located in Paris.

During the war, to facilitate liaison between the main medical storehouses and the armies, a branch of these supply establishments, known as the "Medical Technical Echelon" (Echelon Technique Sanitaire) was established in each army. The commanding officer of the "Medical Technical Echelon" looked after the technical matériel and assured its supply. These supplies were delivered by motor transport which left Paris to go to the motor transport parks of the armies and, by motor transport from these parks to the units concerned.

CHAPTER XII.

SECTION III.

MEDICAL SERVICE—BELGIAN ARMY.[1]

INTRODUCTION.

The Medical Service of the Belgian Army had for its mission:

1) Provide for the care and treatment of the sick and wounded on the battle field.

2) Assure the evacuation of the sick and wounded toward the hospitals.

3) Assure sufficient hospital capacity to meet all demands created by battle operations.

4) The maintenance of the professional standard of medical officers.

5) Supervise the sanitary conditions of the Army and provide establishments for the rehabilitation of the wounded and maimed.

The organization of the office of the "Inspector General of the Medical Service" (I. G. S. S.) is shown in Chart 4, Chapter XIII, Vol. I.

HISTORICAL STATEMENT.

The reorganization of the Belgian Army was planned in 1913. It was in the course of development when, in 1914, Belgium was forced to defend her honor and her independence. In spite of obstacles encountered, as for example the abandonment of all the establishments situated in Belgian territory, including those of Antwerp, the Medical Service, after four years of war, retained the confidence of the High Command and accomplished its task to the general satisfaction of all concerned.

EVACUATION OF ANTWERP AND THE BATTLE OF THE YSER.

At the mobilization, the Inspector General of the Medical Service of the Army (I. G. S. S.) had 166 regular military surgeons, 520 reserve surgeons and 172 medical students at his disposal. To this personnel should be added 148 pharmacists, 965 medical service men and 1,850 litter bearers, recruited from among men who had been exempted from the Army in time of peace.

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[1] Prepared for the M. B. A. S. by the Belgian Ministry of War.

The Medical Service retained the immediate direction of the hospitals at Antwerp, Liége, Namur, Termonde, Beverloo, Brussels, Louvain, Malines and Vilvorde. All of the other establishmments passed under the direction of the Belgian Red Cross. However, during the first weeks of hostilities, the Medical Service was obliged to take over the direction of the hospitals at Mons, Tournai, Ghent, Bruges, Ostende and Ypres. On the 15th of August, 50,000 beds were available for the wounded in the various hospitals which had been organized throughout the country. The fall of Liége and of Namur, the entry of the enemy into Brussels, and the retirement of the Belgian Army to Antwerp on August 20th, followed by its retreat and stabilization upon the Yser, caused the loss of all the establishments located in the interior of the country.

About the middle of October 1914, after two months of war, the situation was as follows: The Belgian Army eluded the Duke of Wurtemberg and came into proximity of the coast, after having abandoned Antwerp. Ostende and Zeebruge had become provisional bases, while awaiting the centralization of the Services of the Rear which were soon to be established in France. The wounded who were in the hospitals in the interior of the country and who could be moved, poured to the coast where beds had only been provided for two to three thousand men. In villas and hotels, hastily reopened, were some 13,000 unfortunates. The Medical Service had been compelled to abandon most of its permanent equipment, notably two-thirds of the supplies of the Central Pharmacy. Two hospital trains, a hospital section of the 2nd Army Division, and four hospital sections of the 4th Division had fallen into the hands of the Germans, while the number of surgeons dropped to about 460, as the enemy detained a large number of them as prisoners of war. The evacuation of the wounded towards the coast could only be effected gradually as it was necessary to conceal operations, which the High Command had planned when it foresaw the loss of Antwerp, from the enemy. The single available railroad line was to effect, first of all, the saving of the Army's supplies and the trains, unknown to all, crossed the bridges which were less liable to come under the enemy's fire under cover of night. The wounded passed afterwards. The wounded evacuated from Antwerp were joined by those who had been evacuated from Ghent and their arrival on the coast required speedy action.

The British Admiralty, on being consulted, requested ten days in which to embark the wounded and thus remove them from all danger. But the pressure of the enemy and the uncertainty as to when liaison with the Allies would be finally established showed that such a delay was impossible. The assembling at Ostende by October 13th of all the wounded, who were scattered in the various

northern localities, was therefore considered necessary by the military authorities. The same day a thousand wounded were sent to England aboard the Government mailboats and thus the general evacuation began.

The Government and General Headquarters left the town. The preceding days panics had occurred in various hospitals where patients, haunted by the fear of being abandoned, had suddenly fled to the streets despite the efforts of the medical personnel. However, the necessary means had been assembled and, in the space of sixteen hours, more than 13,000 wounded, sick and lame were evacuated without mishap, thanks to the assistance of the Allies. Of this number, 8,500 were brought by rail to Dunkerque, a large port accessible to large ships, from whence they embarked for England.

Three days later the Belgian Army took up its position in the Yser region, which it was to immortalize, and renewed the battle which shattered the German drive against Calais. At first, the Belgian Army could not depend on any of its own establishments and this, together with the necessity of not overloading the intrenched camp at Dunkerque, which was exposed to immediate attack in the event of a withdrawal of the lines, forced it to place the first installations 80 kilometers from the front.

During the latter half of October, 1914, during the evacuation of the Flanders coast, the majority of the Belgian wounded were sent to Dunkerque and to Calais. Dunkerque was both a fortress and a port. The uncertainty of future events forbade keeping such wounded in the fortress as were able to continue on their way to Calais. The medical personnel experienced the greatest difficulties at this time. Everything was lacking, there was not a single Belgian hospital in Calais and even indispensable materials could not be obtained for the improvised medical installations. The French and Belgian surgeons were reduced to renewing dressings in the waiting rooms of railway stations. Attention is called to the fact that two hospitals were in operation at Furnes during the battle: a) The British surgical unit which had functioned at Antwerp and which founded the "Belgian Field Hospital" (origin of the base hospital at Hoogestade; b) a unit of Belgian military surgeons which functioned at the civil hospital of Furnes. The four military hospitals at Calais were filled. Wounded who could be moved were brought to the port direct, by whatever means were available, and loaded upon boats going to England or to Cherbour. Between the 21st and 31st of October 10,634 were evacuated in this manner in twenty transports. There was also an immediate need for the establishment of hospitals to care for the wounded who could not be transported.

On October 17th, a start was made by taking over five private clinics, a dispensary and a few of the beds in the "Asylum for Old Men". Subsequently, the locomotive repair shop at the Calais railway station was transformed into a classification hospital and "hôpital de passage", while on the 18th, five more hospitals were opened, giving a total of 683 beds.

About this time the battle of the Yser began and the flow of wounded increased day by day, with the result that the establishments which had just been opened were soon overwhelmed.

On the 18th and 19th of October, eight new hospitals were organized (170 beds); the 22nd, one (177 beds); the 24th, four and on the 25th, two. In spite of this increase and although transportation by sea became regular and frequent (500 wounded were evacuated on the 23rd; 400 the 24th; 1,200 the 25th and more than 2,100 on the 27th), the hospital capacity of Calais remained insufficient. Subsequently, seven more hospitals were opened. Most of the hospitals were formerly school buildings or churches, generously placed at the disposal of the Belgian Medical Service by the municipal authorities or by the congregations.

At first, most of the wounded lay upon the bare ground; later, straw was obtained. The situation nevertheless improved rapidly. Some of the inhabitants generously loaned their mattresses and the French Administration placed 700 beds at the disposal of the Belgian wounded.

Drugs, especially antiseptics and dressing materials, were often lacking. The only surgical instruments available were those which were contained in the portable medical kits, (the equipment in the operating room of the Franciscan Sisters' hospital consisted of a case of instruments technically known as a "Congo Kit" (Boite du Congo").

Food was insufficient and many hospitals were at first supplied by the charitable civilian population. The Belgian wounded at Dunkerque received the same charitable welcome accorded those at Calais. On the whole, there were only 2,000 beds available and the Belgian Medical Corps concentrated its efforts toward getting the wounded in shape so that they might be transported to Cherbourg, Southampton or Folkstone, ports from whence they could finally be sent to the numerous hospitals which had been created by means of French and British donations.

During the months which followed the battle of the Yser, when the influx of wounded again surpassed the capacity of the Calais establishments, recourse was had to evacuations upon England. The number of wounded sent to England can be estimated at about 28,000.

In January 1915, the hospital organizations of the French 10th Region, with headquarters at Rennes, were placed at the disposal of

the Belgian Government by the French Government; this region was at a distance of 500 kilometers from the front. Thus 5,000 beds, distributed among thirty-one hospitals, were placed at the disposal of the Belgian troops.

It is a matter of record that on October 26, 1914, the Belgians opened the sluices at Nieuport and inundated the country. They resisted desperately for six days while waiting for the waters to reach the desired level and on October 31, the Belgian troops, assisted by a few French units which had been sent as reinforcements, drove the Germans out of Ramscappelle by a final bayonet charge.

On November 10, 1914, after fighting four hours with cold steel, the enemy captured Dixmude. Thereafter, and for a long period, this front hardly changed.

It is very difficult to determine the extent of the work of the Medical Service during that time. It is known, however, that during the last thirteen days of October 1914, 11,098 soldiers, among whom 9,050 wounded, passed through the improvised medical establishments.

On October 18, 1914, five car-loads of drugs, dressings, and hospital supplies remained in stock. The pharmaceutical machines and equipment had been abandoned in Antwerp and local resources were nil. It therefore became necessary to send agents to Paris and London to procure sufficient supplies. Nevertheless, despite the number of seriously wounded, there were but 418 deaths among the 11,098 men treated, or an average of 0.29 per cent.

From the above, an idea may be gained of the task entrusted to and devolving upon the Medical Service and, although the stabilization of operations tended to decrease the transport difficulties inherent to the mobility of troops and to the displacement of advanced medical units, on the other hand it maintained the Army in a zone which was very dangerous from a sanitary point of view.

The duties of the battle surgeon were probably lightened, but the task of the hygienist was greatly increased and, when the Yser battle ended, winter was approaching and nothing was in readiness for a sojourn in such an unhealthy region.

The troops lived in the rain and mud, beneath flimsy shelters, with only a negligible number of shelter halves. The normal population of the entire region amounted to only 11,000 souls. This population was suddenly quadrupled, first by the Army and then by the influx of inhabitants who were fleeing from the invaded regions.

Drinking water was lacking, wells were contaminated and cisterns were insufficient. The number of sick in the various hospitals increased considerably. In December, 1914, the proportion attained 1.78 per cent of the effectives and, in January, 1915, 2.55 per cent. This was a most critical period.

The authorities acted energetically and by constructing barracks, drains, bathing establishments and laundries, as well as by other prophylactic measures, they reduced the suffering of the troops to a minimum during this period of the war.

ARMY PHARMACIES.

Medicines, dressings, surgical equipment, disinfecting apparatus, gas masks and preservatives against gases were supplied to the Army by the Central Pharmacy, which carried one month's stock of all the materials needed.

At the beginning of the campaign, the Central Pharmacy of the Army was located at Antwerp. During the retreat toward the Yser it was transferred, first to Zeebrugge and then to Calais. This establishment retained its mobility by being installed aboard one of the mail boats of the Ostende-Dover line. This ship, which was anchored in the harbor of Calais, was a floating depot. It had to be given up later owing to the necessity for returning naval material to its original functions on account of the maritime losses suffered through submarine warfare, and the Army Pharmacy was therefore transferred to land.

A laboratory for analyses and chemical experiments was created in connection with the pharmacy. The day this laboratory was opened, the Germans launched their first attack by means of asphyxiating gas. The Main Pharmacy analyzed the liquid matter with which a protecting mask worn by an enemy prisoner was impregnated, and a few days later the Belgian Army was provided with an emergency mask which successfully overcame the effects of the gases used at that time.

A. Evacuations in the Zone of the Armies.

(Chart 6, Chap. XIII, Vol. I.)

PRINCIPLES—DIRECTION—MEANS OF EVACUATION AND HOSPITALIZATION.

1) *Principles*—The rules governing the evacuation of the wounded were based on the principle that evacuation must be effected as rapidly as possible and in the order of the most urgent cases first.

2) *Direction*—In each Army Division, the Medical Service was directed by the Divisional Surgeon (Médecin Divisionnaire) attached to headquarters. In the units the service was directed by the Regimental Surgeon (Médecin de Régiment), under whose orders were from 5 to 7 surgeons.

3) *Means of evacuation and hospitalization*—Each division had the following means of evacuation and hospitalization at its disposal:

a) An "*Ambulance Column*" (Colonne d'Ambulance—C. A.), with animal drawn transportation, consisting of:

10 four-wheeled ambulances
1 mobile pharmacy
2 vans for hospital material
6 medical litter wagons
1 mobile dressing station.

The personnel was directed by a surgeon, with the rank of Regimental Surgeon, assisted by 6 or 7 surgeons or assistant-surgeons, and was composed at first of about 250 hospital attendants and stretcher bearers (men exempted from the Army in peace time). Later, some of these men were detached as medical personnel with the units.

b) 2 "*Hospitalization Sections*" (3 had been provided for originally)—(Sections d'hospitalisation—S.H.) Each "Hospitalization Section" had:

2 vans of hospital material
1 mobile pharmacy
1 mobile dressing station
1 medical litter wagon.

c) The "*Motor Transport Ambulance Column*" (Colonne automobile d'ambulances et de brancards—C. A. A. B.) composed of:

40 motor ambulances
3 motor trucks with stretchers.

The functions of these medical formations were to follow the division in its movements and establish, according to circumstances, either an evacuation center or hospitals by means of their hospital material and by the utilization of local resources.

The "Ambulance Column" served, principally, to establish a center where all sick and wounded were brought and where they were classified so that they could be evacuated to a hospital establishment specially suited to their particular case.

The hospitalization services acted rather as small temporary hospitals (infirmaries) where the sick and the slightly wounded, requiring but a few days' treatment, were cared for until they could rejoin their units.

The "Motor Transport Ambulance Column" was charged with the transport and evacuation of sick and wounded between the front lines, the divisional medical formations, the field hospitals and the army evacuation hospitals.

d) *Organization of the Medical Service on the battle field.*—On the battle field, the Medical Service was organized as follows:

Briefly, a wounded man first used his "first-aid" package, with or without the assistance of one of the medical corps men of his unit. He was then sent to the nearest first-aid station, where one or more battalion surgeons were located. There he received first-aid and was then evacuated to the loading point (point de prise en charge—P. Ch.), either on foot or upon a stretcher.

The regimental surgeon's station often constituted the "loading point" (P. Ch.), and, in practice, it was very often the "automobile loading point" (point de prise en charge automobile—P. Ch. A.), at the same time. From the "loading point" (P. Ch.) or from the "automobile loading point" (P. Ch. A.), the wounded man was brought by animal-drawn ambulance, more often by motor ambulance, to the divisional dressing station (place de pansements divisionnaires—P. P. D.)

Serious wound cases, requiring urgent surgical treatment, were sent direct from the "loading point" (P. Ch.) to an "advanced surgical station" (poste chirurgical avancé—P. C. A.) These were advanced surgical units detailed to the front by the field hospitals.

From the "divisional dressing stations" (P. P. D.) wounded were sent:

1) To the "evacuation center for wounded" (centre d'évacuation des blessés—C. E. B.) established by the "army evacuation hospital" (hôpital d'évacuation d'Armeé—H. E. A.) at which point they were loaded upon and evacuated by hospital trains, either:—

2) To one of the field hospitals (hôpitaux du front), in serious cases which could not withstand a long trip, or,

3) To a hospitalization section (S. H.), established as an infirmary for lightly wounded cases.

During the period of stabilization, these various medical organizations functioned in the same manner as during open warfare.

The slightly wounded and sick were cared for temporarily in the "Ambulance Column" (C. A.) which functioned as a "divisional dressing station" (P. P. D.) and from there they were sent to a divisional infirmary. The purpose of the divisional infirmaries was to lessen, as much as possible, the number of evacuations toward the rear. They were in reality hospitals for minor diseases and special medical clinics were annexed thereto, such as those for venereal diseases, eye trouble, etc. A dental laboratory was also connected therewith. Such an organization, in close proximity to the troops, was possible only on account of the stabilization of the Belgian front.

Three hospitals, known as "Field Hospitals" (Hôpitaux du Front), were established at the beginning of the war. The surgical personnel of these hospitals was composed entirely of military surgeons of the Belgian Army. These hospitals were provided with

the latest scientific equipment, including operating rooms, sterilizing rooms, a complete equipment of surgical instruments and material, X-ray room, research laboratories, etc.

They were primarily intended to handle serious cases, requiring urgent surgical attention which could not be given at the more advanced medical stations, and which required an operation before they would be able to reach the hospitals further to the rear.

The "Field Hospitals" were directly under the "Inspector General of the Medical Service" (Inspecteur Général Service de Santé—I. G. S. S.). Their location was determined by the Army Command.

The wounded left the zone of the army through the "army evacuation hospital" (Hôpital d'évacuation de l'Armée—H. E. A.), a medical establishment functioning as a center of evacuation for the wounded.

EVACUATION OUTSIDE OF THE ZONE OF THE ARMIES.

Beyond the Zone of the Armies, the wounded and sick were evacuated to the permanent hospitals of the interior. Motor ambulances brought the wounded to the evacuation hospitals, where they were placed upon hospital trains which brought them to the Army base at Calais. At the railway station of the base hospital at Calais was a medical station called "Hôpital de Passage," which was a medical regulating station where the wounded were finally classified and sent to the hospital in the interior best fitted to take care of their particular case.

In addition to the slightly wounded arriving from the front, these medical regulating stations also received wounded who had already been treated in the "Field Hospitals." Those belonging to the last named category usually consisted of serious cases. Furthermore, the convalescents and sick were also evacuated through these establishments and were sent to special establishments according to the nature of their case, (tuberculars, mental cases, nervous cases, blind, etc.).

A large number of hospitals were operated in France by the Belgians for the treatment of special diseases. A list of these will be found at the end of this section.

MEANS OF TRANSPORTATION.

The "ambulance columns" and the "automobile ambulance and stretcher column" were used for the transport of the sick and wounded between the "loading point" (P.Ch.) and the evacuation hospitals. Between the evacuation hospitals and the medical regulating stations (hôpitaux de passage), hospital evacuation trains were employed.

Ambulances and cell wagons were used for the evacuation of the insane between the evacuation hospitals and the medical regulating stations (hôpitaux de passage). From the hospitals at the base at Calais or from the medical regulating stations (hôpitaux de passage), to the hospitals in the interior, the following transportation was employed:

1. Ordinary trains for sitting cases (sick and wounded).
2. Automobiles for the dangerously insane evacuated to the hospital at Dury-lez-Amiens.
3. Hospital cars attached, as far as Tours, to the hospital train for evacuations to the hospital centers in France.
4. Hospital cars attached to ordinary trains.

The rolling stock of the Medical Department was grouped in a "Medical Service Railway Park" (Parc sur Rails du Service de Santé—P. R. S. S.).

After the battle of the Yser, the "P. R. S. S." was organized in three sections:

1st section consisted of eight mixed evacuation trains.
2nd section consisted of eight evacuation trains for lying cases.
3rd section consisted of four evacuation trains for sitting cases.
1 "Park Depot" or supply train (T. D. P.)

The trains of the first section consisted of:

6 hospital coaches for lying cases.
2 third-class passenger coaches for sitting cases.
3 kitchen cars.

The trains of the second section consisted of:

8 hospital coaches for lying cases.
3 baggage cars, one of which was used as a kitchen car.

The trains on the third section consisted of:

8 third class coaches for sitting cases.
3 baggage cars, of which one was a kitchen car.

The "T. D. P." consisted of:

8 box cars used as offices.
1 mobile pharmacy.
1 car used as a mobile railway shop.

EVACUATIONS TO ENGLAND.

The first ships employed in the transport of wounded to England were the Government mail boats. They were turbine ships which had been turned over to the British Admiralty for this purpose. Later, the British Admiralty furnished ships for this service. The period during which evacuations were made to England was short

and only lasted from October 1914 to April 1915. It is estimated that 23,000 men were evacuated to England during that period.[2]

After April 1915, the Belgian hospitals in England received only the wounded and sick from the Belgian organizations in Great Britain, such as supply commissions, volunteers, munition factories, etc.

In June 1915, the Minister of War decided to organize a rehabilitation vocational training school. By January 1916, 950 men had received training and 42 trades were being taught. Later, an agricultural course was added and, finally, schools were established to prepare wounded soldiers for government service in postal and telegraph offices, custom houses, railroads, and the government provincial and commercial services.

In 1916, an institution for the rehabilitation of the blind was established at Amiens.

MEDICAL SUPPLIES.[3]

How procured: The supplies for the Medical Department of the Belgian Army were furnished principally by England and France. At the time of the battle of the Yser, when the national territory had for the most part been evacuated, missions were sent to England to purchase hospital material (bed and bedding), and to France for surgical and medical supplies. The Belgian Medical Service also received donations from various committees, such as the "British-Antwerp Hospital Fund," the "Belgian Hospital Fund," the New Zealand Committee" and numerous private gifts of surgical instruments, medical matériel, dressings, motor ambulances, etc.

Later, a "Director General of the Armament and Technical Services of the Army" (Directeur Général de l'Armement et des Services Techniques de l'Armée—D. G. A. S. T. A.) was established in France. Under his orders was the "Central Purchasing Committee" and a section of this committee was charged with the purchase of surgical and medical equipment. The supply requirements of the Medical Service of the Army were brought to the attention of this service.

A permanent Belgian supply commission was also established in England for the purchase of medical supplies in that country.

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[2] When the first evacuations to England took place no indication as to the final destination of the wounded could be given. A mission of Belgian surgeons was sent to England, in November 1914, to locate and assemble these patients, as well as those evacuated to France. Later, this mission was charged with establishing Belgian hospitals in England. Three hospitals, under the general name of "King Albert Hospitals," were opened in London. After the evacuation of the Belgian wounded to France, only one of these "King Albert Hospitals" was kept open.

[3] See Chart 5, Chapter XIII, Vol. I.

From April 1916 on, the Belgian Pharmaceutical Department alone, purchased £90,000 of supplies in England.

SYSTEM OF STORAGE.

When war was declared there was no general depot for the storage of hospital or medical supplies. All the available medical supplies were stored in the military hospitals. Each hospital carried a ten per cent surplus in reserve, while the Central Pharmacy was to maintain a reserve of six months' supplies.

At the beginning of 1915, it became necessary to construct a storehouse at Le Havre for the storage of medical supplies and, to minimize losses in case of fire, branch depots were established at Fécamp, Conchil-le-Temple and Gravelines (2 hospitals of 200 beds each in reserve).

Following the advance of the troops in 1918, a depot was opened at Bruges. In the meantime, the depots at Conchil-le-Temple and at Fécamp were closed and their supplies were sent to the general depot at Le Havre. After the Armistice the hospitals which had been established in France were closed and the general depot at Le Havre, being no longer required, was transferred to Vilvorde in January 1919.

During 1915, supplies were carried for 5,000 patients. As the war continued, these supplies were increased and reserves of supplies were provided as follows: in 1916 for 20,000; 1917 for 15,000 and in 1918 for 8,000 patients, respectively.

SYSTEM OF DISTRIBUTION.

The directors of the military hospitals requisitioned supplies at the end of each quarter. These requisitions were carefully verified by the chief surgeons who saw to it that requests were made for only such supplies as were indispensable. Requisitions were then forwarded through military channels, to the War Department. To requisitions for increased supplies, the chief surgeon attached a report explaining the necessity for such increase. After having passed upon these requisitions, the War Department ordered the "General Depot for Hospital Material" to supply the hospital concerned.

The shipment of supplies from the general depot for hospital material was done without transfer of funds and it was the same for supplies which the Ministry of War ordered transferred from one hospital to another.

After April 1916, (when the Medical Service became an independent organization), requests for hospital material were transmitted direct to the I. G. S. S., who thereupon gave the necessary orders for shipments from the general depot.

Hospital statistics.[1]

	Capacity.	Maximum capacity.	Specialty.
1. FIELD HOSPITALS.			
Vinckem H. (Red Cross)	250	900	Major Surgery.
L'Océan H. (Red Cross)	900	1,200	Do.
Beveren H	630	700	Do.
Hoogstade H	200	300	Do.
Cabour H	410	700	Gas and fever cases.
2. EVACUATION HOSPITALS.			
The "H. E. A." at Adinkerke (3 detached sections).			
3. BASE HOSPITALS.			
At Calais:			
Petit Fort Philippe	326	417	Wounded and sick.
Porte de Gravelines	1,200	1,480	Do.
Virval	432	432	Surgical cases.
Anglo-Belgian	180	210	Contagious diseases.
Industrial	280	280	Wounded and sick.
Elizabeth Ambulance	148	148	Surgical cases.
St. Emile School	112	112	Mental cases.
27-rue des Soupirants	165	165	Wounded and sick.
Franciscan Sisters	59	59	Do.
Quai de l'Est	71	71	Sick
In the vicinity of Calais:			
Valloire	316	316	Convalescents.
Rocques	322	512	Do.
Guemps	555	555	Convalescents (contagious).
Neuville	120	120	Convalescents.
Gravelines	35	35	Transients.
Bourbourg	375	375	Sick and wounded.
HOSPITALS IN THE INTERIOR.			
At Le Havre and vicinity:			
Rue Ancelot	584	584	Sick and wounded; ophthalmological section and venereal section.
Hellandes	536	536	Convalescents.
Auberville	200	200	Sick and wounded.
At Rouen and vicinity:			
Bonsecours	1,447	1,447	Seriously wounded; prothesis; mechanotherephy; electro-therapy and physicotherapy.
St. Aubin	273	273	Convalescents.
Orival	280	280	Venereal cases.
Ligugé	345	345	Convalescents.
Montpelier	288	288	Tuberculous cases.
Fontgombault	454	454	Convalescents.
Cauvalat	168	168	Tuberculous cases.
Chambéry	150	150	Do.
Soligny-la-Trappe	176	176	Convulsions and nervous disorders.
At Paris and vicinity:			
Hospital Albert I	180	180	Slightly wounded.
Courbevoie	80	80	Convalescents.
Special services for prothesis and maxillo-facial surgery.	47	47	Facial surgery operations (prothesis).
At Cap Ferrat and vicinity:			
Cèdres	250	250	Convalescents and seriously wounded.
Col de Caire	265	265	Tuberculous cases.
At Mortain and vicinity:			
Mortain	635	635	Sick and wounded.
Saint Lô	200	228	Sick.
Cherbourg	485	535	Sick and wounded.
Villiers-le-Sec	750	825	Do.
St. Lunaire	386	386	Do.
Dinard	500	570	Rest camp for refugees and refugee convalescents.
St. Meen	200	200	Sick.
Bonnemain	21	38	Convalescents.
St. Jacques de la Mer	150	200	Do.
Châteaugiron	161	386	Mental cases.
Juaye-Mondaye	225	386	Nervous cases.
4. CONVALESCENT DEPOTS.			
Pourville-lez-Dieppe	67	67	Convalescents.
Caen	146	146	Do.
Cherbourg	160	160	Do.
Port-Bail	213	213	Do.
St Pair	387	387	Do.
Le Mans	97	97	Do.

[1] Chart 7, Chapter XIII, Vol. I.

ANNEX—CHAPTER XII—SECTION III.

ORGANIZATION OF THE OFFICE OF THE INSPECTOR GENERAL OF THE MEDICAL SERVICE (BELGIUM).

1. *Office of the Director General*, confidential affairs, general information, archives, forwarding of documents.

2. *1st Direction:* Technique of the Medical Service, including hygiene, technical paper work of hospitals, functions of the Medical Service in hospitals, in garrisons, in troop units, preparation of technical regulations to be included in military regulations.

Examination, from a medical point of view, of the claims for pensions on account of disability incurred in service.

Examination of questions concerning war veterans.

To this direction were attached the technical committee of the Medical Service and the Belgian Red Cross.

3. *2nd Direction:* Organization and training.

Organization and composition of the medical units in times of peace and war, tables of organization for personnel, equipment and transportation.

Training: Medical School, Postgraduate school, School for stretcher bearers and hospital attendants.

Personnel: Officers, troops (surgeons, pharmacists, administrative officers, Medical Service troops, nurses, etc.)

History of the Medical Service, publications, statistics.

4. *3rd Direction:* Matériel and buildings.

Medical and surgical materiel, pharmaceutical supplies, purchases, buildings, construction, upkeep, barracks, lazarettos, heating, lighting, etc.

Parks and vehicles, medical transport units.

5. *4th Direction:* Administration and accounting service of the Medical Department, hospital material.

Management of hospitals, miscellaneous expenses of the Medical Service, insurance, contracts for the hospital services.

CHAPTER XII.

SECTION IV.

MEDICAL SERVICE (ITALIAN).

In time of war the Medical Service collected, evacuated and treated the sick and wounded, preserved the health of the troops, and provided all medical and anti-gas equipment.

The organization of the service at the beginning of the war followed the provisions of the mobilization plan, and it remained practically unchanged, with the exception of minor modifications necessitated by the new conditions arising from the military situation.

ADMINISTRATIVE ORGANS.

(Chart 15, Chapter XIII, Volume I.)

With the General Commissariat:

a) The Medical Inspector General. He was the chief of the medical organization in the field and had technical control over all of the medical administrative services in the Zone of the Armies.

b) The Medical Section. Charged with the supply of medical material to the armies and army corps.

With the armies and army corps:

c) The army and army corps Medical Administration.

With the divisions:

d) The divisional Medical Offices.

The newly created administrative organizations were:

1. An Inspecting Commission for the prevention of contagious diseases, located at the General Commissariat, and composed of members from both the military and civil Boards of Health. This commission supervised the carrying out of preventative sanitation in the Zone of the Armies.

2. Inspecting Sanitary Sections at each army Commissariat, whose functions were similar to those of the Inspecting Commission but whose scope was limited to the zone of their particular army.

3. An Inspection and Supply Center for the bacteriological laboratories.

EXECUTIVE ORGANS.

The executive organizations consisted of the various military medical units. These were divided into: "First line services,"

which included first aid posts, divisional medical sections, army corps hospitals and field hospitals (ospedaletti); and: "Second line services," which included all of the medical establishments on the lines of communication, such as camp hospitals, base hospitals, reserve hospitals in the zone of the rear, medical convoys and depots for medical stores, etc.

WITH THE TROOP UNITS.

The medical field units were commanded by a medical officer who was attached to the regimental headquarters (Comandi). He was assisted by two medical subalterns in each infantry battalion and by regimental stretcher-bearers. At the beginning of the war, two stretcher-bearers were assigned to each infantry company; these were subsequently increased to four and the number of stretcher-bearers assigned to other troop units was also doubled.

The quantities of medical supplies prescribed for the various units by the prewar regulations remained the same, with the exception of an increase in the number of stretchers proportionate to the increase in the number of stretcher-bearers.

MEDICAL SECTIONS.

These sections were under the orders of the Divisional Medical Offices. They provided regular medical treatment for the wounded and were also responsible for their evacuation.

The Army Regulations in effect at the date of the mobilization provided one medical section per division and one additional section for the army corps troops but, early in 1916, the additional sections were withdrawn from the army corps and assigned to newly organized units.

During the first months of the war, the medical sections were unable to handle the evacuation of the wounded on account of the insufficient means at their disposal, and it became necessary to increase the number of motor ambulances which had been assigned to each section from two to four.

FIELD HOSPITALS.

There were three kinds of field hospitals, according to their capacity, namely: 200-bed, 100-bed and 50-bed hospitals. These field hospitals retained their initial classification throughout the war, although their original capacity was often increased on account of the peculiar conditions arising from trench warfare. Due to these conditions, the field hospitals lost a great deal of their mobility. They were therefore established in permanent buildings or huts and assumed a stationary character.

SPECIAL MEDICAL UNITS.

As the war progressed, better facilities had to be provided for the treatment of the sick and wounded. Permanent detachments of medical specialists were organized and assigned to each Commissariat and to the mobile camp units. These special, mobile, medical units included surgical, X-ray, ophthalmic and stomachic (stomatoiatriche) detachments and were provided with specially equipped motor trucks. They were designed to perform emergency operations in the areas of the first lines.

MEDICAL TREATMENT OF THE SICK.

The medical treatment of the sick was carried out, at first, in accordance with prewar regulations. Later, the medical services, the auxiliary services, and the medical establishments were merged so as to provide better means for the rapid return of the sick to service and to protect the Army from excessive losses of manpower through disease. Army corps infirmaries were established, field establishments were enlarged, medical stations for the treatment of special cases (specialita medica), as well as convalescent hospitals and camps, were organized and the Sanitary Service (preventative hygiene) was improved. The percentage of deaths, as compared to that of previous wars, decreased considerably and the 4% mortality which had been anticipated was reduced to 2%.

CARE OF THE WOUNDED.

The following services provided for the care and treatment of the wounded:

Motorized surgical sections (Ambulanze Chirurgiche): These were composed of skilled medical personnel, with special surgical equipment and provided with motor transportation. The motorized surgical sections visited the advanced positions and medical stations and performed urgent major surgical operations.

SURGICAL GROUPS.

The "Surgical groups" were composed of specialists, temporarily assigned to hospitals which required additional surgical personnel on account of increased activities.

MOTORIZED X-RAY LABORATORIES (AMBULANZE RADIOLOGISCHE).

During active operations the motorized X-ray laboratories went from one field hospital to another, wherever needed, and were employed in connection with surgical operations.

Throughout the war proper medical and surgical attention for the troops was considered of vital importance and was the object of special study. In the first line, the battalion first-aid posts, medical sections, motorized surgical sections, surgical groups and the special camp hospitals formed a successive network of medical establishments, and the wounded were distributed among them according to the gravity and nature of their injuries. In the second line, larger and more completely equipped installations supplemented the work of the first line medical formations.

As a result of the prolonged periods of active operations, modern methods of warfare and the use of new weapons, prewar experiences and estimates were found to be practically worthless. Modern warfare developed the following facts:

(a) Losses in proportion to the strength of the Army were found to be greatly inferior to those sustained in previous wars (although, in certain sections of the front, the percentage of losses among the large units was equally as high). This was probably due to the fact that there were no important open warfare engagements and to the adoption of new defensive and protective means.

(b) In so far as the nature of wounds was concerned, wounds caused by artillery fire attained a preponderance and assumed from 50 to 75 per cent of the total injuries. This resulted, no doubt, from the increased employment of this arm and the adoption of trench artillery.

(c) Regarding gravity of wounds, it was found that there was a larger percentage of serious wounds, due to the powerful effects of modern weapons and projectiles.

TREATMENT OF SPECIAL CASES.

Specialists, chosen from among the most famous University professors, were assigned to each branch (Arma). They acted as consulting surgeons and went wherever their services were required; moreover, special medical detachments were placed under their orders. Assisted by these special medical units, the consulting surgeons were particularly assigned to treat stomachic, psychiatric, venereal and other special clinical cases. These units rendered excellent service (rendimento).

SUPPLY OF MEDICAL MATERIAL.

(Chart 16, Chapter XIII, Volume I.)

To each army was assigned a "Central Medical Supply Depot" which was stocked by the Ministry of War to meet the requirements of the various armies and in accordance with the requests of the General Commissariat.

The central depots at the disposal of the army Medical Administrations supplied the advanced medical depots which, in turn, supplied the zones in the proximity of the firing lines. This facilitated the delivery of supplies to the field hospitals and medical sections. The troops generally obtained their supplies direct from the medical sections.

The kinds and quantities of medical supplies allotted the various medical field units were regulated according to current needs. Thanks to the foresight of the Italian manufacturers, many of whom had enlarged their plants for the purpose, the Italian Army always had sufficient medical supplies to meet all emergencies.

EVACUATION OF THE WOUNDED.

(Chart 17, Chapter XIII, Volume I.)

Means for the rapid evacuation of the wounded from the firing line to the mobile field units and from the latter to the hospitals in the interior, were constantly studied by the medical administrative authorities.

The wounded were picked up on the battle field by stretcher bearers and carried to the first-aid posts, where they received first aid. They were then removed to the medical sections, either on stretchers, on mule back, or in motor or animal drawn ambulances, by the divisional units. The transportation employed depended on which means were readily available.

In the high mountainous regions, in winter, sleds were used extensively to transport the wounded. The ingenious scheme of attaching skis under the stretchers was adopted and resulted in the construction of stretchers on runners (stretcher-sleds). Aerial cable railways (teleferiche) were of great assistance in transporting the sick and wounded in the mountain districts. The aerial railways reduced the duration of the transport to a minimum and caused the least possible discomfort to the patients, who would otherwise have been carried over long, and usually very dangerous, roads on mule back or on stretchers.

After having given the wounded all possible attention the medical sections sheltered those who, on account of the serious nature of their wounds, could not be transported and evacuated the others to the various army corps field hospitals with the means at their disposal.

The wounded were classified for the first time in the field hospitals. Those who were expected to recover within 10 days remained in these hospitals, received treatment and, upon recovery, were returned to their respective units. The others were removed to the field hospitals or to the reserve hospitals of the army Commissariats by

motor ambulances, ordinary motor cars, or by special trains which had been assigned to the armies for this purpose.

The distribution of the wounded was regulated by the army Commissariats and those who required special treatment were sent to the various special medical formations. The removal of the sick and wounded to the hospitals in the interior of the country was regulated by an office (section) at the General Commissariat and such cases were transported exclusively by hospital trains.

In order to have a sufficient number of beds available within the territory which had been assigned to it, each army Commissariat informed the General Commissariat as to the number of wounded to be transferred and reported on the condition of the latter, particularly in connection with the existence of contagious diseases.

The wounded or sick who were not suffering from contagious diseases were sent direct to the hospitals of the interior; those suspected of having contracted contagious diseases were sent to special hospitals located in the rear of the Zone of the Armies, where they remained under observation for a certain length of time.

HOSPITAL TRAINS.

Most of the Italian hospital trains belonged to various welfare organizations (Red Cross, etc.). As a matter of fact, at the beginning of the war the Italian Army possessed only sixteen hospital trains and these were simply converted freight cars; moreover, the measures which had been taken to render these improvised hospital trains serviceable for use on long journeys proved unsuccessful.

However, Italy's deficiency in this respect was soon remedied and plans for a new type of hospital train were develcped. The new type of hospital train consisted of third-class corridor passenger coaches, equipped with heating apparatus, and to which kitchen and infirmary cars were attached. Construction on the new model hospital trains began toward the end of 1916 and these trains gradually took over the traffic which had formerly been handled by the Italian Red Cross and the "S. M. O. M." societies. Fifty nine of the new type hospital trains were constructed during the war.

CONSERVATION OF MAN POWER.

The Italian Medical Service constantly endeavored to cure the sick and wounded and return them to their respective units, wherever located, within the shortest possible time.

It was therefore provided that the sick and wounded who were likely to recover within a short time be treated in the unit infirmaries or in the medical establishments of the Army Corps, so as to assure

their return to their respective organizations as soon as they were completely recovered.

In the case of the seriously sick and wounded, only those requiring lengthy treatment (thirty days for the men and sixty days for officers) were evacuated to the interior of the country. The sick and wounded who remained in the Commissariat hospitals were sent to the medical establishments of the interior as rapidly as possible. Officers were sent to convalescent hospitals and men to the convalescent depots on the lines of communication. Recovered cases were placed at the disposal of the various army headquarters for assignment to the "Replacement (training) battalions" (Battaglioni di marcia). These battalions were special organizations to which men were sent for the purpose of undergoing special training and rehabilitation and to prepare them for reassignment to front line units (in linea).

In order to enforce compliance with regulations concerning the return of the sick and wounded to active service as soon as possible after recovery, the Supreme Command organized a "Central Medical Commission", at the General Commissariat and a "Medical Committee" for each army. Toward the end of the war, the above mentioned organizations were supplemented by another "Central Medical Commission" and the organization of "Medical Sub-Committees." The latter were under the orders of the Army Medical Committees (council).

The Army Medical Committees and Sub-Committees operated in the Zone of the Armies proper and, at stated periods, re-examined soldiers who had been declared unfit for service with combat units and who had therefore been assigned to special detachments at the various headquarters, other special organizations (corpi), or to second line establishments and services.

In the same manner and for the same purpose, the Central Medical Commissions operated in the other territories which were included in the Zone of the Armies; moreover, the authority of these central commissions was extended to cover the medical reserve establishments and the regimental depots, as well as the examination of casuals on sick leave within this zone.

Soldiers evacuated into the interior or granted sick leave outside of the Zone of the Armies were obliged, upon recovery, to report to their respective mobilization centers. These men were then used in the formation of new units or were assigned as replacements for the "Replacement (training) battalions."

SANITATION AND PREVENTATIVE HYGIENE (PROFILASSI).

The Sanitary Service and the Service for the prevention of contagious diseases, which had been organized during the war, were

results of stern necessity. These services formed a protective barrier between the Army and the contagious epidemics which, owing to the concentration of large masses of men within restricted areas, as well as contact with the enemy, might have spread among the troops and the civil population.

Thanks to the efficient preventative measures adopted by these services, incipient outbreaks of cholera (in 1915), smallpox (in 1918) and typhus (in 1919) were restricted to a small area, with but few losses, and these diseases were rapidly eradicated.

The administrative organs of the Sanitary Service were:

The Sanitary Inspecting Commission at the General Commissariat.

The Sanitary Inspecting Sections with the various army Commissariats.

The Inspection and Supply Center for the bacteriological laboratories (which has already been mentioned above).

The executive organs of this service were:

The Bacteriological Laboratories, assigned in varying numbers and in accordance with the requirements of the troops.

The segregation (quarantine) camps for prisoners of war.

Special hospital (quarantine) trains for the transportation of contagious cases. Two of these special hospital trains were exclusively used for the transportation of repatriated Italian prisoners of war who were suffering from tuberculosis.

Disinfecting Sections: These were newly created units, each composed of more than eighty men, divided into three sections (squads) and equipped with the necessary means for the sanitation of the battle fields. One section was assigned to each army corps and army.

The preventative sanitary measures prescribed by the Italian medical authorities included inoculation against typhus, typhoid and cholera; moreover, a Government decree rendered vaccination compulsory.

CHEMICAL WARFARE (ANTI-GAS) SERVICE.

This service was also organized during the war. From the beginning of the war the organization of a Chemical Warfare (anti-gas) Service became an urgent necessity and plans for the creation of such a service were thoroughly studied. These plans resulted in the formation of a most efficient organization which was responsible for the provision of chemical (gas) means of offense and defense.

The first type of mask used in the Italian Army was known as the "alculine" model and this mask had been improvised as a means of protection against "alogeni" gas. This mask was immediately followed by an improved model (of which there were three types: "polivalente," with detachable eye-pieces; ordinary "polivalente", and Italian "polivalente Z") which provided pro-

tection against various gases (" fosgene," " chetoni," " bromo-chetoni," etc.)

Gas mask production attained unforeseen proportions and the combined military and auxiliary establishments produced, on the average, 30,000 masks per day. The replacement of unserviceable gas masks was carried out with all possible speed. Supplies of gas masks were either shipped by rail from the main depots at Milan, Bologna, Florence, etc., direct to the advanced medical depots (M. A. M. S.) or else sufficient stocks of masks were maintained in these advanced depots to meet the requirements of their respective armies.

The troops received general instructions concerning gas warfare and were taught how to assist gas victims. Special training courses were instituted where instruction in the use of gas masks and other means of defense against gas was given and, finally, a system of gas observation and gas alarm posts was organized in the trenches.

Later, when gas was used on a larger scale and the employment of " Yprite " gas increased the effects of this means of attack, it became necessary to provide adequate counter measures and the Chemical Warfare Service assumed a very important position from both the military and the industrial standpoint.

The Supreme Command and the General Commissariat provided the Army with British " respirator " masks; special clothing for protection against " mustard " gas (antipritici), including gloves, overshoes, etc.; trench gas-alarms (anemoscope, etc.); special materials for the construction of gas shelters (gas proof tents, ventilators, etc.) and special medical supplies for the treatment of gas cases, etc.

Approximately 2,000,000 British " respirator " masks, as well as hundreds of thousands of articles of protective clothing were issued to the troops. Anti-gas material of all kinds was prepared in the military and auxiliary establishments; tons of materials required in the preparation of anti-gas equipment were procured and utilized (although it was believed, at first, that the necessary kinds and quantities of materials could not be obtained); the production of oxygen containers was intensified in order to overcome the initial shortage, and thousands of these tanks were manufactured and distributed to the oxygen producing establishments, etc.

To provide for the supply and replacement of chemical warfare (anti-gas) materials, a special depot was organized and placed under the control of the General Commissariat. This depot contained stocks of all kinds of chemical warfare material required by the Army.

The organization of the Chemical Warfare Service was completed by the establishment of " anti-gas " first aid stations along the firing line especially equipped for the treatment of gas cases;

the formation of special medical units for the treatment of men suffering from the effects of "Yprite" gas; the creation of other special services and the inauguration of special courses of training for the surgeons and officers attached to the Chemical Warfare Service, etc.

Although the Chemical Warfare (anti-gas) Service required extensive preparation and organization, it responded to all demands made upon it, diminished the losses from gas and elevated the morale of the troops by overcoming the effects of the enemy's gas attacks.

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CHAPTER XII.

SECTION V.

THE MEDICAL SERVICES (AMERICAN).[1]

DUTIES.

The duties of the Medical Department comprised essentially:

The initiation of sanitary measures to insure the health of troops and of the inhabitants of occupied territory.

The care, methodical disposition and transportation of the sick and wounded.

The establishment of hospitals and other formations necessary for the care of the sick and wounded.

The supply of sanitary material.

The preparation and preservation of proper records of sickness and injury.

For our forces abroad this work was carried on through the office of the Chief Surgeon, American E. F., and the Chief Surgeon, S. O. S., and was divided into administration, personnel, hospitalization, finance, supply, transportation and sanitation activities.

The problem of hospitalization was the one upon which practically all else save sanitation was dependent. This problem was featured by lack of supplies, personnel and transportation, which needs were acute from January 1918 almost up to the signing of the Armistice. Questions of distribution and utilization, with rare exceptions seldom, caused anxiety.

The work of sanitation in the American E. F. presented many difficult problems, chiefly because of the nature of the country and its climate, together with the great dispersion of our new troops throughout the inhabited rural districts. Living conditions of the troops were uniformly unsatisfactory and the difficulties attendant upon new construction resulted in overcrowding and a very natural increase in the respiratory diseases. Great assistance was rendered by the corps and army sanitary schools, where every effort was made to train the new officers to meet the numerous difficulties of service with troops in France.

ORGANIZATION.

The organization of the control subdivision of the Medical Department of the A. E. F. is shown in Chart 8, Chapter XIII, Vol. I.

[1] "Some Accomplishments of the S. O. S."

GENERAL STAFF CONTROL OF MEDICAL ACTIVITIES.[2]

The Fourth Section, General Staff, G. H. Q., directed policies relative to the establishment and operation of means of hospitalization and evacuation of the sick and wounded of the A. E. F.; and also co-ordinated these with the other army activities.

This centralization of what may be called the strategic handling of our sanitary resources was a matter of rapid development. The successive steps of this development were made necessary by the constant increase in the American effort in the winning of the war. From the very first the section of the General Staff known as G–4 controlled the allowances; decided on the location of hospitals in all parts of France; ordered new construction and co-ordinated these projects with other activities of the A. E. F. The execution of these polices of procurement and location rested largely with certain sections of the S. O. S. After the organization of the A. E. F., the hospitalization section of the Chief Surgeon's office enjoyed direct touch with the G–4 in matters relating to the procurement of hospitals. When the Chief Surgeon moved to Tours, making his headquarters in the S. O. S., he left with G–4 two medical officers who were long familiar with this program. This small group was expanded and, under the direction of the Assistant Chief of Staff (A. C. of S.), G–4 became Group "B" of this section, supervising all the combat activities of the Medical Department in the Zone of the Armies; and many Medical Department matters arising in all branches of the General Staff were referred to G–4–B for study and recommendation.

A medical officer, later a member of G–4–B, had been on duty as medical observer in France before our entry into the war. Previous to arrival of Headquarters, A. E. F., he had visited and inspected the Atlantic ports and had taken up the matter of hospitalization with the French Minister of War. American medical officers were detailed as liaison agents in the office of the French "Sous-Secrétaire d'Etat du Service de Santé" and in the office of the Chief Surgeon of each of the French military regions; later an officer of the French Medical Department was attached to the Medical Group in G–4.

An intimate and cordial liaison was thus established and the French "Service de Santé" aided us even to the point of crippling its own service.

With the administration or professional conduct of our hospitals—our human repair shops—G–4 had nothing to do; but with the establishment and regulation of the transportation which brought the wounded to the hospitals; with the location and establishment of all the means of hospitalization in the Zone of the Advance; with the

[2] General Moseley's Report to the Commander in Chief.

organization of the vast clearing houses which daily distributed the wounded to base hospitals, G–4 had everything to do.

Perhaps one of the most dramatic accomplishments of the war may be covered in the brief statement that out of the grand total of 271,455 sick and wounded Americans evacuated through our five regulating stations at Connantre, Creil, Dunkerque, Le Bourget and St. Dizier, 98.9 per cent were treated in American hospitals, by American personnel, and were carried to our hospitals by trains or motor transport whose movements were controlled by Americans; all under the direction of G–4, G. H. Q., A. E. F.

MEDICAL SUPPLIES.[8]

(Chart 9, Chapter XIII, Vol. I.)

With the arrival of troops in June, July and August, 1917, large quantities of medical supplies accumulated upon the docks at St. Nazaire. At that time every effort was being made to acquire permanent storage facilities for the Medical Department in the various sections of the A. E. F. As far as possible, supplies were put under temporary shelter until depots could be located and established. The first depot was established at Cosne and later became known as Intermediate Medical Supply Depot No. 3. For many months this served as our large accumulating and distributing point. Following this there were established depots at Is-sur-Tille (Advance Medical Supply Depot No. 1), and another at Gièvres (Intermediate Medical Supply Depot No. 2). In addition to the small medical supply unit provided for each division, there were established eventually in the Zone of the Armies supply units as part of army parks. These parks usually carried about an eight days' reserve for the troops they were to serve.

It early became evident that the question of adequate medical supplies and equipment for the A. E. F. was to become a serious problem. Leaving the War Department at home to decide upon the quantity, character, and time for shipment would not meet our requirements. On the contrary, it was clearly evident that recourse on our part to routine requisitions would fall far short of remedying the situation. After numerous conferences an "automatic supply list" was drawn up. The original supply studies made and officially promulgated in the late summer of 1917, contemplated placing supply procurement for the Medical Department of the A. E. F. as far as possible upon an automatic basis, and assumed the early establishment in France of a ninety days' reserve. The accumulation of this ninety days' reserve was deemed essential and had of necessity to be incorporated into any procurement plan. Of the contemplated total reserve fifteen, thirty

[8] "Early problems of the Medical Department A. E. F." by Col. Tuttle, M. C.

and forty-five days' supplies were to be held in advance, intermediate and base sections respectively. The automatic unit adopted was the amount of medical supplies necessary for 25,000 men for one month. The method devised for building up the reserve was by shipment to France for all troops embarked (and with troops when possible) of a four months' supply, in addition to initial equipment. It was expected that troops en route to France would, before arrival at their final station in France, have consumed thirty days' supplies. This, therefore, would leave a balance of ninety days' supply which would accrue to the credit of the Medical Department in depot storage in France. Thereafter for each 25,000 troops in France there would be shipped to the A. E. F. each month one increment or unit of automatic supply in addition to the reserve shipments above mentioned.

Approximately 3,000 items appear on the automatic supply shipping list which was forwarded to the War Department and eventually adopted there. The prosecution of this scheme would have satisfactorily settled all supply difficulties. However, the upset in the shipping schedule, created by the sudden necessity of sending an unexpectedly large number of combat troops to Europe in the spring of 1918, brought about a realization that we would never be able to accumulate a ninety days' reserve in France. With a lack of bottoms to transport sufficient medical supplies to France, urgent needs rapidly ate into our small reserve and created in the supply depots a situation which we termed the "starvation period". At one time the situation bordered on the critical, and only through energetic efforts and extremely good judgment displayed by those charged with distribution was needless suffering averted.

To partially meet our needs European markets were combed with a view to obtaining in them any class of supplies, but particularly bulk articles, that would result in a saving on transatlantic tonnage. In European purchase the chief difficulty centered on the slowness of delivery. When a General Purchasing Board was established for operation in France and London, a medical officer was attached to it to represent the needs of the Medical Department. The term "tonnage" soon became a bugbear. One heard it on all sides. About every conceivable deficiency in the A. E. F. was, or perhaps could be, appropriately ascribed to lack of sufficient tonnage. In studying this problem early estimates by authorities in the United States had indicated that the Medical Department would require approximately 1 per cent of the total A. E. F. transatlantic tonnage. It was soon seen that, if shipments were conducted along any such basis, the building up of the much needed reserve could never be accomplished. A figure more in keeping with requirements would have been an allotment to the Medical Department of 1.8 per cent of

the total tonnage. For example, in February, 1918, despite conservancy efforts and comparative absence of combat activities, our reserve in depots in France fell below twenty days' supply. Fortunately, the stock was well balanced in essential articles. Urgent representation to our General Staff resulted in a big increase of medical tonnage allotments for the next two months. There was then put in force a system of tonnage allotments to the various supply services, apportioned monthly on a cabled statement from the United States of ship space available. Every effort was made by the General Staff to give the Medical Department a fair share of these allotments, but with another upset in the shipping schedule, receipts of medical supplies again began to fall off at a dangerous rate. Realizing that we could never accumulate a ninety days' reserve, forty-five days' supply was accepted as the figure at which we should aim, and every effort was concentrated on maintaining a balanced stock based on this figure. To make a long story short, we were never able to hit even this stride. However, in the final analysis, our automatic supply list was so nicely balanced and our purchases abroad so well timed that, while we experienced many anxious moments, to be sure, over the outlook, at no time did suffering or want on the part of sick and wounded arise through lack of essential medical supplies.[4]

A list of supply depots follows. Suitable buildings for supply depots were not available in France and construction was necessary in every instance except at Cosne, the first depot established. At the base ports, at Gièvres, and at Is-sur-Tille buildings of similar type were erected. Construction could only keep pace with the actual necessities of the day, thus making it impossible to reserve space for expected shipments or to properly segregate in separate buildings the various classes of supplies. At the time of the signing of the Armistice the Medical Department had established and in operation the following depots:

	Capacity (square feet).
Issue depots:	
Cosne	72,000
Is-sur-Tille	125,000
St. Nazaire	20,000
St. Sulpice	25,000
Storage and issue depot, Gièvres	375,000
Base storage depots:	
Montoir	146,250
St. Sulpice	225,000
Miramas	76,000
Hospital center depots:	
Bazoilles-sur-Meuse	10,000
Vittel-Contrexéville	6,000
Rimaucourt	5,200
Langres	2,000
Beaune	5,000
Mars-sur-Allier	12,000
Mesves	11,000
Vichy	9,000
Savenay	8,000
Allerey	10,000
Toul	13,500
Beau Désert	6,000
Clermont-Ferrand	6,000
Total	1,168,450

[4] The schematic representation of the supply activities Medical Department, A. E. F., are shown in Chart 10, Chapter XIII, Vol. I.

ESTABLISHMENT OF "ARMY DUMPS" (MEDICAL).[5]

As the "Paris Group" was organized, and later the First Army became organized, the establishment of army dumps became essential. The First Army dump established was at Lieusaint, and this was organized and administered for the purpose of supplying combat units in the Paris Group, and later the First Army.

The supply table authorized the replacements necessary for one combat division for eight days and the officer in charge of this distribution point was authorized to maintain in storage as many times this amount as there were combatant divisions in his sector. Gradually, however, a policy was developed of establishing corps or army dumps for which there was authorized a definite fixed stock maximum without reference to the number of combat units to be supplied, but based more upon the number of such dumps established in relationship to the known number of divisions to be employed in the operation. Such dumps, for instance, were established at Toul, Souilly, Vaubécourt, Fleury and Les Islettes, and in the order named.

MEDICAL SUPPLY ECHELONS AND SYSTEMS OF REPLENISHMENT.

Essentially this scheme of distribution involved the use of six echelons. They were as follows:

Divisional medical supply unit.
Army or corps medical supply park.
Army advance, medical supply park.
Advance Services of Supply depots.

It was the policy to establish in each base section, as the need developed, a small issuing depot to cover the local distribution problem, and in all Services of Supply sections there were established as parts of hospital centers similar units. These hospital center depots requisitioned and issued all medical supplies for their own centers.

The logical stock for army or corps dumps would include only items of combat equipment and supplies and trench stores, and divisional units would naturally only requisition such articles. It was, therefore, contemplated to immediately establish (and sites were actually selected) full stock army advance medical supply depots on the basis of one per army. The limit of the fixed stock maximum for dumps would have been decided by army G-4 upon the recommendation of army chief surgeon, and again could be modified only through the same channels. Such a policy precluded the possibility of a dump becoming so overlooked as to become immobile. The method of call by dumps upon the army advance unit would

[5] Extract report of the Surgeon General, 1919.

normally be in any informal manner. Thus depot officers in rear echelons in order to fill the calls from forward dumps had only to know shortages in authorized stock maximums.

Just as it was necessary to establish for army or corps dumps fixed stock maximums, so also was it essential in the case of army advance medical supply depots.

The method of call from units such as base and evacuation hospitals, etc., upon the army advance medical supply depot was formal, inasmuch as requisitions were made out by unit supply officers at proper intervals, and with the approval of the commanding officer of the unit were forwarded direct to the depot for filling. The army advance medical supply depot was essentially an army unit and under the direct control of the army commander, through his chief surgeon.

"CONTROLLED STORES" POLICY.

During the summer of 1918, the policy of "controlled stores" was developed and put into execution. This system centralized in one office distribution control up to the limit of depot requisitions and such other large shipments. Although the primary object of "controlled stores" was to place distribution under a comprehensive scheme in one office, it was also the object to centralize the huge question of accountability. Its establishment in the American Expeditionary Forces was in conformity also with accepted policies in vogue in the United States. This system would throw into one office (Chief Surgeon, S. O. S.) a record of all large receipts and at the same time all large requests. Having such data at hand, distribution was clearly facilitated and with a resulting great conservation of effort.

COMBAT HOSPITALIZATION AND EVACUATION.[8]

There are certain ideas governing modern practice in battle surgery which are not met with in the treatment of injured human beings in civil life. In battle the needs are: first, to get the wounded man away from the immediate line of battle; second, after diagnosing his injuries, to send him as far as possible from the line for surgical care and, third, after the surgical care is given, to send him entirely away from the front for recovery and convalescence.

In order to do these things, successive echelons of hospital organizations are maintained from front to rear, and the wounded are evacuated as rapidly as possible to units far from the front, in the endeavor to have at all times a maximum number of empty beds near the battle lines.

[8] General Moseley's report to the Commander in Chief.

The A. E. F. system of hospitalization and evacuation, evolved after close study of what had previously been accomplished by the Allies, was a combination of the scheme of action laid down in Field Service Regulations (F. S. R.) with the best practice of the French and British. (Chart 11, Chapter XIII, Vol. I.)

Immediately back of the battle lines are located the dressing stations. Practically all the wounded passed through them, for they were a combination of "first aid" and sorting stations where the wounded men received a hasty examination and a tag or label indicating the nature of the injury and its classification as to degree of severity.

A few kilometers in rear of these are the Field Hospitals, which are a part of the division which they serve. The very severely wounded, who constitute 8 per cent of all battle casualties, cannot usually be transported beyond the Field Hospitals without depriving many of them of their chance of recovery.

Several miles behind the Field Hospitals are the Evacuation Hospitals. These are also mobile, but are not under the control of the divisions. To them come the less severely wounded (32 per cent) and, as soon as they are able to travel, the very severely wounded also. In addition to both of these classes, the slightly wounded (40 per cent) who are usually able to walk unaided to the dressing stations or to the Field Hospitals, are brought here when they are found to need hospital care for any length of time. From the Evacuation Hospitals, all patients are sent as rapidly as may be to the Base Hospitals, large fixed units located far from the actual front and equipped for all sorts of medical and surgical care. When these are located in the Zone of the Advance they are known as Advance Base Hospitals, and even from these, all patients whose wounds are at all serious are eventually evacuated to other Base Hospitals in the rear, sometimes as far back as the base ports, there to remain until complete recovery or until their evacuation to the homeland. When surgical care is no longer necessary and the wounds have healed, but the patient still needs to regain his strength, he is finally evacuated to a Convalescence Hospital or Camp, there to await his restoration to duty after complete recuperation, or to civil life if physically unfit.

In providing for our battle casualties, main reliance was placed on the use of Evacuation Hospitals. Our shipping schedules called for two evacuation hospitals to be sent to France with each division. We never received more than 25 per cent of our allowance, but while no grave concern was caused in the early history of the A. E. F., it later became a matter of considerable anxiety. For fixed or trench warfare, the French Army was fairly well equipped; the lines had

remained in place long enough to permit the French to establish well organized Evacuation Hospitals, almost immediately behind their lines. When our divisions took over part of the trenches, we usually arranged with the French to have them turn over one or more of these hospitals to us and, of course, we possessed and operated our own divisional Field Hospitals. When, however, our wounded were admitted to French evacuation or base hospitals, numerous difficulties arose, largely because our American personnel were not permitted to look after our own wounded in the French hospitals. The French gave freely and generously of the best they had and undoubtedly did everything they could for our men, quite as much as for their own; but even if methods of treatment were of the best, still the difference in language frequently prevented our men from making their wants known and there was a very natural feeling on the part of our wounded that they preferred to be cared for by our own people.

Beginning with the great German offensive of March 21, 1918, a new situation was created—trench warfare over great sectors of the front became open warfare. Great changes in the battle lines took place daily. Immediately the tremendous need of transportation made itself felt. It was part of our first agreement with the French that when one of our divisions was assigned to a French corps for duty, the French Army would look after the hospitalization and evacuation of our wounded. The serious condition of the tactical situation led the French to withdraw our divisions from one part of the line and hurl them into another so quickly and secretly that the establishment of separate American hospitalization would have been difficult indeed. For instance, when the 1st and 2nd Divisions were hurriedly thrown into action on the Soissons front, the maneuver was executed with such speed and secrecy that it was quite impossible to establish American hospitalization directly behind them, and the French, already over crowded with wounded, were obliged to care for our men also in their hospital system. It must always be remembered, however, that this particular movement of American troops was a masterstroke of Foch himself. The German advance had been unbroken; in a few days they would have been able to pour tons of shells into Paris itself. Ludendorf had merely to smash our 3rd and 42nd Divisions and swing to the southwest. This never happened. The 3rd and "Rainbow" Divisions held, and our 1st and 2nd American Divisions, coming from Ludendorf never knew where, together with the French Moroccan Division, charged to the west of the Soissons salient on the morning of July 18 to the utter confusion of the Germans. From that moment, the Allies never ceased advancing. On August 31, 1918, it was agreed that

when American divisions were loaned to the French Army, due notice of impending movements should be given to proper American authorities so that American hospital facilities could be provided; and the French were further requested to designate suitable sites for American hospitals in their battle orders. The nine days serious operations on the Château-Thierry front were handled with smoothness and precision through our own American hospital formations. Our forces were operating with the French 6th Army, but we were given complete opportunity to care for our own wounded in our own way, while the French "Médecin Chef" assisted in every possible manner in the successful operation of our hospital trains and in the location of sites for hospitals. Every aid the French could give was ours.

During the great battle of Picardy in April, 1918, our 1st Division was put into the lines with the French Army at Cantigny, all necessary hospitalization to be furnished by the French. Because of the strained traffic conditions then existing, rendering unwise any duplication of hospital service, the French deemed it inexpedient to establish an American Evacuation Hospital in that sector. By arrangement with the French, however, we were permitted to establish a Red Cross Hospital at Beauvais, provided it would be known as a French military hospital with a French officer in command. With a mixed Army and Red Cross personnel, this hospital was immediately established and performed excellent service; yet, while this temporary arrangement was a distinct advantage, difficulty still remained because the men were evacuated to the rear in French hospital trains and to French hospitals all over France. Finally, permission was received to remove American wounded from such trains and send them to American hospitals as they passed through St. Germain, a suburb of Paris.

During the second battle of the Aisne (latter part of May, 1918), we had nine American divisions intermittently engaged, creating new problems of hospitalization. The French had unfortunately lost hospitalization to the extent of some 45,000 beds in the German advance and were not in a position to care for our casualties. For the first time, they therefore not only permitted, but aided us in every way to establish our own chain of hospital service. The difficulties seemed almost insurmountable. The transportation service in this part of France was so demoralized by the rapid German advance that it was indeed difficult to operate hospital trains, yet, by concentrating all our available resources in ambulances and by borrowing all we could secure from the French we were able to remove our wounded to Paris, where a Hospital Center with capacity of 10,000 wounded was created during this emergency. Plans were carefully made and carried out to provide for the large number of casualties

expected in the battle of St. Mihiel, but happily the number apprehended was never realized, and we were actually over-hospitalized; this in the face of critical shortages of personnel, ambulances, and other hospital equipment.

In the great Argonne-Meuse offensive two of our divisions, the 2nd and 36th, were assigned to the 4th French Army, but American Mobile and Evacuation Hospitals were established in the rear of these American divisions and cared for their heavy casualties with efficiency. The evacuation of the wounded was carried out in this territory by American and French hospital trains furnished through the Evacuation Section of our St. Dizier regulating station, even though the sector was under French command. Our Second Corps operated with the British Army, where the British hospitalization and evacuation resources were always available; consequently the unnecessary Field Hospitals and ambulance companies of each of the divisions actually brigaded with the British were concentrated in our training areas. This personnel was pooled and utilized from time to time wherever their services were most needed, and constituted a reserve which enabled us to carry out obligations we could not otherwise have met.

Two of our divisions, the 37th and 91st, were eventually sent to Belgium to cooperate with the French and Belgian forces in their final offensive. We sent with them an Evacuation Hospital, a Mobile Hospital, and two evacuation ambulance units, which were established behind our divisions; and with the aid of French and Belgian hospital trains, all our battle casualties in that sector were efficiently handled.

During nearly all American operations, our ambulance shortages were so serious as to necessitate the use of motor trucks for transporting wounded, but we were able to meet our requirements. Operating and other personnel in the hospitals worked day and night without rest during the big drives, and our hospital trains and ambulance transportation were operated to their maximum possibility. In the height of our operations we had twenty-one trains of our own and thirty or forty borrowed French trains in operation daily.

AMBULANCES.

There never were enough motor ambulances shipped to France to cover the needs of the A. E. F. During the early days of the A. E. F., the Medical Department was itself responsible for procuring ambulances, practically in competition with other branches of the service; this was later taken over by the Motor Transport Corps (M. T. C.). At first ambulances were shipped to France with their organizations,

but this was found impracticable, and the A. E. F. was notified by cable that ambulances in the future would be shipped to St. Nazaire for setting up. Incoming sanitary trains were eventually ordered to remain at base ports until completely equipped with transportation. At such base camps the personnel of each ambulance company or Field Hospital was required to report to the M. T. C. and assist in the assembly of their ambulances and motor vehicles; then to proceed overland in their own transportation to the Medical supply depot at Cosnes, where they would receive the remainder of their equipment. After being fully equipped each unit would join its divisions, wherever located, by the same means of travel. All transportation arriving for incoming sanitary trains was issued automatically to the nearest unit irrespective of its ownership. Shipments of ambulances previous to February, 1918, never covered current needs. Base Hospitals and Hospital Centers in the S. O. S. were also directed to send part of their personnel to base ports for their ambulances in much the same manner as sanitary trains of divisions. The constant shortage of ambulances rendered it impracticable to supply the smaller units. Pools of ambulances were established under control of the Chief Surgeon for all units not serving in the Zone of the Advance, and ambulances were furnished as needed, frequently being called upon in such emergencies as in the unloading of hospital trains. Organizations in the Zone of Advance were furnished their ambulances in accordance with Tables of Organization, but only on receipt of priority orders from G–4, G. H. Q., as this equipment was placed in Class IV.

MOBILE UNITS.

Each divisional sanitary train has four Field Hospitals, and similar units are assigned to corps and armies.

It was necessary to segregate one Field Hospital out of every four for special work in treatment of gas casualties, and to add to its facilities by allotting liberal supplies of new clothing and special chemicals, as well as shower baths. Another Field Hospital in each group was equipped to specialize in providing proper hospitalization for the severely wounded who could not, without grave danger, stand further transportation to the rear. A mobile surgical unit was attached, and extra bedding and operating material added. The remaining two out of four Field Hospitals continued to function normally.

A new type of hospital unit had been found necessary by our Allies and had been adopted by our Medical Department. It was called a Mobile Hospital, and has complete equipment for a modern

surgical hospital of 120 beds, with operating facilities for six surgical teams. Moved by truck transportation, it brought specialized surgical aid close to the battle line, giving the non-transportable wounded a chance for recovery, and it filled a very important role. It had been hoped to provide one Mobile Hospital for each combat division, but we were never able to place more than twelve complete units in operation.

Evacuation Hospitals are the backbone of combat hospitalization; they are army units and not part of the S. O. S. They are the great clearing-house in the chain of hospitalization of armies in the field. From them steady streams of wounded are evacuated to Base Hospitals in the rear by hospital trains, and for this reason they must be located on or near standard gauge railroad sidings.

Evacuation Hospitals were to have been automatically provided at the rate of two for each incoming division, but this was never accomplished because of shortage in tonnage. Under Tables of Organization, each was to have had a bed capacity of 432, but in the early stages of American operations it was realized that to meet modern battle conditions and to try to cover the shortage in number of Evacuation Hospitals, each one should have a capacity of 1,000 beds. This was accomplished by having a mobile section with 500 folding cots and other essential equipment, with tentage for quick transportation, and a semi-fixed section with 500 beds, mattresses and a more liberal hospitalization equipment. The mobile section practically followed the troops, while the semi-fixed section followed as soon as transportation by rail or truck became available, being installed close to the mobile-section in such buildings as could be found for shelter.

FIXED ESTABLISHMENTS.

Coincident with the first landing of American troops, the providing of hospital buildings for our sick and wounded became an instant duty. With the shortage of men and material in France, it was impossible to build American hospitals until such time as we could import forestry and construction personnel, as well as saw-mills and other appurtenances. We, therefore, called on the French Government, who turned over several hospitals to us and also aided us in obtaining suitable buildings. These were difficult to find, and we had to take hotels, barracks, schools, and even stables.

When we entered the war, France, Britain and Belgium had already secured nearly all of the best hospitalization facilities, and many hospitals had also been established by other than governmental agencies, such as the various benevolent societies throughout the world.

The only buildings we could therefore secure were usually difficult to adapt for the purpose, and to administer and maintain. French school buildings, for example, usually lack running water, toilet facilities and sewer connections, and under French law, the teaching personnel retain their living quarters therein.

The first American military hospital in France was established in St. Nazaire, and contained under one roof a boys' school, the French teaching staff with their families, and the American medical personnel together with cases of measles, mumps, scarlet fever and meningitis. Summer hotels and other buildings usually required extensive additions to the heating facilities, and in plumbing and water supply. Under French law when such buildings are taken possession of for military purposes, the owner is usually allowed to retain possession of certain parts and all must be restored to its original condition upon termination of the lease.

It was therefore necessary, for these and many other reasons, to design and construct our own fixed hospital establishments. The first and most important one of these, the Base Hospitals, were designed with a 1,000 bed capacity, expansible under a "peak-load" to double that number. In addition, smaller Camp Hospitals of 300 normal and 600 crisis capacity were provided. Plans as originally furnished by the War Department would have been excellent had it been possible to construct such buildings in France. Planned with full consideration for American ideas of comfort and sanitation, broad porches, ample plumbing and wide spaces between buildings, they simply could not be built in France from lack of labor and material. The Base Hospital groups (Type A) designed and constructed here were standardized and simplified so as to make use of the 20 by 100 foot portable huts, or any other easily constructed buildings approximating these dimensions and which could be readily obtained in Europe. (See American chapter on Construction for design and description.) As adequate sites could be secured, Base Hospital Centers were developed, each containing from two to ten or more Base Hospitals. There was naturally an economy in the installation of central water, sewerage and lighting plans, and efficiency was also secured by the simplification of the requirements for the administration and supply of such groups, as well as the bringing together of specialists in the various branches of the medical profession, some of whom could not well have been limited in their activities to a single hospital. In some of our projects, centers with a capacity of 20,000 beds were placed in construction, and the great center at Bazoilles was of tremendous importance from the very first.

The hut or barrack types of hospital buildings were built in sections at the factory, the respective parts being interchangeable so

that a building of any desired length could be built by erecting additional sections.

There were 153 Base Hospitals and 66 Camp Hospitals in operation on November 11, 1918.

HOSPITAL TRAINS.

The evacuation of sick and wounded from Evacuation and Advance Base Hospitals was carried out almost entirely by hospital trains.

On Armistice Day we actually owned 19 of the standard 16-car Army trains and two French hospital trains. Many more had been ordered, but these orders were cancelled in the interest of economy. The standard hospital trains were purchased in England in order to economize on tonnage and were really completely equipped mobile hospitals with facilities for giving every needed surgical attention and for serving hot meals enroute. They were designed after models used successfully by the Allies, with some adaptions tending toward American ideas of comfort. Owing to the shortages of material in France only two French trains were secured for our exclusive use, and these were of lesser capacity than the others, which could handle 400 "lying" cases or 650 mixed classes of patients. Many French trains were loaned to us on a daily "trip" rental basis but the two above mentioned were all that were actually ours.

Hospital trains were assigned for use to regulating stations on the order of the A. C. of S., G–4; in each of the great regulating stations an officer of the Sanitary Corps (Medical Department) was assigned with necessary assistants to direct the movement and supply of hospital trains for the local Regulating Officer, all working under the orders of G–4, G. H. Q.

Under the system eventually in use, reports were received daily, or twice each day, from all Evacuation Hospitals in a given area and allotments of empty beds in Base Hospitals in the rear were also wired to the Regulating Officer by the Commanding General, S. O. S. The chief of the Medical Group in the Regulating Office then caused all data to be tabulated; issued orders for the movements of hospital trains from garage to the various Evacuation Hospitals; for their loading with patients, and for their movements to destination and return to garage. The regulating stations thus became great clearing yards through which all wounded who could be moved were evacuated to the rear. The evacuation of wounded passing through St. Dizier from our operations in the great Meuse-Argonne offensive were more than double those handled by the French during the terrible days of the attack of Verdun.

Evacuation through St. Dizier, Meuse-Argonne Offensive, September 26–November 11, in 415 Hospital Trains.

	Per cent.	Evacuations.		Per cent.	Evacuations.
Officers	2.0	3,762	Wounded	51	79,415
Enlisted men	96.5	148,157	Sick	36	56,015
Others	1.5	[1] 2,989	Gassed	13	19,468
Total	100	154,898	Total	100	154,898

[1] Including 4,548 Second Army evacuations from Toul.

CONVALESCENT DEPOTS.

In all combat activities, a comparatively high percentage of casualties are but slightly wounded and do not need to occupy space in an Evacuation or Base Hospital; in fact, usually rather resent being considered as hospital cases. They do need rest and medical attention. If sent far to the rear, it usually takes a long time for them to get back to the front, making an unnecessary depletion of the effective fighting strength of the combat divisions. The problem is solved by the establishment of Convalescent Depots; really "rest camps", far enough from the front to be out of ordinary shell range, but near enough so that the men may return to duty without delay after the necessary rest and treatment. The essentials needed are merely proper sleeping accommodations (cots), good food, light exercise, and such work as the officer in charge may prescribe. Shelter may be either tentage or huts, and sometimes existing buildings may be found available. Many divisions established such depots on a small scale, and when the Armistice was declared, the Medical Department had begun the establishment of such a depot on a large scale at Révigny for the First Army, and had planned to establish one for each army at the front.

CONCENTRATION AREAS.

It was early recognized that incoming sanitary formations, such as Mobile and Evacuation Hospitals, ambulance companies, surgical teams and other front line personnel must be sent to some one definite locality for equipment and training. For this reason a Medical Department concentration area was set aside at Joinville (Haute-Marne), for exclusive use of sanitary formations, with a billeting capacity of approximately 500 officers and nurses and 10,000 enlisted men. While one of each type of unit was set up from time to time, for purposes of demonstration and training, it was not the intention to provide means of hospitalization therein. Overworked units were sent back to this area for "rest periods" and for the overhauling of equipment.

It was tactically so located as to be able to furnish units quickly to almost any part of our line in emergency, and the value of the area was amply demonstrated.

UNITED STATES ARMY AMBULANCE SERVICE.

Early in the European War the American colony in Paris organized and supported by voluntary contributions, a hospital at Neuilly called the "Ambulance Américaine." This eventually became generally known as the finest hospital in the world, for nothing was spared to render its equipment and facilities complete. During the first battle of the Marne, a beginning was made in organizing field transportation for this unit. Starting with a few remodeled Ford cars, eventually there were several sections, each of which contained twenty ambulances, a heavy truck for supplies, a kitchen trailer, and a Ford touring car for the use of officers. These units did most excellent work and were greatly appreciated by the French.

On the visit of Marshal Joffre to America in 1917, we were requested by the French to furnish additional ambulance sections of this kind, and the United States Army Ambulance Service was at once organized under orders of the War Department, absorbing the existing "Ambulance Américaine" units and forming others in the United States. After some 70 or 80 units reached France we were informed that no more were required by the French Government. It seems that this decision was made by the French Motor Transport Service rather than by their Medical Department, and was a matter of great regret to the latter when they learned of it. When the United States entered the war a large number of ambulances became immediately necessary and the A. E. F. was obliged to request assistance from the Allies. Notwithstanding their own serious shortages, this was freely given, even to the extent of the French and Italian Governments turning back to us a number of sections which had been organized and presented by America to them.

The excellent results obtained by these self-sustaining units were such that their organization, which was evolved from the experience of four years of war, may well be considered in any redraft of Tables of Organization.

SUMMARY OF HOSPITALIZATION AND EVACUATION ACTIVITIES.[1]

Hospitals in use in the war should be classified under two headings, (*a*) those for duty at the front, which were mobile, and served with the divisions, corps and army units, and (*b*) those fixed formations in the interior of France.

[1] Prepared for the M. B. A. S. by the Chief Surgeon, A. E. F.

(*a*) Hospitals for duty with the armies were allowed in the following proportion:

3 motorized and 1 animal drawn Field Hospital with the sanitary train of each division.

3 motorized Field Hospitals with each corps sanitary train.

4 motorized Field Hospitals with each army sanitary train.

Field Hospitals: These were equipped and organized as per Tables of Organization in the "Manual for the Medical Department." With the divisions it became necessary often to combine two of these hospitals, through which cases were sorted and sent to the rear. One Field Hospital had in addition a mobile surgical unit with extra bedding and surgical equipment. This was for the treatment of the wounded who were too ill to travel—"non-transportable." It became necessary to equip the fourth Field Hospital with devices for treating "Gas cases," including baths, extra clothing, chemicals, etc. Field Hospitals carried their own tentage, but whenever possible occupied such buildings as could be found in a suitable location.

Mobile Hospitals: These were authorized to the extent of one per division in action. Twelve were actually used. They were moved at will by the army surgeons and by their use, modern surgical hospital equipment could be carried well towards the front. Their equipment was largely surgical, including X-Ray apparatus, in connection with which there was an electric lighting plant, sterilizing apparatus, and all operating room features, as well as 120 beds and equipment for the same. Each Mobile Hospital had a complete mobile laundry. In these hospitals could be treated the severely wounded who, owing to their own physical condition or the condition of the roads and distance from other hospitals, could not be evacuated to the rear without jeopardizing the patient's chances for recovery. They were entirely transportable, it taking only a few hours to pack them. Though small, they were complete in every respect, the main difficulty in the World War being that there was insufficient transportation available to properly place them correctly at the right time. The Mobile Hospital and the mobile surgical unit were in many cases sent forward to augment Field and Evacuation Hospitals. Experience with this hospital in the war has fully justified its existence.

Mobile Surgical Units: This unit is transported on three trucks and contains electric light facilities, a small operating room and sterilizing and X-Ray equipment. It is intended to augment the Field Hospitals of a division, corps, or army, and it proved to be a very valuable addition to field sanitary equipment developed in the war.

Evacuation Hospitals: Evacuation Hospitals were authorized to the extent of two per division. Because of tonnage restrictions this

number was never reached. Equipment for 16, including tonnage, was sent to France early in the formative period. These conformed to the Manual of the Medical Department and provided 432 beds each on bed sacks. Experience in the war showed that this was insufficient for an Evacuation Hospital, therefore, it became necessary to increase their capacity to 1,000 beds, which was done during the summer months with those which had arrived; 500 of these were in frame beds and 500 in steel folding cots.

Evacuation Hospitals were located at the railheads where hospital trains were sent to evacuate the wounded to the interior of France. All sick and wounded went through them. They should never be located away from a railhead on account of the required supplies and transportation facilities for evacuating the sick and wounded.

Neuro-Psychiatric Hospitals: Three of these, formed with miscellaneous medical personnel, were established in the Zone of the Armies, one at Toul, one at Benoitevaux, and one at Nubécourt.

Convalescent Depots: The Medical Department was seriously handicapped in its operations by inability to establish in time, through shortage of personnel and equipment Convalescent Depots in the army areas. Patients getting into the hospital draft could not be returned to their organizations except through the routine channels of replacement divisions, regulating stations, etc. A large percentage of cases with minor injuries, or sick for one or two days only, were transferred to the interior of France, that might have been sent to these depots had they been organized. A large Convalescent Depot was in the process of organization at Révigny for the use of the First Army when the Armistice ended activities. Had it been possible to provide them throughout the entire period of activity, it would have relieved the hospital trains and base hospitals of much embarrassment. Lack of these depots caused a drain on combatant effectives at the front.

(*b*) Hospitals provided in the interior of France, on the Lines of Communication, were as follows: Camp Hospitals, Base Hospitals (Hospital Centers), Convalescent Camps, American Red Cross Military Hospitals, American Red Cross Hospitals, American Red Cross Convalescent Homes.

Camp Hospitals: These had an authorized normal capacity of 300 beds. (G. O. 76, A. E. F., July 1917.) Exceptions to this were No. 25 at the 1st Replacement Depot at St. Aignan of 2,200 beds, and No. 52 at Le Mans of 2,300 beds. Their chief function was to care for the sick of divisions in training, for which they were provided at the rate of one per division while in training areas or while at rest; they were also established for S. O. S. troops, leave areas, way stations, etc.

Base Hospitals: The first were organized in the United States with a capacity of 500 beds. It became evident from the start that this was too small, the personnel being 27 officers, 65 nurses, and 153 enlisted men. These hospitals were increased, equipped and personneled to 1,000 beds capacity with 36 officers, 100 nurses and 200 enlisted men. The amount of personnel as supplied in these hospitals on the 1,000 beds basis was none too large. In times of activity surgical and gas teams were sent from them to the front to augment the activities of Field and Evacuation Hospitals.

Base Hospitals were allowed on the shipping schedule to the extent of four per combat division. This number failed to arrive, and at no time after the heavy activities of the summer of 1918 began were there sufficient Base Hospitals in France until fighting ceased on November 11th. Units failed to arrive, they were often displaced on the shipping schedule by combat troops, and when they did arrive their equipment was not received for many months afterwards.

The hospital personnel was strained to the limit of physical endurance during the Château-Thierry and Argonne-Meuse offensives. The breaking point was near at hand when the fighting ceased.

The buildings provided were, on the one hand, hospitals constructed by the American engineers of 1,000 beds capacity, with space reserved adjacent to the wards for an expansion of 500 beds in tentage. On the other hand, existing buildings were taken over, as in the large hotel centers of Vichy, Vittel, Contrexéville, the Riviera and Paris. In many cases a small hospital taken over from the French "Service de Santé" in existing buildings was enlarged by the addition of barracks, as in the case of Base Hospital No. 17 at Dijon, No. 18 at Bazoilles, No. 9 at Châteauroux, No. 27 at Angers, No. 34 at Nantes, No. 8 at Savenay, No. 6 at Talence.

Hospital Centers: The "Type A" hospital constructed in barracks by the American engineers was planned in November 1917, in the office of the Chief Surgeon, A. E. F., at Chaumont for individual Base Hospitals of 1,000 beds, with space reserved on the side of the wards for the addition of 500 beds in tentage, to be used for crisis expansion. It was very evident from the start that if these Base Hospitals were to be used to the best advantage they should be grouped together in "Hospital Centers" in order to facilitate the receipt of supplies and equipment as well as for the care and evacuation of sick and wounded. The largest of these Hospital Centers were located at Mesves, Mars, Savenay, Bordeaux, Bazoilles, Rimaucourt, Beaune, Allerey, Nantes, Brest, Périgueux, Limoges, Langres, Joue-les-Tours. In Paris the hospitals were also grouped as one center. The principal Hospital Centers in existing buildings were

Vichy (hotels), Toul (casernes), Clermont-Ferrand, Vittel-Contrexéville, Cannes and the District of Paris.

Construction of Base Hospitals was necessarily slow, owing to the difficulty in obtaining demountable huts, water pipe, brick, and other building material, as well as the shortage of railroad cars on which to ship it. Owing to the early arrival of troops in France and their speedy participation in the fighting after their arrival, it became necessary to use many hospitals before the construction was fully completed, and many of them were badly served with roads, lights, water, soil destruction, and sewerage connection. The lack of construction operated to the detriment of good service, and at the time of the Armistice the emergency capacity of some hospitals had been gone into to such an extent that merely shelter, food, and a cot bed were provided. This was particularly true of the Hospital Center at Mesves which, owing to its location, had to receive many hospital trains of patients who could not be evacuated to more distant parts of France.

The Hospital Centers were located on or close to our Lines of Communication because it was thought that the American Army would occupy the Alsace-Lorraine sector. This provided very small hospitalization for the unexpected drive that occurred in March, in the region of Amiens and Montdidier, and between Rheims and Soissons in June and July 1918. Our troops at this time were operating under French command in the region of Montdidier and it was impossible to utilize our own hospital trains or establish our own Evacuation Hospitals. The French claimed that our evacuation system would interfere with theirs, so it became necessary to evacuate our cases on French trains and many went to French hospitals scattered over the Departments of Loire-Inférieure, Sarthe, Mayenne, and Eure. However, later on at Château-Thierry it became more evident that our Evacuation Hospitals would be required and the French finally consented to their establishment, after which our own trains were used to evacuate from these.

Hospitals in French Buildings: All of our first hospitals were given to us freely by the French "Service de Santé." Equipment was transferred to us with the hospitals, but suitable buildings in France were limited, owing to the fact that the French had not only the Americans to take care of but also the British, the Italians, the Russians and the Czecho-Slovaks. Our transportation was limited to such an extent that it was necessary to confine our activities to points on or close to our Lines of Communication.

By the middle of 1918, it became evident that it would be impossible to keep up our program of hospital construction, and the French Government was asked to help out in liberating more buildings for our purposes. This was done in the following manner.

It was the desire on the part of the French Government to divide the burden of hospitalization among the territorial Departments equally and among the different classes of buildings in the Departments. Therefore, long lists of buildings were sent by the "Commissaire Général des Affaires de Guerre Franco-Américaines" to the Chief Surgeon through the French Mission. It was necessary to reject the major part of these buildings as they were either too dilapidated for hospital use, too small to be utilized, on account of our deficiency in personnel and transport, or too remote from our Lines of Communication to allow them to be supplied or to allow us to evacuate to or from them. These long lists of buildings included, in the main, four classes: First, military barracks; second, hotels; third, public or private schools; fourth, miscellaneous buildings, including storehouses, buildings, factories, etc.

The process of taking over these buildings, making the lease or requisition, as the case might be, correctly recording the state or condition of the building when taken, to say nothing of the improvements and installations necessary, was a stupendous undertaking, but in the long run, was considerably cheaper than building.

The amount of hospitalization offered by the French "Commissaire Général" amounted to, in terms of beds, 155,422. The number accepted and organized into hospitals which were in operation on November 11th was 107,948, whereas, in addition to this number, many thousands more had been accepted and taken over but were found to be unnecessary at the time of the Armistice. There were 97,972 beds furnished in American buildings on November 11th. The total number of beds occupied in all hospitals was 184,421. The number of beds provided and actually set up in Base and Camp Hospitals and Convalescent Camps was 192,844. The total number of normal and emergency beds, as described above, was 276,547.

Convalescent Camps: These were provided at Hospital Centers, having a bed capacity of 20 per cent of the center. To these Convalescent Camps were sent cases for rehabilitation and retraining, prior to their return to the replacement depots. These were known as Type "C" hospitals. The construction consisted of kitchens, dining rooms, storehouses, offices, officers' quarters, latrines, etc. while tents were furnished for wards. The establishment was simple in construction and proved to be a very valuable asset to our hospitalization plans in that the morale of the man was restored by active outdoor exercises and by separation from the hospital environment. He was given a small amount of drill, interesting employment, as well as amusements. Bands were furnished and athletic sports indulged in. Amusement and drill halls were built.

Tentage: American " ward " tents are single wall, not very suitable for habitation in winter for European climate. A large contract was made with the British Government for 10,000 " Marquee " double wall tents of the hospital type, capacity 14 beds normal, 16 beds emergency; 3,000 tents were delivered. Another contract was made with three companies in France for the tent known as " Bessonneau." This is a double wall tent, capacity 26 beds normal, 30 beds emergency. It is well lighted with windows, stoves can be installed easily and this tent is quite warm. If supplied with electricity, suitable walks and roads, this tent makes an admirable ward as it is warmer than the barrack ward. Orders were placed for 10,000 " Bessonneaus " with the three French companies; 3,000 had been delivered by the British and deliveries were coming in at the rate of 50 per day at the time of the Armistice. The Bessonneau tents did not begin to arrive until about the first of October and there were 800 Bessonneau tents in use on November 11th. It became necessary to utilize our American ward tents in the Convalescent Camps in the fall of 1918. There were approximately 2,500 of these in use.

American Red Cross: American Red Cross Military Hospitals and Convalescent Homes were a valuable asset to the A. E. F., particularly in Paris, where up to the time of the Château-Thierry offensive the Medical Department was not allowed to establish hospitals. After July 1st, the Medical Department did establish many hospitals in and around Paris and on November 11th arrangements were under way by which we would have had 20,000 beds in that city. Other notable Red Cross hospitals were at Beauvais, Juilly, Jouy-sur-Marne, Toul, Froides and Glorieux, as well as Convalescent Homes for officers, nurses, and men.

EVACUATION OF SICK AND WOUNDED.

Ambulances: Two types of ambulances were used, the light Ford for front line work and the heavier G. M. C. for evacuation ambulance companies and the S. O. S. Ambulances were restricted to these two types to avoid a multiplicity of parts. There were three motorized ambulance companies, as well as one animal drawn, in each divisional sanitary train, three motorized with each corps sanitary train and four motorized with each army sanitary train. When the St. Mihiel offensive was undertaken the supply of ambulances in the A. E. F. was entirely inadequate, as hardly 50 per cent of the number authorized had been sent to France. All that saved the day was the return to us of a certain number of Ford and Ambulance Sections organized under the U. S. A. A. S., and lent to the French and Italian Armies.

Hospital Trains: Two were leased from the French and 19 were purchased from the British Government. A total of 48 were ordered

constructed. As many as 40 French trains were borrowed at one time during the activities in the Argonne and Meuse.

There was never sufficient transport of our own for the sick and wounded. Shortage of ambulances and hospital trains had been placed at 40 per cent in April 1918, and 20 per cent in October 1918.

Light railways were used to some extent in the Meuse and Argonne offensive. Had the war lasted they would have been used much more extensively as they were beginning to become available in larger numbers.

Canal Boats: Two were borrowed in the Château-Thierry offensive to convey seriously wounded to Paris, 16 more were in process of conversion to hospital barges by the D. G. T. on November 11th.

References to the above are the Manual of the Medical Department, Report of Activities G–4, Medical Group, G. H. Q., A. E. F., as well as various letters and statistical reports of the Chief Surgeon's Office, A. E. F.

MEMORANDUM—DENTAL SERVICE, A. E. F.

The Dental Service of the American Expeditionary Forces presents to the American Army the world's record for dento-military organization and achievement. It represented a total strength of about 4,000; composed of over 2,000 graduate dentists, approximately 1,900 of whom were commissioned officers, the remainder being dental assistants and dental mechanics. The activities of the Dental Corps undoubtedly maintained the reputation, high ideals and traditions of American dentistry.

Organization: Zone of the Armies. The dental organization for combat divisions consists of a Division Dental Surgeon and 30 operating dental surgeons, with organization units of the command. Each army corps had a Corps Dental Surgeon for supervising the division dental surgeons, dental officers with corps troops, and the headquarters dental clinic. Each army had a Chief Dental Surgeon who coordinated and supervised the entire dental service of the command, directed the corps and division dental surgeons, the dental surgeons with army troops, and the dental service of Evacuation and Mobile Hospitals attached thereto.

Services of Supply: Each depot division, replacement depot and embarkation area was organized with large dental infirmaries at favorable locations, where a number of dental officers were assigned, under centralized management, for the purpose of rendering high class professional treatment to insure a dentally fit condition for the greatest number of men. The advance, intermediate and base sections of the S. O. S., and the District of Paris were organized under the direction of Supervising Dental Surgeons, whose duty was to coordinate and direct the dental service therein. Each hospital in the A. E. F. was equipped with dental service. Base and

Evacuation Hospitals usually had two dental officers equipped with complete base outfits and laboratories; all other hospitals had at least one dental officer equipped with operating outfit only. Each Base and Evacuation Hospital was also supplied with personnel and special equipment for maxillo-facial surgery. Each Hospital Center and certain specially designated Base Hospitals were supplied with maxillo-facial surgical teams and the special equipment necessary to carry on that highly specialized class of surgery. Hospital centers were organized under local Dental Supervisors for centralizing activities, coordinating the service and handling supplies.

Equipment: All dental officers arriving in France brought portable dental outfits, the pre-war field equipment. It soon became evident that these outfits could not be transported in combat organizations. It, therefore, was modified to consist of three chests comprising the essential equipment and supplies for actual field service. This modification also contemplated the use of emergency kits for dental officers during the period of battle activities. These were carried in hospital corps pouches by the dental officer and his assistant, who were thus able to render emergency dental treatment for the command at all times. Each division was supplied with a portable dental laboratory and a limited amount of maxillo-facial equipment. This was placed in charge of an especially qualified officer and located at one of the field hospitals, thus making it possible for handling within the command all dental cases of the division.

Services rendered: During the period when divisions were in training areas it was possible to conduct a high class tooth conservation service with a view of maintaining dental fitness and military efficiency. Primary endeavor was made to inspect the mouths of the entire personnel of organizations for the purpose of first rendering oral prophylaxis—extracting all broken down teeth, putrescent roots, evacuating abscesses, and removing rough calcarious deposits. During combat activities, when dental officers were only equipped with emergency kits, it was impossible to give more than emergency treatment for the relief of pain. This service comprised free extractions, minor surgical operations and medicinal applications, with a few plastic fillings, merely sufficient to return a soldier to the front line without appreciable loss of time. After the Armistice was signed and troops returned to rest and billeting areas, the character of dental service changed again to a careful consideration of tooth conservation, masticatory restoration and prosthetic construction. Large dental infirmaries were organized in base sections of the S. O. S. and embarkation areas, in which base dental equipment and complete laboratories were installed. Here the modern practice of dentistry was carried on to the fullest extent. Reports of dental operations for the last few months give pleasing evidence of the high character

of dental service rendered, and the great number of officers and men served. The records for March, 1919 as compared with September, 1918, show a gain of 300 per cent in dental activities between periods of active field operations and rest. The consolidated report for February, 1919, shows that 119,792 persons were treated, and 183,031 operations performed.

Schools: Schools were organized in each division immediately upon its arrival, for the purpose of teaching newly commissioned dental officers methods and proceedings of a military practice, including records and paper work, and the customs of the service. This method was afterward changed by the organization of the Dental Section, Army Sanitary School which, in addition to the above subjects, instructed the student dental officers in first-aid, including emergency splinting, so that they could be utilized in the capacity of auxiliary medical officers during the battle activities.

Special Appliances: The following appliances were developed to meet the requirements of the service:

Amex Denture: A denture cast in aluminum of one piece, wherein the base plate and the teeth themselves are reproduced in this light inexpensive metal. This process of plate construction lends itself admirably to the military service, inasmuch as more than 98 per cent of the dentures required are only for partial loss of teeth. For full dentures, well matched porcelain incisors and cuspids are attached thereto, solely for aesthetic purposes. This appliance materially reduces the expense of dentures, supply stock, and necessary equipment.

Emergency Kits: This equipment was developed solely for the purpose of making it possible for a dental officer and his enlisted assistant to carry with him at all times the necessary dental instruments and medicines for emergency treatment.

Folding Trench Chair: This article was developed for the purpose of supplying a seat with stabilized head-rest for convenience in rendering dental service in trenches and dug-outs. It is made of aluminum, reinforced by steel, and can be folded and carried in a musette bag with the two pouches of the emergency kit (weight 4½ pounds).

The Amex Casque: A surgical appliance for face and jaw reconstruction, an evolution of a similar article used in the surgical services of the British and French Armies. It consists of adjustable steel band, fitting around the circumference of the head, with adjustable cranial bands and an adjustable perpendicular rod and horizontal face bow. Its use in facial and jaw reconstruction permits of absolute fixation for either soft parts or osseous fragments, and is invaluable in this class of highly specialized surgery.

Roll of Honor: Seven dental officers and six enlisted dental assistants were killed on the field of battle, thus having made the supreme sacrifice in the service of their country. Five of these officers were killed while functioning as auxiliary medical officers.

ANNEX—CHAPTER XII—SECTION V.

STRATEGIC LOCATION OF HOSPITALS IN THE S. O. S., AMERICAN E. F.[8]

With reference to the location of fixed hospitalization, i. e., base and camp hospitals, for the American forces operating in Europe, early in the life of the A. E. F. it was decided to adhere as near as possible to a distribution in the S. O. S. which would provide approximately 15 per cent of beds in the advance section, 60 per cent in the intermediate and 25 per cent in the base section. This conclusion was based upon a careful study of the problems and immediately presented there. Obviously both the front (combat zone) and the rear (debarkation areas at the base) were teeming with activity and relatively congested in men, animals and material. This rendered it extremely difficult to get a foothold for many extensive hospital projects in these areas. The area offering most elasticity and providing room where hospitalization might be fully developed, without interfering with combat or supply operations, covered the wide zone between the two above mentioned termini; known as the intermediate section.

In arriving at any decision as to the location of hospitals, two transportation problems had to be considered. If the majority of the hospitals were grouped at or near the front, this would mean a much heavier demand on rail transportation in transporting the necessary supplies across the heart of France. On the other hand, if hospitalization were concentrated in the base, it might reduce the supply demands but would materially increase the need for long hauls of hospital and other trains transporting patients. From a hospitalization standpoint the intermediate zone therefore might be considered as a "neutral zone," requiring in the aggregate minimum demands on supply and evacuation facilities. Fifteen per cent of fixed hospitalization in the advance section was allowed in order that the slightly sick and wounded requiring separation from their units only a matter of a few days or a few weeks would be hospitalized very near their commands and upon return to duty could quickly reach them through replacement units. For the base, 25 per cent was adopted for the reason that between 15 and 20 per cent of all wounded ceased to be military assets and must eventually gravitate toward the base with a view to their evacuation to the homeland for

[8] Prepared for the M. B. A. S. by Col. A. D. Tuttle, Office of the Chief Surgeon U. S. Army and Assistant to G-4, G. H. Q., A. E. F.

discharge on account of disability. The additional allowances for the base were inserted to provide for local admissions and the sick removed from incoming transports.

With a larger part—60 per cent—of hospitalization in the intermediate section, patients could be sent either towards the base or back to the front with equal facility as circumstances warranted. In that section, the supply situation, on account of the great dispersion in units permissible offered no special problems, hospital centers of 20,000 beds experiencing no difficulty in maintaining a normal flow of food and other supplies.

IN THE COMBAT ZONE.

In the case of the mobile hospitalization units employed in the combat zone, their location had some strategic application and depended largely upon routes of evacuation available. Even at the very front the field hospitals had to be placed on or near good roads, affording easy access by ambulances. The evacuation hospitals were located at rail-heads provided with standard gauge tracks, with adequate sidings for hospital trains. These railheads converged on the regulating station which controlled all the rolling stock operating in the territory allocated to its supply and evacuation functions. The fixed hospitalization units above mentioned (in the Zone of the S. O. S.) functioning behind the regulating stations, were the great "reservoirs", to which nearly all the sick and wounded from the front were evacuated. They had a geographic relationship to the regulating station in that they must be established along standard gauge railway lines radiating from that station. This was necessary in order that up and down movements of trains could be made without "crossing movements". It must be remembered that as the front was approached the "marching time" of trains on the main lines of traffic was frequently concentrated to 20 minute schedules, i. e., a density of 72 trains every 24 hours or, to put it in other words, three trains passing a given station in the same direction every 20 minutes.

THE ALLIES.

With reference to the medical services of the Allies, particularly the French and British, the proximity of their Zone of the Interior (or home country) offered unusual advantages. Since for this reason, a balanced distribution of their hospital resources was not quite as important as it was for the American forces, whose Zone of the Interior was overseas and 3,000 miles away. Therefore, a comparable review offers many difficulties if an attempt is made to follow the subject lucidly.

Aside from their strictly military hospitals, the French had, even up to the Zone of the Armies, numerous hospitals falling into two other categories, the "mixed hospitals" for the joint treatment of military or civil personnel and the "benevolent hospitals" for the strictly civilian population. The latter in vacated regions immediately became available, however, for use as military hospitals. As far as possible, the French attempted to hospitalize their seriously wounded and their slightly wounded in the front areas. The moderately wounded, particularly those requiring hospitalization over a prolonged period, were gradually evacuated to hospitals in the Zone of the Interior. Each of the French regions (there are 21 in all) had its own system of hospitals, in which the mixed, or semi-military, and benevolent, or civilian institutions, could, under certain conditions, be utilized for the army sick and wounded, especially those who were sent to their homes for convalescence as preliminary to their return to duty on the line.

With all France studded with these hospitals, the French Medical Service always had at its disposition an almost inexhaustible reserve in the matter of beds available. Furthermore, the upkeep of these hospitals was more or less a local concern, the majority of the personnel employed in them being local volunteers.

For the intensive definitive surgical care required on the more important cases, the French, as did the Americans, concentrated their military hospitals in large groups at important geographical or railway centers. Because they could depend upon local sources of supply not available to the American forces, they were able to maintain the majority of these large institutions comparatively near the front.

In the British service, and particularly during times of stress, even the general hospitals in the bases served merely as relay stations to the homeland. For a considerable period of time, nearly all cases which gave evidence of requiring treatment over a period of weeks were evacuated to England. In the fall of 1917, owing to the heavy demands being made upon trans-channel traffic, the British started to develop large convalescent depots in their bases in France and Belgium with a view to retaining as far as possible all those cases offering any prospects of early recovery and fitness for return to duty on the line. For example, in the Trouville-Dieuville region they developed a project for the establishment of a convalescent depot for the accommodation of 30,000 convalescent sick and wounded. Even after the establishment of these institutions, in emergencies (or "crisis" as they were more frequently termed) they relied mainly upon the great "reservoir" of hospital beds in England, to which evacuations were made daily in order to keep vacant

the necessary number of beds in their general hospitals and other hospitalization relays on the continent.

From the above, it will be seen that the geographical situation alone eliminated any possibility of parallelism between the American as contrasted with the hospital services of the Allies. The very fact that the latter had "Home Territory" or "Zone of the Interior" resources immediately available whereas the American Service was separated from such resources by 3,000 miles of water, rendered of little or no value any attempt at a comparison of the reason for the strategic location of American and Allied hospitalization and evacuation.

CHAPTER XIII.

SECTION I.

REGULATING STATIONS (BRITISH).[1]

Organization and method of functioning of the British Regulating Stations.

In the British Service the general idea of regulating stations and their physical form was the same as that of France, Belgium and the United States. This office was directly under the Deputy Director of Supply (D. D. S.) of the Line of Communications (North or South) who was a representative of the Quartermaster General.[2]

"Regulating stations were planned where traffic could be marshalled prior to its despatch to railhead, with the object of avoiding congestion at the end of the line. Trains were placed on sidings until the empties on trucks at railheads were evacuated, when loaded trains replaced them; consequently every truck could be placed in operation, a most important thing in war, where trucks are always scarce."

The officer in charge of the regulating station had no control whatsoever over indents or requests for supplies or stores made by the armies except fuel and petrol packs, nor did he order stores and supplies sent to the regulating station. Practically his sole duty was to forward to the armies supplies of every kind sent to the regulating station. It was an office of record for stores received and issued, the latter restricted however to forage, fuel and petrol packs.

The method of the distribution of supplies proper: frozen meat, groceries, etc., was as follows: The armies indented for the necessary amounts. These requests went to the Officer Commanding (O. C.) advanced supply depots, located in close proximity to the regulating station (usually about 3 kilometers), in the event of shortage at the advanced depot, the officer in charge called upon the base depot for the necessary supplies. Frozen meat and bread were specially packed and cars labeled at base showing destination and unit for which intended. These cars arrived daily at the regulating

[1] Draft approved by Q. M. G. British Forces.
[2] Chart 1, Chap. XIV, Vol. I.

stations from the bases and were combined with the grocery packs which were made up at the advance supply depot, forming together with the forage, fuel and pack petrol, the trains forwarded to the supply railheads daily by the Regulating Officer. Wood was loaded at stations near the forests and sent to the regulating stations in unlabelled cars. The quantities were advised and the Regulating Officer waybilled these quantities to sections. Indents from armies were received in terms of trucks or tons. The Regulating Officer labelled the cars on the siding with the destination together with unit that was to receive the contents of car.

METHODS OF SUPPLY TO ARMIES OF FOOD, FORAGE, PETROL, LUBRICANTS, ETC.

Automatically, supplies sufficient for the known number of troops were sent up daily through regulating stations to the railheads, where the indents of Senior Supply Officers of divisions were put in. The Quartermaster General (Q. M. G.) and General Headquarters (G. H. Q.) had nothing to do with the routine. It was the function of Deputy Directors of the two lines to see the supplies were sent up, and either to add or cut off certain supplies in accordance with army advices.

The Q. M. G. was the necessary authority for any alteration in the scale or character of the ration, and for the issue on repayment to certain Army or civilian war organizations.

Ammunition was normally forwarded from the ammunition bases by carload lot upon request of the armies concerned, going to railheads separate and distinct from the supply railheads.

Forage was ordered daily from a base by O. C. Regulating Station through D. D. S. (North and South). Quantities required by each section were wired to O. C. Regulating Station by A. D. S. & T. of army. The total pounds for each section was sent to railheads daily unless a wire was received altering the quantity or cancelling it. The cars were labelled as they stood on the siding at regulating stations. A reserve of one day's requirements for all sections regulated was kept close to the regulating stations. "Standard pack" petrol was ordered from the base by O. C. Regulating Stations in accordance with requirements of sections. These cars were labelled on the siding in the regulating station as in the case of forage, a reserve of one day's requirements was usually kept at the regulating station. Standard pack was ordered from a base in terms of tons or trucks by the O. C. Regulating Station who kept a day's reserve on his rake labelled as in the case of other supplies heretofore mentioned. (Chart 2, Chap. XIV, Vol. I.)

The Regulating Officer marshalled all cars on the proper tracks upon their arrival at the regulating station either from base or

advanced supply depots. A list of these cars showing contents and destinations was furnished the A. D. R. T. (Assistant Deputy, Rail Transportation). Not to exceed 150 cars were to be in the regulating station any night. This number was the limit allowed by the D. R. T.

Reserve supply held in the advanced supply depots in the vicinity of the regulating stations varied. It may be taken as between 14 to 30 days consisting in large part of food and forage.

From the regulating stations complete trains of supplies, etc., were dispatched to the units at the front, the points of destination of these trains being designated as railheads.

"Railhead, as applied to military conditions, does not necessarily mean the end of steel. It means the end of the line as far as traffic is concerned. Beyond that point it is not possible to use the tracks, usually through the possibility of tactical interference. As the army advances, the rail will be pushed forward behind them, so that its position will constantly change in mobile warfare.

"Should the advance be extended very far into the country, the establishment of forward arsenals, supply depots, etc., becomes important, and for this purpose important railway junctions are usually held and made use of. The limitations as to the distance of these depots from the landing place will be governed by the success attending our arms, and will be fixed by the Commander in Chief. When establishing these bases, the first reserves will be obtained by forwarding additional quantities of material, above the quantity actually required by the advanced troops, the extra supply being held at these depots until eventually they reach the maximum which has been decided upon by the Commander in Chief. A number of these advanced depots may be established, and should be so situated as to be distributed over the front. The railways will be the chief factors as to their situation, since the forward rails from the depots toward the troops are of vital importance. One of these depots may supply several bodies of troops, and converging lines will be used for this purpose. In distributing the depots, every effort is made to provide a chain covering the whole front which will enable the forces to fall back upon a depot should the line be pierced at any point. These depots must be sufficiently far back not to provide an encumbrance to the mobile troops from being in an exposed position, but should be as far forward as is consistent with their safety.

"During the development of the lines of communication, the concentration of the main armies will be in progress. Owing to the time required to embark cavalry and transport, bodies of infantry will be embarked with proportions of the other arms. As soon as the forces are landed they will be taken to concentration camps, and the various formations assembled, preparatory to the advance,

which may be road or rail according to the distances to be travelled. If the troops are to travel by road, the marches will commence by easy stages, increasing in length each day, until men and animals are hardened. As each formation landed will bring its own administrative units, the administrative personnel will be building up, and the chain of supply, which we will discuss later, becomes completed.

"In selecting the position, the question of loading accommodations must be considered, since there will be a mass of material arriving daily. The use of motor transport has made it possible to hold the railheads farther back, since a motor lorry carrying three tons of material can cover a distance of ninety miles in a round trip. With such a margin it is always possible, in cultivated countries, to utilize a location having some siding accommodation, which may later be extended, as a railhead. The material must be carried by motor transport on leaving the rail, and the addition of a few miles to the motor journey does not handicap the system of supply.

"The lines of communication as far as railhead are more or less of a permanent nature. The railways are utilized, improved, and applied to our needs. When we can no longer move by rail, we move forward by road. The direction will depend upon the movements of the field army, and these vary every day; the movement of the connecting-links must correspond. The position of the points where actual connection is to be made can only be defined by those conversant with the plans of the Commander, and as he does not desire that his plans should be made public, he cannot inform the lines of communication authorities of his intentions. It is sufficient if he defines the point at which contact will be made, and arranges for someone to be there to direct the movement of traffic."[3]

Priority of shipments and all questions of conflict were settled by the Quartermaster General, at G. H. Q.

Storage of the railheads consisted in 2,000 to 5,000 rations for small detachments entraining or detraining without rations. Storage in advance of the railheads consisted in temporary depots called "Field Supply Depots" of which there were normally two in each army. These depots held certain reserves (40,000 to 400,000 rations of food and forage) and in addition these depots absorbed the overflow from the railheads. These were also special field supply depots for the storage of uncommon stocks, as well as army ammunition dumps, engineers dumps and army gun parks holding a varying quantity of reserve stores, etc., depending upon the operations and the contemplated plans of the high command.

[3] "Military Organization and Administration," by Major G. R. N. Collins, 4th Batt. Canadians, 1918.

CHAPTER XIII.

SECTION II.

ORGANIZATION, FUNCTIONS AND OPERATION OF REGULATING STATIONS (FRENCH).[1]

I. ORGANIZATION AND PERSONNEL.

Regulating Commissions (Commissions Régulatrices) were organs which were responsible for the execution of all movements by rail concerning the armies which they were to serve, whether these movements were from the interior toward the front or from the front toward the rear.

All movements of personnel or material, either from or to the armies, were first directed upon a Regulating Station (Gare Régulatrice) and this station determined their despatch to final destination.

From another standpoint, the Regulating Officer or "Regulating Commissioner" (Commissaire Régulateur) was responsible for the constitution, upkeep and renewal of the stores of supplies, in accordance with the instructions of the Direction of the Rear (Direction de l'Arrière—D. A.).

Regulating Commissions therefore had a dual function:

They regulated transports by railway and they supervised and shipped supplies.

In the accomplishment of these duties, the Regulating Commissions were under the orders of the Commander in Chief (Direction of the Rear), but, while they received orders direct from the Commander in Chief concerning the supervision and shipment of supplies, the necessary instructions concerning the technical operation of the railways were issued to them by the "Direction of Military Transports" (Direction des Transports Militaires aux Armées—D. T. M. A.), through the "Railway System Commission" (Commission de réseau) of that line upon which the regulating station was located. (The D. T. M. A. was an organ of the Direction of the Rear.)

[1] Prepared for the Military Board of Allied Supply by the "Direction Générale des Communications et des Ravitaillements aux Armées—D. G. C. R. A.," General Headquarters of Marshal Foch.

As a railway transportation agency, a regulating commission had a dual directing organization (military and civil) consisting of:

A field officer representing the Command.

A railway official, responsible for the technical operation of the regulating station.

As a supply agency, the regulating commission had a single, military, directing organization. The regulating officer did not have to consult the technical member of the commission with reference to anything which pertained to supply. Moreover, in the final analysis, the regulating officer had authority over the technical member and could, upon his own responsibility, impose his decisions upon him whenever these affected military operations.

This organization, which gave the regulating officer a dual role, may seem rather complicated, however, it was the only one capable of assuring complete coordination among the services and staffs working in the regulating station, i. e.: the supply services and the railway services. Although some of these services were independent, all of them had to cooperate constantly and without this close liaison the regulating stations would have been unable to accomplish their missions.

The regulating officer had the following military personnel at his disposal:

1. Officers of the railway service.
2. Officers or officials of the various supply services which functioned at the regulating stations.
3. Clerical personnel and orderlies in varying numbers, corresponding to the importance of the regulating station.
4. Lines of communication troops and services (troupes d'étapes) for maintenance and fatigue duties.

In so far as the technical (railway) personnel was concerned, the regulating officer had, through his technical assistant (Commissaire technique), all the personnel of the railroad companies which operated in the zone of action of the regulating station. (Chart 7, Chapter XIV, Volume I.)

II. ZONE OF ACTION OF A REGULATING STATION.

To each regulating station was assigned a "zone of action" (zone d'action), consisting of a certain number of railway lines or sections of lines, upon which all movements, from the military transportation standpoint, were under the exclusive control of the regulating commission.

The zones of action of the various regulating stations were determined by the Commander in Chief (Direction of the Rear). In a general way, the zone of action corresponded to the zone of the army, or armies, served by the regulating station.

Although it is easy to imagine two armies as addressing themselves to a single regulating station, on the other hand, it is difficult to conceive one army as addressing itself to two regulating stations. As a matter of fact certain sections of railway line, in a particular zone of action, could be used jointly by two armies, at least temporarily. In such cases, all that was necessary was an agreement between the two regulating stations concerned, i. e., the regulating station which controlled the zone of action and the station which served the army, but whose zone of action did not include the railway line involved.

The zone of action of a regulating station could be subdivided into two parts: A part which was *permanent* as far as possible, on account of the relative stability of the regulating stations and, a *variable* part, on account of the changeable composition of armies and the modifications which might occur as the result of military operations.

The first part, which was known as the "rear zone" (zone de l'arrière), contained the facilities which were necessary for the operation of the various services of the regulating station; the second part contained all of the supply stations or railheads (gares de ravitaillement) of the army concerned. The second zone was sometimes called "advanced zone" (zone de l'avant).

Comparatively important advance or retreat movements by the troops were required in order to necessitate a modification of the first zone and this involved the delicate operation of removing or transferring the regulating station. On the other hand, the assignment of new missions to the armies or changes in the composition of the armies, sufficed to require the modification of the second zone.

This was an easy operation, nevertheless it presented certain difficulties. As a matter of fact, both the military and the technical personnel needed time in order to acquaint themselves with the various new installations which were to be employed, and for the study of means of obtaining best results therefrom. It was therefore advisable to avoid changes in the zone of action just prior to operations which might require intensive traffic, and before preparations for same had been completed or had received sufficient study. However, circumstances often necessitated modifications in the zone of action of regulating stations during military operations.

In all cases, it was necessary to establish a certain correlation between the two subdivisions (rear and advanced zones) of the zone of action.

The "rear zone" corresponded to shipments, storage of necessary supplies and side tracking of waiting trains (hospital trains or "en cas mobiles"—emergency supply trains). The "advanced zone" corresponded to the zone of the railheads.

Although the rear zone could conveniently contain installations whose capacity exceeded the requirements of the advanced zone, the possibility of reversing this situation had to be avoided at all costs. Therefore, while the advanced zone had to be modified to meet the requirements of the armies, the rear zone had to increase its facilities whenever these became insufficient, either by taking over new sections of railway lines or by establishing new installations (sidings or grids).

The distance between the regulating stations and the front varied greatly. This distance could without inconvenience be quite considerable (up to 10 or 12 hours' journey), although in such cases special provisions had to be made to reduce possible emergencies, which might arise from this situation, to a minimum (such as traffic accidents, with consequent delays in the arrival of the trains).

Whenever a large number of trains was operated and uncertainty as to the location of the receiving stations of the zone of action made it impossible to predetermine the final destinations of these trains, upon their dispatch from the regulating stations, a "regulating station of movement" (gare régulatrice de mouvement) was organized in order to overcome these inconveniences.

However, the distance between the regulating stations and the front must not be too small. Apart from the difficulties which might arise from this situation in case of a sudden retirement by the troops, it was necessary that the facilities and operating services of the regulating stations be protected as much as possible, within reasonable limits, from enemy activities (bombardments by long range guns or by airplanes).

From this point of view, the events of 1918 greatly modified the conditions which existed at the beginning of the war. This question will be taken up again later.

III. ORGANIZATION OF THE SERVICES OF THE REGULATING STATIONS.

The studies which had been made during peace time admitted, at first, that the Regulating Commission should be able to establish all of its services in one station. It was only proposed to side track "en cas mobiles" (emergency supply trains) and hospital trains outside of the regulating stations.

But it soon became evident, even at the beginning of the campaign, that but few stations were large enough or contained sufficient installations to meet the requirements of the armies.

As a result it was found necessary to extend the authority of the regulating officer, not only over the various services which functioned at the regulating station, but also over those which had to

be established in the stations located in the zone of action of the regulating station and which were provided with suitable facilities. These stations were designated as "branches" of the regulating station (gares annexes de la G. R.).

It was apparently feared, at first, that the authority of the chief could not be exercised satisfactorily under this arrangement, and that the dispersion of the services might result in an independence on the part of the latter which would be incompatible with the proper operation of the entire system. Subsequent results demonstrated that nothing of the kind was to be feared.

IV. SERVICES REPRESENTED AT THE REGULATING STATIONS.

The principal services represented in a regulating station were:

1. The "Intendance" (Quartermaster or supply service) Service: whose supplies were distributed as follows:

a) Groceries (petits vivres): (sugar, coffee, salt, lard, spirits (eaux de vie), dried vegetables, etc.) which were stored in a special shed (hangar) called the "provision shed" (Halle aux vivres).

b) Bread: Bread was kept in railway cars. As a matter of fact, it simply passed through the regulating station and came either from the "Army bakeries" (Boulangeries d'Armée—B. O. A.) or from the "intermediate depots" (Stations Magasins—S. M.).

c) Meat: Frozen meat was kept on railway cars. Meats also simply passed through the regulating station. The necessary supplies of frozen meat were shipped to the regulating station daily, by the "cold storage warehouses" (Entrepôts frigorifiques) which had been designated to serve that particular regulating station.

Meat on the hoof (live stock) came from the "cattle park" (Entrepôt de bétail) of the regulating station. This "cattle park" was generally organized in a station, located near the regulating station concerned, and was equipped with suitable loading facilities.

d) Oats, hay and straw: Were kept in railway cars, with the exception of certain small stores which were maintained at the regulating station for use in case of emergency. All of these supplies came from the intermediate depots (S. M.) and simply passed through the regulating station.

e) Wine: Wine was kept on railway cars. It was shipped regularly by the intermediate depots concerned.

The Intendance service also handled supplies of clothing and equipment. These were stored in a special building which was known as the "Clothing depot of the regulating station" (Magasin d'habillement de la G. R.).

2. Medical Service (Service de Santé): which maintained at each regulating station;

a) Reserve medical personnel (Réserve de personnel sanitaire—R. P. S.), composed of surgeons, nurses, etc., as replacements for the army served by the regulating station concerned.

d) Reserve stores of medical supplies (Réserve de matériel sanitaire—R. M. S.), consisting of dressings, drugs, stretchers, surgical equipment, etc.

c) An "Evacuation hospital" (Hôpital d'évacuation—H. O. E.).

3. Artillery Service (Service de l'Artillerie): There existed a regulating station "section" or echelon (echelon de G. R.) composed of a small Artillery personnel for the inspection of the ammunition or artillery material which passed through the regulating station. (See Chapter IX, on the supply of ammunition and artillery material).

4. Engineer Service (Génie): Stores of Engineer material were maintained at the regulating station. These were known as the "first Engineer reserve" (lère réserve), and consisted for the most part of tools and supplies in current use, such as stakes, shovels, picks, sheet iron, girders, smooth or barbed wire, stoves, etc.

5. Air Service (Aviation): The Air Service also maintained a store of spare parts which were in current use in each regulating station.

V. FUNCTIONING OF THE SUPPLY SERVICE OF THE REGULATING STATION

The "supply service" (service du ravitaillement) of a regulating station:

(1) Received requests for supplies for the troops, which were transmitted by the headquarters of the army concerned, and determined how these requests were to be satisfied.

(2) Determined, in agreement with the same agencies, the stations where the supplies were to be delivered.

(3) Caused the loading aboard the railway cars, by the Intendance service of the regulating station, of the food supplies which were to form part of the various shipments.

(4) Assembled the "sections" (rames) thus loaded and formed them into the "daily supply trains" (trains de ravitaillement quotidiens—R. Q.), and, in conjunction with the other shipping services of the regulating station (Artillery, Engineers, Medical, Postal, Air, etc.), made necessary arrangements concerning car space and assignment of same; moreover, it issued orders so that the cars loaded by these services would be assembled.

(5) Directed the trains thus formed upon designated railheads.

(6) Notified the large units, to which the receiving bodies belonged, as to the time of arrival of the supply trains and concerning their exact composition.

VI. DETAILED STATEMENT CONCERNING THE VARIOUS OPERATIONS MENTIONED ABOVE.

1) The requests for supplies from the army headquarters were telegraphed to the regulating station concerned. Telegrams pertaining to the daily supply for the lines of communication units were wired by the headquarters of the lines of communication (D. E.) concerned.

The requests from the D. E. were naturally very explicit as, each time, they had to mention the quantities and kinds of supplies desired, as well as the consignee and date of delivery. These telegraphic requests were sometimes preceded by a telephonic request for the purpose of gaining time, since this made it possible to prepare the shipment before the actual written order was received, but it was necessary, in order to prevent mistakes, to confirm these verbal requests by telegraph.

It was also necessary to absolutely forbid units other than the army or D. E. headquarters to make requests. Army corps, and particularly the local Intendance services, were inclined to address themselves to the regulating station direct. While this procedure often resulted in quicker satisfaction of requests, it also most assuredly caused errors and created confusion, moreover, it rendered control impossible.

2) The determination as to the location of railheads and the hours for the distribution of supplies was made by agreement between the headquarters of the army, or of the D. E., and the regulating officer concerned, except in the case of very small or temporary issues of supplies.

The designated railhead was provided with the necessary facilities. It could become the seat of a "railway station commission" (commission de gare) and was organized in accordance with the importance of the services which it was to render. A representative of the Intendance service of the regulating station was detailed to the railhead, to take charge of the food supplies upon their arrival at that point and to inspect them; he was also to establish proper relations between the Intendance service of the regulating station, the supply officers of the troop units and the Intendance services of the large units. If the station was to assume a more or less permanent character as a supply station, telephone communications were generally established with the regulating station[2], without using the wires or equipment of the railroad system.

[2] This telephone liaison was most useful. It would have been desirable, for the purpose of establishing similar installations during periods of movement, if the commander of the lines of communication at the regulating station (Commandant d'étapes de G. R.) could have had crews of telephone personnel at his disposal during these periods, because the telegraph troops of the second line, which established the liaisons during periods of stationary warfare, were not always readily available for this purpose at other times.

This system presented special advantages during stationary periods and was perfectly adaptable during periods of movement.

The hours for the issue of supplies could be determined from the train schedules, which will be mentioned again later.

3) The supplies used in making up the daily trains (R. Q.) were stored, either in the "provision shed" (Halle aux vivres) of the regulating station or on railway cars; these cars had been sent completely loaded by the intermediate depots (S. M.) and could be forwarded without breaking up the load (sans rompre charge). This was the case for bread, oats, forage.

From the strength reports (états d'effectifs) and requests received, the Intendance service ascertained the amount of freight to be carried for each large unit. The empty cars which were needed to carry this freight were switched upon the siding of the provision shed by the technical service, after agreement with the Intendance. The Intendance personnel loaded the cars and then labeled them with the indication of the unit for which they were destined. It also labeled the loaded cars, which had been forwarded complete by the intermediate depots, which were to form part of the supply section (rame) and recorded the contents of each car.

4) The loaded sections (rames) then had to be assembled and formed into daily supply trains (trains de R. Q.). This was the duty of the regulating station officer who was in charge of the "daily supply train service" (service de R. Q.), and he determined the composition of the trains while the supply sections were being loaded.

For this purpose, the technical (railway) service assigned a number of trains to the lines which the regulating officer had designated as supply lines (lignes de ravitaillement). Some of these trains, in accordance with the information in the hands of the regulating officer and with a view to satisfying the requirements of army headquarters to the fullest extent possible, were used by the officer in charge of the daily supply service to transport the supplies, in conjunction with the technical services.

During periods of stabilization, on account of the relatively small amount of troop movements, the supply trains could have a practically fixed composition. The same trains were generally scheduled each day for the transportation of supplies to the same units. This procedure obviously offered great advantages because each train was known, from one end to the other, by the technical military personnel. Its formation, schedule, control and alteration, by the addition or cutting out of cars, could be more readily accomplished. However, during periods of movement the composition of the daily supply trains could not maintain the same stability, and the only thing which could be determined beforehand was the loading of the

cars, which had to be done by a certain time on account of the uncertainty in the hours of departure and the grouping by general directions of certain trains chosen from the "schedule table" (tableau de tracé des trains). This schedule table was used as the basis for the operation of the trains, with slight modifications corresponding, for example, to the prolongation of certain "runs" (marches).

For the determination of the composition of the trains, the officer in charge of the daily supply service received the following information from the Intendance service:

1. An estimate as to the number of cars which were to be included in the supply sections (rames). Experience acquired made it possible to establish very close estimates.

2. A statement as to the quantities of frozen meat or livestock (meat on the hoof) which were to be included in the daily supply train (R. Q.). He also received from the other services at the regulating station (Artillery, Engineer, Medical, Air, etc.), information as to the number of cars loaded by each and which were to be forwarded to various units.

3. Finally, in agreement with the postal regulating officer, he provided for the addition of mail cars to certain trains designated for this purpose by the regulating officer.

The officer in charge of the daily supply established a report, known as the "daily supply sheet" (Feuille de R. Q.)—(various models)—which specified the number of sections (rames) or cars which were to enter into the composition of each train. He figured the approximate weight of the train and, if necessary, submitted the data obtained for concurrence by the technical commissioner, and presented the completed report to the regulating officer for final approval.

The daily supply sheet was prepared in two parts. In the morning, for trains leaving between 6 p. m. (18 o'clock) and midnight and, in the evening, for trains leaving after midnight. A copy of same was immediately transmitted to the technical (railway) service and served as an order of execution for the formation of the trains. Thus, the sections or cars which had been loaded during the morning were switched and assembled during the day and forwarded at night, between 6 p. m. and midnight; the sections loaded during the day were switched and assembled during the early part of the evening and forwarded after midnight.

Another copy was transmitted to the postal service. The postal service used same in grouping the mail sacks and for the loading of the mail cars which had been placed at its disposal by the technical service, at the passenger platform, and to establish the rules which were to govern the postal convoying personnel.

Finally, all the services at the regulating station also received a copy of the daily supply sheet and this enabled them, in case of necessity, to request the addition of cars to certain trains.

As soon as the composition of the trains was completed, the officer in charge of the daily supply service advised the headquarters of the army and of the D. E. concerned, by telegram, as to the daily supply movement (schedules, locations of railheads, etc.); this wire was sent each day about noon.

VII. OPERATIONS PERTAINING TO THE FORMATION OF TRAINS IN A REGULATING STATION.

There remains to be given a practical statement as to the handling and maneuvers which the supply sections (rames) had to undergo in their passage through a regulating station.

Most of the supply trains came from the intermediate depots (S. M.).

Theoretically, the departure of trains from the intermediate depots and their arrival at the regulating stations were to take place at regular hours. Between each intermediate depot and its corresponding regulating station, train runs (marches) were established, in accordance with schedules prepared by agreement between the Minister of War, the Director of Military Transports and the various Railway System Commissions concerned. The military commissioner of the intermediate depot was to regulate his shipments to the regulating station in accordance with the scheduled runs which had been indicated.

In practice, particularly during the latter part of the war, when a serious railway transportation crisis occurred in France, the despatch of trains from the intermediate depots and their arrival at the regulating stations were often subjected to considerable delays, despite the efforts of the operating personnel.

Some of the trains coming from the intermediate depots were delayed so long, that it was impossible to use their contents in making up the daily supply trains at the regulating stations and, in order to overcome these difficulties, it became necessary to maintain larger stores of reserve supplies at the regulating station during the latter part of the war than had been maintained at the beginning of the campaign.

Upon arrival at the regulating station (see Chart 8, Chapter XIV, Volume I), the trains were received on a siding known as the "reception siding" (Faisceau de réception), which is marked R on the chart. There the trains were "checked" (reconnus), that is, special personnel was designated by the various services at the regulating station to carefully examine and register the contents of each car composing the train, as well as its particular destination, if necessary.

When the checking operations were completed, the train was "broken up" (débranché). A yard engine shunted the cars which had to be rehandled, and which could not be attached direct (as received from the rear), to the daily supply train, upon the sidings which served the installations of the various services at the regulating station (Intendance, Medical, Engineers, etc.).

The completely loaded cars, which did not have to be rehandled to enter into the composition of the daily supply trains, were shunted upon a second siding (marked F on the chart) whose tracks were, in so far as the size of the siding and the diversity of the supplies permitted, specialized by class of commodities; in other words, one track only received carloads of oats, another carloads of hay and a third carloads of bread, etc.

For the formation of the daily supply trains, the yard engines had to shunt the cars upon the "formation siding" (indicated by F on the chart), generally by operating from the opposite end of the lines, in order to pick up the cars which had been in the regulating station for the longest time. After picking up the cars which were to be included in a section (rame), whose composition had been determined beforehand, as well as those which were held on the various sidings reserved to each of the services of the regulating station, the daily supply train (train de R. Q.) was shunted upon a third siding, known as the "waiting siding" (Faisceau d'attente), (indicated by A on the chart), where the trains were held until their hour of departure for the front. Only at the last moment were cars containing personnel, animals, or mail attached to the waiting supply trains.

Upon the return of the supply trains to the regulating station, inverse operations to those described above were not generally the case. Only cars bringing back supplies or materials which were to be held temporarily at the regulating station were allowed to remain there. All empty rolling stock remained at the regulating station as short a time as possible and was forwarded to large railway stations in the interior of the country, known as "distribution stations" (gares de répartition), where it was then used so as to meet general requirements to best possible advantage.

VIII. MOBILITY OF REGULATING STATIONS.

The details given above concerning the extensive facilities which existed in the regulating stations, might lead to the conclusion that regulating stations were permanent establishments whose transfer could not be undertaken without seriously interfering with the supply of the troops.

Naturally, the removal of a regulating station was always a delicate operation and, whether caused by circumstances or as the result of enemy activity, the Command constantly endeavored to defer it until arrangements for such a transfer were absolutely completed. Moreover, experiences of the war proved that the organization, transfer, or suppression of regulating stations were necessary and frequent operations during all critical periods.

Nevertheless it should be remembered that these operations always required particular attention on the part of the Command (in this case the Direction of the Rear) and special efforts on the part of the regulating officers concerned.

First of all, the activities of a regulating station are proportionate to the importance of the military operations undertaken by the armies which it supplies. A regulating station which today serves a calm sector which is weakly manned, thereby enabling it to readily establish a regular supply service and one which remains practically unchanged from day to day, may find its activities increased ten fold on the morrow, if the army which is assigned to it enters into active operations. Perhaps the output required of this regulating station may be such that it will be unable, by itself, to answer the requirements and it therefore becomes necessary to designate another regulating station, or to completely organize a new one, to assist it and operate as a "branch" (annexe) of the overworked regulating station.[3]

On another part of the front, where enemy activity has brought about an appreciable retirement (intensive bombing by airplanes), it may be feared at a certain moment that a given regulating station will lose its liberty of action and thus be unable to accomplish its task. The supplies of this regulating station, its services, and the formation of its daily trains are then transferred to another station, located further to the rear, and the original regulating station operates solely as a "regulating station of movement" (régulatrice de mouvement).[4]

[3] A "branch regulating station" (régulatrice annexe) may include: (*a*) all facilities and all services of a regular regulating station, or, (*b*) only the installations of certain regulating station services. In the first case, the branch regulating station may form a number of complete daily supply trains (R. Q.) for the regulating station to which it is attached; in the second case, it may form only the ——— sections (rames) of the daily supply trains, according to the services which are included in its organization.

[4] In a regulating station of movement, no trains were formed (made up) and no switching, removal or addition (hooking up) of cars was done, with the possible exception of mail cars. Trains simply passed through this station, but it was at this point that the trains received indications as to their final destinations.

IX. THE REGULATING STATIONS DURING THE WAR.

The following résumé will suffice to show the flexibility, as well as possible variations, of the system of regulating stations as demonstrated during the war.

The regulating stations which had been designated to provide for the supply and evacuation requirements of the armies began to operate on August 19, 1914. These stations were located at:

Besançon, Gray, Is-sur-Tille, Troyes, Châlons-sur-Marne, Reims and Laon for the French armies and Amiens for the British armies.

When the general situation forced the Command to withdraw the left wing of the Allied Armies, toward the latter part of August, 1914, the corresponding regulating stations were also withdrawn toward the rear, viz:

The regulating station at Troyes was transferred to Nevers; that of Châlons to Les Aubrais; those of Reims and Laon to Noisy-le-Sec and that of Amiens to Le Mans.

Immediately after the battle of the Marne, when the advance was resumed, the regulating stations followed the armies by establishing branches (annexes) in the proximity of the latter and, as soon as the front was stabilized, the regulating stations permanently established themselves in these more advanced positions.

The network (système) of regulating stations was then distributed as follows (winter of 1914 and spring of 1915):

French armies	Gray-Besançon.
	Is-sur-Tille.
	Chaumont-St. Dizier.
	Troyes.
	Noisy-le-Sec.
	Le Bourget.
	Creil.
	Calais.[5]
	Dunkerque.
British armies	Abbeville.[6]
	Calais.[5, 6]
	Boulogne.
Belgian army	Calais.[5]

The years 1915, 1916, and 1917 were characterized by the stability of the regulating stations, as a result of the minor changes which occurred in the front line during this time.

[5] Attention is called to the peculiar situation of the regulating station at Calais. This station served the armies of three different nations: France, Belgium, and Great Britain.

[6] Abbeville and Calais became British regulating stations only in June 1915, at the time when the strength of the British armies was increasing considerably.

However, during this same period, the material means placed at the disposal of the armies increased in vast proportions. This resulted in a great deal of extension work in all of the existing regulating stations (particularly at St. Dizier, during the operations around Verdun), as well as the creation of new regulating stations, i. e.: Romescamp, in 1916, for the British Army; Fère-en-Tardenois and Connantre, also in 1916, for the French Army. Moreover, on account of the entry of the American Army into the lines, Is-sur-Tille (American regulating station) was organized during the latter part of 1917, for the use of that army.

The events of 1918 brought about a radical change in the military situation and this demonstrated the flexibility of the regulating stations particularly well. In January 1918, the regulating stations were located as follows:

Gray, Is-sur-Tille, St. Dizier, Connantre, Noisy-le-Sec, Le Bourget, Creil and Dunkerque for the French armies.

Romescamp-Abbeville, Boulogne and Calais for the British armies.

Calais for the Belgian army.

Is-sur-Tille for the American army.

The important German advance which occurred in March, 1918, required that special measures be taken immediately. As a matter of fact, it was necessary to provide for the supply of the armies in spite of the retirement of the front, which involved withdrawing the most advanced regulating stations.

At the end of March, "secondary regulating stations" (régulatrices de seconde ligne) were organized to assist the existing regulating stations and to receive, or permit the reduction, of the personnel and stores located therein.

Secondary stations were successively created at Mantes and at Sotteville-les-Rouen for this purpose and, finally, Le Mans was organized to relieve and assist Mantes and Sotteville.

The attack between the Oise river and Cambrai was followed by the Flanders attack. The regulating station at Dunkerque, (which had been discontinued as a French regulating station, as a result of the participation in the battle to the south of Amiens by the French troops which had been stationed in Belgium), was again put into operation and served as a branch regulating station of movement for the regulating station at Sotteville (April 12).

A French regulating station was also established at Calais. Finally, an advanced French regulating station, serving as a branch of Sotteville, began to operate at Romescamp on the 18th of April.

The German advance following the attacks of May 27 and those of June 9th and 12th, astride the Oise, necessitated further measures:

First, the organization of a regulating station at Les Aubrais, near Orléans, in case of the withdrawal of the regulating station at Le Bourget and, as soon as the station at Les Aubrais began to function Le Bourget received orders to operate solely as a regulating station of movement. Secondly, the station at Creil received orders to function only as a regulating station of movement, with that at Mantes as rear regulating station.

During the latter half of July, the Allied counter offensive began. Therefore, in anticipation of the German attack of July 15, on the Champagne front, the station at Troyes was again equipped as a regulating station and served as branch (annexe) for the regulating station at Connantre. Romescamp was also completely equipped as a French regulating station (July 11th), to meet the eventual requirements of the First French Army to the south of Amiens, but it remained temporarily as a branch of the regulating station at Sotteville.

In August, the station at Troyes ceased to function and Connantre became once more the only regulating station for the entire Champagne front. During the same month, as a result of the Franco-British advance toward Roye and Chaulnes the regulating station at Sotteville, which was now too far from the front, was reduced to the role of branch for the station at Romescamp and the latter became a main regulating station. At the end of August the regulating station at St. Dizier, which was supplying the Second French Army, took over the supply of the First U. S. Army also.

In September, as a result of the general Allied advance, the stations at Creil and at Le Bourget resumed their normal functions and the regulating stations in their rear became branch regulating stations. (Mantes became the branch regulating station for Creil and Les Aubrais was reduced to a minimum.)

During the latter half of September, in preparation for the Flanders operations, Dunkerque was completely reorganized and fully equipped. Consequently, Romescamp became a branch of the regulating station at Dunkerque and Sotteville was discontinued on September 22nd.

From the 26th of September to the 11th of November, the general Allied offensive occurred. As a result of the complete operation of the station at Le Bourget, the regulating station at Les Aubrais was discontinued on October 11th. The regulating station at St. Dizier, which was very busy on account of the increase in the number of American troops west of the Meuse, was assisted by Is-sur-Tille. The regulating station at Le Mans was discontinued on November 5th.

Finally, projected operations in Lorraine had brought about a final modification in the distribution of the regulating stations.

Besançon was to operate as a branch of the regulating station at Gray, so that the regulating station of Is-sur-Tille might be able to provide for the supply of the entire army which was to undertake the offensive in Lorraine.

The above résumé, although very brief, certainly will suffice to show the numerous combinations which can be carried out in the system of regulating stations. Each particular case requires a new combination and this, in turn, must be dropped as soon as the military situation changes.

ORGANIZATION OF RAILHEADS.

GENERAL PRINCIPLES.

The orders issued for the movement of supplies of all kinds should aim to effect the rapid release of the cars and prevent their immobilization.

The unloading of the trains should not be dependent on the arrival of the convoys, on the other hand, it is also necessary that the supplies for the convoys should not await the arrival of the trains. It is essential that movements and supplies be absolutely independent.

Dumps (stockages) should therefore be established near the railheads, so that all trains can be unloaded upon arrival and the loading of convoys take place without regard to the arrival of the trains.

Summed up, two principles are involved:

(1) The immediate release of the railway cars is of prime importance.

(2) It is essential to establish dumps near the railheads.

ORGANIZATION.

1. *Unloading.*

The unloading of foodstuffs, ammunition, and materials of all kinds immediately upon arrival of the trains at destination is absolutely indispensable.

The direct transfer of the contents of railway cars to trucks, wagons or narrow gauge cars is undoubtedly advantageous, but should not result in the maintenance of loaded cars at the stations.

Every railway car should be immediately unloaded in a dump if no convoys are there to receive its contents.

2. *Dumps.*

The establishment of dumps at the railhead is necessary in order to obtain:

Immediate unloading of cars upon arrival at railheads, with consequent rapid turn around of rolling stock and, maintenance of

stores at the railheads so that supplies for the convoys of the troops may remain independent of the arrival of the trains.

The amount of stores to be maintained in the dumps is proportionate to the distance between the railheads and the troops which are supplied therefrom; the stores should increase with the distance of the troops from the railhead.

If the troops are 10 or 15 kilometers away, the supply of the convoys presents few risks and it is sufficient if the dumps contain one day's supplies in advance.

However, if the troops are 40 or 50 kilometers away, it is necessary that the stores be sufficient to provide for any emergency which may arise and it is advisable to maintain four or five days' supplies on hand.

Summed up, the necessity for the establishment of dumps and the quantities of stores therein increase proportionately with the distance which separates the troops from the railways.

3. *Personnel.*

In all railway station dumps (gares de stockage) should be stationed a permanent representative of the Command, charged with regulating all operations, determining priorities, and enforcing traffic regulations.

This officer is either a "military railway station commissioner" (Commissaire militaire de gare), if the operations are to remain within the territorial limits subordinate to the railway service, or, an "army service zone commandant" (Commandant d'étapes), specially appointed, if, as most frequently happens in the case of important railheads, the operations are to extend beyond these limits.

He is assisted by a sufficient number of officers and operating personnel, which he distributes according to requirements.

The strength of this personnel is proportionate to the amount of simultaneous unloading which is to be effected, and is based on an average capacity of four tons per man, per day.

In addition to the representative of the Command, a railhead requires the permanent assignment of representatives from the various services which function at the railhead, (Quartermaster, Artillery, Engineers, etc.). In so far as their particular service is concerned, these representatives are responsible for the proper storage and handling of supplies, as well as for administrative operations in connection therewith. The representatives of the supply services have special personnel at their disposal, belonging to their branch of the service and in accordance with local requirements. (Accountants, non-commissioned officers, foremen, etc.).

4. *Railhead facilities.*

The organization of a railhead requires: *a*) For each class of supplies (food, ammunition, engineer material, etc.), separate installations (chantiers), with dumps corresponding to the amount and nature of the stocks which are to be kept on hand.

b) The improvement of the road system (highways) in the vicinity of the railhead to prevent congestion and allow uninterrupted movement of convoys in all directions.

c) A system of approaches in connection with the roads leading to or from the railhead, arranged so as to permit trucks and wagons to load, either at the dumps or directly from the trains, and then return to the highway. This system should be so conceived that loading operations may be continuous and prevent all confusion and disorder in the movement of trucks or wagons arriving at or leaving the railhead.

5. *Conclusion.*

It is only by conforming to these principles that rolling stock can be used to best advantage, that the supply services can be spared useless labor and all miscalculations in the supply of the troops be avoided.

CHAPTER XIII.

SECTION III.

ORGANIZATION OF THE BELGIAN REGULATING COMMISSIONS.[1]

1. HISTORICAL.

Regulating commissions did not exist in the Belgian Army at the beginning of the war, these were created during the course of the campaign.

Their powers and functions were based upon the organization of similar military organs existing in the French Army. Before describing their functions, it may not be amiss to rapidly examine the functioning of the Belgian system of supply before the creation of these commissions.

During the period August–September 1914, the trains of supplies (rames de wagons) which had been loaded by the base services at Antwerp for despatch to the large units of the field army, were first sent to a railway station in the region of Antwerp, which served as a "collecting station" (gare de rassemblement). At this station the trains were formed by army divisions, by grouping together the cars destined for a particular army division, and they were then designated as "daily supply trains" (trains du jour—T. J.). Thus formed, the T. J. were sent to the "station of the services of the rear" (gare des services de l'arrière), where they were held until they received orders to proceed to the distribution station of the division concerned, which was known as the "divisional station" (gare divissionnaire). These orders were issued by the 4th Section of the General Headquarters and a military authority, the "Chief commandant of stations" (Commandant principal des gares), supervised the movement.

During the retreat to the Yser, the Belgian base was successively transferred from the region of Antwerp to the region of Ostende-Bruges and then to Calais. The system of supply however remained unchanged.

After the transfer of the Belgian base to Calais, the daily supply trains (T. J.) were formed there and sent direct to the railheads (gares divisionnaires) designated by the 4th Section at G. H. Q.

[1] Prepared for the Military Board of Allied Supply by the "Direction des Voies de Communication," at the Belgian Ministry of War, and reduced to the compass of this work by Lieut-Col. Ellery Farmer, Inf., U. S. Army.

At the beginning of the stabilization period on the Yser front, these railheads were located at: Bergues, Rosendael, Leffrinckoucke, Ghyvelde, Furnes and Adinkerke. The two last named were located in Belgium, all of the others, because of the lack of sufficient installations, were in France.

The duration and nature of the war (position warfare) caused an increase in the amount of supplies to be transported toward the front. As a result, the Belgian base services were enlarged and certain services moved to Gravelines, Bourbourg, Loon-Plage. Moreover, an extensive system of narrow gauge and standard gauge railways was constructed in the immediate rear of the front and new railheads were established in Belgium. (Chart 3, Chapter XV, Volume I.)

Circumstances, as well as the advantages to be derived from having organizations similar to those of the Allies, led the Belgian G. H. Q. to establish a system of regulating stations.

2. ADOPTION OF THE FRENCH SYSTEM OF REGULATING STATIONS.

(Chart 3, Chapter XIV, Volume I.)

The Belgian Army held its positions on the Yser, and the Belgian line of communication was obliged to utilize a portion of the French "Northern" (Nord) railway system running from Calais to the Belgian frontier. The new organization therefore had to adapt itself to this particular situation. Inasmuch as the "Northern" system was in the hands of the French, Belgian military delegations were attached to the French Regulating Commissions at Calais and Dunkirk in 1916. Later, in 1916, the two Belgian delegations were united and functioned at Calais, where the French Regulating Commissioner for the British and Belgian Armies was located; however, a Belgian representative was maintained at Dunkirk. The Belgian delegation at Calais acted as liaison agency between the Belgian base services and the French military railroad services. It centralized requests for transportation emanating from the various Belgian establishments located in the base area and regulated the organization of transports in conjunction with the French Regulating Commission, which had sole authority over the technical services of the "Northern" railway system.

The Belgian delegation at Calais determined the composition of supply trains of food, ammunition and materials of all kinds. These supplies were loaded upon cars by the base services and were forwarded to Coudekerke, which was the freight station for Dunkirk. There the supplies were sorted and the daily supply trains were made up. In fact, Coudekerke functioned as a regulating station.

The Belgian delegation at Calais remained in constant touch with the French Regulating Commission. It was responsible for the regular despatch of Belgian transports over the French "Northern" railway system and their transfer, at the proper time, to the Belgian railway system.

The Chief of the General Staff of the Belgian Army established a Regulating Commission which was charged with supervising the execution of transports on the Belgian railway system. This commission was located at Adinkerke.

8. GENERAL POWERS OF A REGULATING COMMISSION.

A railroad regulating commission is an organization which is charged with the regulation of rail transports on the lines of communication of the Army.

It remains in touch with the army and with the neighboring regulating commission.

It is subordinate to General Headquarters, from whom it receives its orders through the 4th Section, either direct or through the "Commission of the Field Railway System" (Commission du réseau des Chemins de fer de campagne).

It consists of a military commissioner and of a technical commissioner, who are assisted by military personnel (officers and men) and by technical personnel. It is generally located at a regulating station.

It has sole authority over the railroad system and over the railway lines which have been assigned to it.

It receives the requests for transportation from the various units and fulfills them, if they comply with the regulations on the subject; if not, these requests are submitted to G. H. Q. for decision.

For the execution of transports which it must regulate, the commission is assigned a certain number of "runs" (marches) between the railway stations located on the system which it controls. It can not use other "runs" without the consent or approval of the "Commission of the railway system" (Commission de Réseau).

It authorizes commercial transports destined for the needs of the civil population, within the limits prescribed by G. H. Q.

It determines the composition of the trains operating on the system assigned to it, taking into account regulations governing the operation of trains. No change can be made in the schedules nor in the composition of trains without the approval of the regulating commission.

The regulating commission cannot interfere in any way in the technical operation of the railroads (switching, yard operations, etc.); these pertain exclusively to the technical service.

The function of the regulating commissions was to assure the regular movement of trains upon the system which was assigned to them, furnish rolling stock to the units requesting same, control the regular transport of supplies, troops and evacuations and, above all to prevent congestion in the railway stations.

4. BULLETINS FOR TRANSPORTS OF MATÉRIEL.

To avoid the congestion of railway stations and prevent the immobilization of railway cars, the delegation at Calais sent a daily report to the "Director of the Services of the Rear" (Directeur des Services de l'Arrière—D. S. A.), which contained a list of the cars which were to be sent during the afternoon to the services at the front. This director issued a bulletin which was distributed, at 7 o'clock every evening, to all army authorities and which enabled the various units and services to take the necessary steps for unloading the matériel rapidly the following morning.

The daily supply trains of the "Intendance," which arrived during the night and which had to be unloaded during the morning were not included in these bulletins.

5. COMPARISON BETWEEN THE FRENCH AND THE BELGIAN SYSTEMS.

The basic principles governing the organization of the Belgian regulating commissions were similar to those which governed the French system.

The essential differences between the Belgian and the French supply services were the following:

1) *In the French Army* requests for supplies were sent by the General Staff of the Army to the Regulating Commissioner of the army concerned, who filled them through the intermediate depot (station-magasin) and who also was responsible for the regularity of transports. The Regulating Commissioner therefore had a double task.

In the Belgian Army requests for supplies were transmitted direct by the 4th Section of G. H. Q. to the intermediate depot (station-magasin) concerned, which was charged with filling them. The services of the "station-magasin" turned the supplies over to the Regulating Commissioner for shipment and delivery to destination. His duties were therefore quite simple.

The Belgian regulating commission was exclusively a railroad organization, while the French regulating commission was both a railroad and a supply organization.

2) In Belgian terminology, the heads of the lines were called either "*supply railheads*" (gares de ravitaillement) or "*evacuation railheads*" (gares d'évacuation). These railheads comprised:

a) Divisional railheads (gares de ravitaillement divisionnaires), which handled the daily supply: bread, meat, gasoline in cans (bidons), oil, grease, etc. As a general rule, there was one train per day for each army division.

b) Ammunition railheads (gares de ravitaillement en munitions).

c) Artillery material railheads (gares de ravitaillement en matériel d'artillerie).

d) Engineer material railheads (gares de ravitaillement en matériel du Génie).

e) Evacuation railheads for wounded (gares d'évacuation pour blessés).

In France, the Regulating Commissioner decided upon the railheads. In the Belgian Army, railheads were determined by the Chief of the General Staff of the Army. Therefore he also determined what duties should be assigned to each railhead, after agreement with the 4th Section of G. H. Q.

This difference was due to the fact that the entire Belgian Army constantly operated as a single unit and that the railroad services of the field army as well as the supply services, were in the hands of the Chief of the General Staff of the Army, under whom they functioned through the chief of the 4th Section of G. H. Q.

The railroad and supply services were the object of a daily order which was issued by the Chief of the General Staff. This order was known as the "*Order for the service of communications*" (Ordre pour le service de communications).

In order to intelligently issue this order the chief of the 4th Section of G. H. Q. received daily reports through a representative of the Regulating Commissioners. The chief of the 4th Section informed the Regulating Commissioners as to what supplies were to be transported and also indicated the order of priority of these transports, as the Belgian Regulating Commissioners were not authorized to establish priorities. On the other hand, the chief of the 4th Section was advised as to the amount of matériel available and concerning the progress of the work under way; in other words, he was informed as to transportation possibilities.

Being conversant with the requirements of the different services, the chief of the 4th Section was thus enabled to prepare his daily orders.

Although the Belgian Army only possessed a limited amount of motor transportation available for supply transport, (one day's food supplies and one day's ammunition supplies, according to the caliber of the guns) and although the positions of the railheads were always determined the preceding evening and their locations indicated to the units and services by means of the above mentioned "orders," not one of the Belgian railheads, from the beginning of the war

until the final offensive, was ever menaced to the point of being rendered useless.

3) The French Regulating Commissioners and Railway Station Commandants had personnel to look after maintenance (loading, unloading, switching). In the Belgian Army, the Regulating Commissioners and the Railway Station Commandants had no personnel at their disposal; these operations were carried out by the shipping services and by the consignees.

The Belgian system offers a great economy in labor but it cannot be applied unless the consignees remain on the spot, as they are also responsible for the unloading. This system naturally could not apply in any army, and particularly in the French Army, where troops were constantly being transferred.

Although this system represented an economy in labor, on the other hand, the army units were obliged to perform the unloading operations themselves and this imposed additional duties upon the combatant troops. However, although the Belgian Army was lacking in man-power, it was obliged to adopt this method. It is obvious that whenever the available personnel permits, it is preferable to maintain special unloading personnel in the various railway stations, recruited from the oldest classes of the militia.

6. COMMISSIONED PERSONNEL EMPLOYED IN THE SUPPLY SERVICE.

In the Belgian Army, a very limited number of officers was assigned to the Supply Service. As a matter of fact, the 4th. Section of G. H. Q. only comprised: a chief of the Section, who held the rank of Major, and four subalterns. The delegation at Calais consisted of two officers. One officer was assigned to the "Annex" at Dunkirk, while the regulating station at Adinkerke comprised: One Regulating Commissioner, who held the rank of Major, and three commissioned assistants, (four assistants during the offensive).

7. OPERATION OF THE REGULATING STATIONS DURING THE OFFENSIVE OF 1918.

At the time of the 1918 offensive, when the line of communication of the Army lengthened, new regulating stations were organized and their authority extended over certain sections of the line. During the advance of the troops, regulating stations were established at: Cortemarck, Bruges, Malines, Tongres, Aix-la-Chapelle, (the last named for the Army of Occupation).

With the exception of the regulating station which operated in the base area and the regulating station which was closest to the field army, both of which functioned as per paragraph 3 above,

the intermediate regulating stations were liaison agencies and their principal functions consisted of supervising the speeding up of transports on the section of the line of communication which was under their control.

The existence of these intermediate regulating stations was justified on account of the scarcity of telephone material and the weakness of the line of communication, especially because this line was being constantly extended, because repairs thereto were most difficult and that, due to these facts, numerous emergencies arose which could not be foreseen.

8. NOTES CONCERNING THE OPERATION OF THE DAILY SUPPLY.

Daily shipments: As already stated, the locations of the railheads for the following day were prescribed in the "Order for the service of communications" issued the preceding evening at the latest. After the daily distribution, the motor transport supply column (food) spent the night in the neighborhood of the railhead.

The following morning the motor transport column received its daily supplies at a fixed time. It loaded the supplies upon its trucks and distributed them to the troops during the afternoon or in the evening. When this was accomplished the motor transport supply column proceeded to and spent the night in the neighborhood of the railhead which had been designated for the following day.

Special shipments: Units and services were advised, by means of the "Special Bulletins" mentioned in paragraph 5, as to the arrival of matériel which they were to receive and the consignees took immediate possession at the railhead.

CHAPTER XIII.

SECTION IV.

REGULATING STATIONS (ITALIAN).

The system of regulating stations, whether as regulators of movements (railways) or as regulators of movements and supplies, presupposes the existence of a special railway system for each, the operation of which is exclusively entrusted to a particular regulating commission.

The French railroad systems, particularly those in the north and east, are quite extensive and form a network of lines radiating from Paris. These railways are cut by belt lines having their center also in Paris, thus forming trapezoidal figures. It was a simple process to unite some of these trapeziums and form small systems which could be exclusively assigned to regulating commissions.

Taking into consideration the railroad systems of Italy, particularly during the first period of the war, it will be seen that these formed but two main railway lines, viz.: the Verona-Vicenza-Udine line which served the First, Second and Fourth Armies and the Padua-St. Giorgio di Nogaro line which served the Third Army.

The First, Second and Fourth armies were all located to the north of the Verona-Vicenza-Udine line. This railway ran parallel to their front and all movements of supplies, as well as all changes in the locations of these armies, had to be effected over this line.

This did away with the possibility of assigning a regulating commission to each army and, since there was only one main artery for the movement and supply of several armies, it was essential that all transports be regulated by a single agency. As a matter of fact, had the French system of regulating commissions existed in Italy, all railway movements passing through the zones of several armies would necessarily have been accomplished by means of a continual agreement between these commissions, moreover, as such movements were the rule rather than the exception. a great deal of confusion and delay would have ensued.

To the north of the Verona-Vicenza-Udine line, in the Zone of the Armies, there existed no groups of railways under the jurisdiction of the Italian Army. It was perhaps necessary to have regu-

lating stations where the movements from the interior of the country could be regulated by the Administration of Movements and Transports but, in the war zone their scope of action would have been limited to the operation of lines only a few kilometers in length, hence there was no need for regulating stations of the French type in the Italian Army.

The inapplicability of the system of regulating stations on the Italian railway system was fully proved by the fact that when the French came to Italy in 1917, they were unable, from the railway point of view, to establish regulating stations on the railroad lines in use in that country.

As a matter of fact the French Regulating Commission in Italy (which was called the French base), located at Milan, functioned in the same manner as the Italian "Intendenza". It required the concentration in Milan of nearly all the materials and stores necessary for the French Army and supply trains were forwarded to Verona from Milan daily.

Technically speaking a French Regulating Commission was established, with the commander of the base as Regulating Officer, while the technical personnel of the system was represented by the chief of the Traffic Division of the State (Government) railways at Milan. However, it was impossible to place the necessary railroad lines at their exclusive disposal, therefore, from the railway point of view, the commission did not exist. The commission also encountered difficulties in the employment of trains, either because the rolling stock was already engaged by the Administration of Movements and Transports or for other reasons. It was likewise found impossible to place a certain number of routes (itinerari) on the Milan-Verona line under the permanent control of the French on account of the limited capacity of that line in relation to the enormous traffic which had developed thereon.

For the above reasons, the Milan station could not serve as a regulating station for the French base in the true meaning of the word, but only as a general supply station. Verona was considered by the French as a "regulating station of movement" but, owing to existing conditions, its functions as such were very limited.

The Italian Second Army Corps in France, which formed part of a French army, was supplied by the regulating station which served that army. This regulating station was located, first at Connantre and later at Le Bourget.

The reason that the Italian railway organization differed substantially from those of her Allies during the war, was that the railroad systems leading toward the eastern frontier were insufficiently developed and that, as a consequence, the Italian armies were obliged

to depend on one principal artery for all of their supplies, as well as for the exacuation of men and materials. This resulted in the centralization of all movements by rail under the Administration of Movements and Transports and coordination in rail transport was thus obtained.

However it is not improbable that in a future war, as a result of the new railway arteries which have been constructed and which now form part of the Italian railroad system, the French system of regulating stations will be employed by the Italian Army.

CHAPTER XIII.

SECTION V.

REGULATING STATIONS (AMERICAN).[1]

(Chart 4, Chapter XIV, Vol. I.)

The American establishment of regulating stations was the direct adaptation of the French system as employed by them at the time of our entry in the hostilities and very slightly, if at all, modified by us. It functioned in a corresponding manner and served a corresponding purpose. (See French section of this chapter.)

A regulating station may be defined as "a large railroad yard where cars from supply depots and from the rear are received and made up into trains called "rames" for the divisions."[2]

The general theory of a regulating station is to maintain the supply depots at a distance of absolute safety, and to ship in bulk each day to the railheads of the troops a supply of food and forage sufficient to cover their daily requirements and to forward, at the same time, all express, mail and freight in the division cars at the front. Thus, the daily automatic supplies on arrival at the regulating stations are sorted into separate cars for each division, and such units as will suitably supply a certain number of troops for one day, and are turned over to the T. D. for dispatch to the railheads to which trains can be taken in safety.

The physical requirements of a regulating station are simple: a large railroad yard, preferably situated at a junction of several lines leading from the various interior depots, and with two or more separate lines leading to the front it serves. This insures against interruption of traffic should one line be cut by shell fire or blocked by wreck, so that supplies for the front will go forward on a free line. It should be near enough to all points in its zone so that trains leaving after dusk or during the night can arrive by dawn. The flexibility of the system and the soundness of the principle are thus readily demonstrated.[3]

A regulating station is the nerve center of the supply and transportation systems in the Zone of the Armies. It is the connecting

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[1] Extracted from the report of General Moseley, G–4, G. H. Q., to C. in C., by Colonel Harry L. Hodges, General Staff, Chief of Staff, M. B. A. S.

[2] For the organization of American regulating stations see Charts 5 and 6, Chapter XIV, Vol. I.

[3] For the method of handling rames and trains in the yards of the regulating station, see detailed reports of Regulating Station "B," St. Dizier, referred to in General Moseley's report as Appendix "I." (Historical Branch, War Plans Division.)

link between the armies and the Services of the Rear, coordinating the army with the railroads that tie the Services of the Rear together. It is that point where the control of the S. O. S. ceases and the control of G. H. Q. commences. The Regulating Officer is responsible directly to the Assistant Chief of Staff G–4 G. H. Q.

On the regulating station falls the responsibility for the regularity of supply, of troop movements and evacuations, and above all, that congestion is prevented at railheads, and that cars of supplies, men, horses, etc. reach their proper unit without delay even though the unit in question be moving.

In principle, each regulating station supplies one field army, its zone of action corresponding to that of the army it serves.

Two regulating stations only were actually constructed: Is-sur-Tille (Côte-d'Or) and Liffol-le-Grand (Vosges).[4] The latter was not completed until after the Armistice. In addition, there were used successfully the French stations at Creil, Mantes, Le Bourget, Noisy-le-Sec, Saint-Dizier, Gray, Connantre and Dunkerque.

Intensive exploitation of railroad lines in the Zone of the Armies renders them extremely sensitive to any congestion. A clock-like regularity of movement has to be maintained if the railroad systems are to be ready at all times to meet the great demands placed upon them by changing battle conditions, which may necessitate vast quantities of ammunition being hastened forward, the removal of troops from one portion of the line to another, and unavoidably, the great increase in the number of wounded to be evacuated. An intelligent priority must be established, among even the most important classes of shipments, one which can be enforced without loss of time and with full knowledge of the attendant circumstances, and which, with frequent modifications, can be made to meet changing battle conditions.

The great difficulty is that all contingencies arise simultaneously. During battle the regular flow of supplies, foodstuffs, gasoline and forage must necessarily be maintained uninterruptedly, while at the same time ammunition, reinforcements, replacements, engineer material and increasing numbers of wounded must be transported.

The authority to establish priority is vested in the Regulating Officer. Supply, transportation and evacuation are, therefore, centralized in the regulating station, the coordinating organism of all these different factors. Consequently all calls of the armies for supplies or transportation are addressed to the Regulating Officer, who must so make his calls upon the depots and other organizations of the rear that a steady uninterrupted flow may be maintained in such a way that the yards of the regulating station and its rail-

[4] See General Moseley's report, Chapter VI, Vol. I.

heads are always sufficiently unencumbered to operate smoothly and rapidly. To enable an absolute control to be exercised over all shipments for the front— they must pass through the regulating station yards—where they are checked, recorded and their destination verified. In this way mistakes are corrected and missent cars reduced to a negligible minimum.

The slightest congestion in the regulating station yards will jeopardize the regularity of the supply of the troops; hence no shipments can be made from the rear except upon the call or with the authorization of the Regulating Officer if the supply of the troops themselves is to be kept up in such a way that their freedom of movement is guaranteed.

The Regulating Officer calls upon the services of the rear for the necessary food, forage, fuel and gasoline in bulk, based on the requirements of the number of troops in the army served by him, and these complete trainloads of supplies in bulk arriving at the regulating station are broken up and formed into sections of trains called "rames," each containing exactly the quantity of food, forage, fuel, required for the day following by each division or corresponding group of smaller units served from one railhead. To the different rames are added cars of mail or other special supplies, cars of replacement troops, men returning from hospitals or leave centers, etc., destined for the various units. The rames are then grouped into trains and dispatched to the railheads from which the units for whom they are intended are supplied.

Should a division change its location upon short notice, its rame is merely forwarded to its new railhead or intermediate railhead, as the case may be if the division is on the move. The Regulating Officer in consultation with G–4 of the army determines upon this intermediate station and the continuity of supply is maintained during the move.

Shipments of ammunition, engineer and other supplies are made by rames in the same manner as the subsistence supplies and their movements are similarly controlled by the Regulating Officer, who must at all times be thoroughly conversant with the exact situation of all the lines in his zone, all railheads and dumps, intended operations which may affect the supply, and with the status of all shipments due to arrive at the regulating station from the rear. He should be so familiar with the armies' needs that he will know instantly what articles should be held at depots and what articles should be forwarded on the limited transportation that can move during times of congestion. The Regulating Officer is advised by wire as each shipment is made from the depots, with any other information of value.

Division requisitions other than "Class I" supplies (articles that are needed and consumed daily by the troops, such as rations, forage and fuel) were filled and shipped in carload lots to the regulating station, to be forwarded on the daily supply train to the railhead, at which point the supplies were turned over to the division for distribution.

A standard type car containing 27,000 American garrison rations with a 30% bacon component, exclusive of fresh meat and soft bread, was fixed as a basis for the ration supply. Refrigerator cars averaged 25,000 rations of frozen meat, and only complete cars of forage were handled. The system of plus and minus (See G. O. 44, G. H. Q., 1918) accounting at railheads was instituted. If "overages" existed on several days shipment, these overages were carried until a complete carload accumulated so that a car of any-one article, such as rations, hay, oats, etc. could be withdrawn to balance the supply. An overage at all times, rather than a shortage, was carried.

In order to intelligently handle requisitions, movements of troops, material and hospital trains, the regulating station is organized into departments, with a capable officer in charge of each department. This officer is a member of the staff of the Regulating Officer and wholly responsible for the functioning of his department. The Regulating Officer is an acting staff officer functioning directly under G-4, G. H. Q. His duties consist of coordinating the departments and services at the regulating station.[5]

The theory of regulating is thus emphasized, that is, a central point for supply and evacuation, a central point for the make-up of solid trains which may be diverted to a point for arrival not later than twenty-four hours after they leave the regulating station, and the essential of strategy, constituting secret battle order and secret orders of movement for divisions or corps to be changed from one part of the front to another, with no indication of the movement to the enemy. Secret orders on a contemplated movement on a certain date, may be issued to the Regulating Officer. Until that date, replacements, food and material can be moved forward on a daily basis to points at which the troops are concentrated. On the date of movement, an increase in supplies at the new railheads, and a decrease in the old railhead, may be made and replacements and material re-routed on the same day that the movement actually takes place. If the supplies were routed direct from the depot or base port to an organization, all parties along the line of communication would know several days in advance, the actual location of the troops or contemplated changes. Stockages of ammunition, material and

[5] See Appendix "A" to this section and G. O. No. 44, G. H. Q., Mar 23, 1918.

supplies before the attack, are made gradually so that movement of large quantities of material may not be perceptible to enemy air reconnaissance or to espionage.

The daily supply of a division of 28,000 men is generally figured at eighteen to twenty-three French cars ageraging ten tons each and at about 9 to 10 U. S. A. box cars averaging about twenty tons each. In view of the fact that there is usually but a limited amount of trackage available for reception and classification of subsistence and material, the needs of the army with relation to the activities engaged upon must be carefully studied in ordering supplies from the depot.

Over-ordering from depots causes congestion at the regulating station just as readily as over-shipment to railheads is dangerous and must be always guarded against.

The proper functioning of a regulating station depends absolutely on unloading in a maximum time of twenty-four hours all cars of material and supplies received at a railhead, not only to allow track space for the supply of the following day, but also to keep a steady flow of empty cars or cars filled with salvage or evacuable material constantly passing to the depots for reloading. In this respect two zones are established, the first from the base ports to the depot and return, and the second zone from the depots to the railheads and return. By a constant check on through freight and material from the depots to the railheads via the regulating station, a balance of rolling equipment is established, which places at the disposition of those troops in the Zone of the Armies a dependable supply of rolling stock always available for the filling of their daily requirements.

The Railhead Superintendent is kept advised by the regulating station of any unusually large shipments which require extra personnel at railheads, and in turn the Railhead Superintendent advises the regulating station of any congestion which may necessitate diversion of material, and in this manner congestion is anticipated and avoided.

The Railhead Superintendent is the connecting link between the railhead and the regulating station, just as the regulating station is the point where the Services of Supply ceases to handle the supplies and turns them over to the armies. At the railhead the final disbursements take place to the smaller units of the divisions, regiments, etc., and the great organism of the Services of Supply, its base ports, its intermediate and advance depots, its repair shops, bakeries, cold storage plats, and its countless other installations with their many ramifications, all closely bound together by vast railroad systems feeding into the different regulating stations, has for its sole object the regular delivery of reinforcements and of ammunition, clothing, foodstuffs and other supplies to the different

army railheads. At these points the responsibility of supply system ends.

The railhead, as the name indicates, is a point on the railroad where the supplies are unloaded and turned over to the supply trains of the divisions or other army units. It should be as centrally located in the divisional areas as the railroad facilities permit in order to reduce to a minimum the animal or motor transport required in distribution.[6]

Railheads fall logically into two general categories: (1) Temporary; (2) permanent or semipermanent. The former, used often for one day by troops on the march or advancing or retreating, and changing to meet the varying conditions of battle, requires no construction or modification. (For further study, see reports made by Regulating Officers at Stations of Saint-Dizier and Is-sur-Tille.) A side track with a road or unloading platform capable of handling one or two daily rames is all that is required. No storage space is necessary as all the supplies are supposed to be carried away by the divisional train before nightfall. During the battle of Château-Thierry and on the march to the Rhine, practically all the railheads fell in this category, almost any railroad station with a reasonable yard being selected, the important factor being one of location rather than of facilities. In fact, during the march of the Third Army into Germany, the terms of the Armistice made thorough reconnaissance in advance impossible and railheads had to be selected on the basis of pre-war maps and information.

The railheads of the Saint-Mihiel and Argonne-Meuse sectors, on the other hand, fell into the second category. The front here had been comparatively stable for four years and most of the railheads conveniently situated for the supply of the troops in the line, in support or reserve, were developed to a considerable degree by the construction of additional sidings, unloading tracks, and buildings for storage. In fact, each of the important railheads in these areas resembled more or less a small depot where a limited reserve of supplies of different classes was maintained.

The proximity of the railheads to the front lines and the constant changing of effectives supplied by the railheads brings forth points which cannot be over emphasized. First, the danger of over-stockage, and secondly, the flexibility of supply.

Track facilities are the first consideration in the establishment of a railhead and often any extra stockage carried must be placed under tarpaulins and subject more or less to weather conditions. Railheads in active campaign are often under shell fire and are constantly

[6] See Chart 7, Chapter VI, Vol. I, giving locations of railheads during American operations.

subject to bombing. Instances of the above are the facts that for several days the railhead of Verdun was under fire both from high explosives and gas, and the daily rame was stopped two miles below the railhead and unloaded. Rames cleared by unloading the cars on the main highway and the supply was distributed with almost the same ease as if the spot had been a well equipped railhead.

With the exception of small emergency stockages stored well away from the railhead, the actual stockage at the railheads after each day's issue should not exceed one day's supply. During rapid German advances, supplies of ammunition and material directly behind the French lines were captured or destroyed, but at no time did the loss of subsistence or forage exceed the one day's issue at each French railhead and, as the troops retreated the French rames containing their daily supply were simply stopped in the rear of the troops.

It was not the policy of G. H. Q. to maintain large stockages at these advance railheads as most of them were under shell fire, but for the large offensives there was naturally a great increase, especially as we only counted on an advance. The liability of destruction by enemy bombardment was taken into account but that was unnecessary. Often, overcast weather protects against a real observation, and as soon as the attack starts the railhead is left far enough behind to be comparatively safe. As might be expected, the railheads of the reserve are more elaborately organized than those nearer the front. (See for further study, description and report of the large railhead at Souilly.)

In theory, there should be one railhead for each division, but it often happened in practice due to the massing of troops for an attack and the lack of suitable railroad facilities that more than one division had to be supplied from a single railhead.

The railhead is under the command of the Railhead Officer, who reports directly to the Regulating Officer. He has at his disposal a labor detachment sufficiently large to unload the supply train upon its arrival. Where possible a reserve stockage of one day's food, forage and fuel is maintained in order to prevent any delay in filling the division trains when the daily rame does not arrive on time.

In each corps area, at least one railhead with a platform suitable for entraining troops and artillery must be kept free at all times to provide for any emergencies of hurried troop movements. The wisdom of this precaution is strikingly exemplified by the instance, at the beginning of the Meuse-Argonne drive, when 30 train loads of tanks, without previous warning, were detrained in a very short period of time and were of immediate service where needed.

Regardless of the difficulty of so doing, the supplies must arrive at the railheads regularly with proper advance notice and with each car properly marked for its railhead. Questions regarding con-

tents, consignee and destination must be straightened out before the train arrives at the railhead. The test of the efficiency of the regulating station is the rarity with which errors in such matters occur. Too much emphasis can not be put on these details being attended to in advance as often all activity at a railhead must be carried on at night with feverish haste either to avoid observation or to escape as far as possible the guns of the enemy.

Flexibility can only be obtained through a regulating station of movement to which the depots in the rear ship daily complete cars of balanced rations, frozen meat, forage and fuel, which cars are formed into rames according to the effective strength of the forces to be supplied for delivery within twenty-four hours from the time the rames leave the regulating station. The same applies to casuals, replacements and all material sent to the Regulating Station for disposition.

There are several distinct elements and agencies which directly affect the regulating station, over which the army has no control and which must be coordinated under a representative who is empowered to act on matters affecting the transportation service as a whole, the Service of Supply and the priority of movement of material credits allotted to any one army in the field. In the first place regulating stations often function for more than one army. Depots invariably supply other elements and are not confined solely to the supply of a single army. Railway transportation is not restricted solely to the traffic for a single army. Again the basic practice on which an army functions is the freedom from administration and direction, outside of its immediate zone of activity. In other words, there must be an agency such as the regulating station upon whom the responsibility for satisfying these calls may rest. If administration in the army extends to the regulating station, it soon extends to the depots, and the line which must be drawn is best drawn at the Railhead, from which supply and evacuation for an army in sector, both in practice and theory, starts.

ARMY PARKS.[7]

In addition to the regulating stations and railheads, a system of army parks was organized which were for the immediate use of troops coming out of the line, who had to be quickly and completely re-equipped or re-supplied, and who could not be moved further to the rear. These parks maintained balanced stocks of articles most urgently needed and were so placed as not to interfere with the regular flow of automatic supply to the railheads.

[7] Extracted from General Moseley's report as G–4, G. H. Q., to the C. in C., by the American Section, M. B. A. S.

These parks were generally camouflaged for protection, as a great deal of storage was done in the open, but aside from that were liable to destruction.

Parks were under the direct control of the chiefs of the supply services of the A. E. F. who were responsible for keeping them properly stocked. Articles were requisitioned for in bulk or by drafts on credits and were sent, whenever possible, in solid trains, if traffic conditions on the roads permitted.

There were two types of army parks, one typified by that established at Lieusaint (Seine-et-Marne), about 35 kilometers outside the prospective zone of operations, during the fighting around Château-Thierry. This was a geenral storage park for all services. The second class of army parks was typified by those established during the Argonne-Meuse operations. They were closer to the front than the first class, inasmuch as the operations were entirely offensive and advances alone were counted upon. These parks differed from the one at Lieusaint in that they were established separately by each service.

These are the main features of the plant by means of which our fighting armies were fed, clothed and transported, by which the flow of ammunition was maintained to the guns, the sick and the wounded brought back in comfort to the places of safety. The coordination and direction of these complex factors and installations fell to G-4, G. H. Q. It must decide upon their location, their inter-relation and sufficiency, and once established, it must assure their smooth working, to leave the maximum of freedom of action to the tactical command. A depot or regulating station requires months to construct, and once built cannot be moved. An extensive study must therefore be made of all contingencies, to be ready for a retreat, an advance, a concentration in an unexpected sector,—all of these possibilities must be considered beforehand.

As a typical example, let us consider briefly, from the G-4 point of view, the situation as it existed in France in the spring and summer of 1918. The plans for the future development of the A. E. F. installations were naturally largely influenced by the strategic situation as it then existed. The combined resources of the Allies were required to meet the sledge-hammer blows of the enemy directed against different vulnerable portions of the front. All available reserve troops, regardless of their nationality, were needed at the threatened points, notwithstanding in what army zone they might be.

In April and May, French divisions had been thrown in with the British to help block the way to Amiens; Americans were fighting shoulder to shoulder with the French at Montdidier in a French sector, and later Americans, British, Italians and French were used

together between Rheims and Château-Thierry. This necessitated the utilization in common of the different existing installations of the rear required for the supply of these troops, and with this situation before us plans were laid for the development of additional facilities from the viewpoint of their usefulness to the common cause.

The old front was served by a chain of regulating stations: Sotteville-les-Rouen, Creil, Le Bourget, Noisy-le-Sec, Connantre, St. Dizier, Is-sur-Tille and Gray. These in turn were backed up by a series of advance depots as indicated on the map which shows these different installations as they existed on July 1, 1918.[8] All of these regulating stations, with the exception of Is-sur-Tille and Gray, were in a position to be threatened by a further enemy advance, and as the Allies were still on the defensive, the chance of a further advance rendering Creil, Le Bourget, Noisy-le-Sec, Connantre and St. Dizier useless as regulating stations, was not beyond the range of possibility. Their loss at this time would have completely disorganized the Allied supply system, and to provide against such a contingency, the development of a series of so-called regulating stations of the second line was considered, and detailed studies were made as to their proper placing. After discussing and rejecting the possibility of satisfactorily utilizing the existing French facilities at Le Mans, Nantes and Les Aubrais, the minimum combined requirements of the French and American Armies were determined to be four new regulating stations, of which two: Poinson and Chailleurs, were to be constructed by the Americans, and La Loupe and Conches were to be undertaken by the French. It was felt that these, together with Is-sur-Tille, would enable the Allied forces to successfully continue the struggle even should their existing facilities be lost.

Then, suddenly beginning with the memorable counter-attack south of Soissons by American and French Colonial troops on July 18, 1918, the whole aspect changed. All work on these second line regulating stations was abandoned and the construction of the regulating station at Liffol-le-Grand, which had been stopped at the moment of the German advance, was ordered ahead full blast. Thus in less than two weeks, from a defensive position with attention directed towards the development of facilities along a general line running east and west, south of Paris, we had passed to the offensive and very soon had an army of 750,000 men advancing to the attack on the St. Mihiel salient. In spite of the complete change in the situation the supply system worked, just as it would have done if we had been forced to fall back on Paris.

[8] See report of the 4th Section General Staff, Appendix I.

Appendix A—Chapter XIII—Section V.

PROPOSED ORGANIZATION OF REGULATING STATIONS.

1. EXECUTIVE SECTION.

(*a*) Coordinates the operation and administration of the entire plant.

(*b*) Handles mail and correspondence,

(*c*) Supervises telegraph, telephone and courier service,

(*d*) Distributes personnel of regulating station and railheads,

(*e*) Promulgates orders and bulletins,

(*f*) Post administration, under which head comes all troops including casuals and their distribution.

(*g*) Motor transport,

(*h*) Finance, rents, and contracts.

2. SUPPLY SECTION.

(*a*) Charged with the automatic supply of rations, fuel and forage to the troops in the area served by the regulating station,

(*b*) Forwarding requisitions to the depots for all other supplies and materials requested by the troops,

(*c*) Maintenance of reserve and emergency stocks at regulating stations and railheads.

(*d*) All routine correspondence with depots involving supplies, requisitions and shipment of supplies.

(*e*) Keeps complete data: On supplies on hand at railheads; status of all requisitions handled; on all shipments made on requisitions and enroute to destination.

3. RAIL TRANSPORTATION SECTION.

(*a*) Maintains close liaison with the Transportation Service.

(*b*) Arranges all transportation for supply and troop movement, including the spotting of cars and the make-up of rames.

(*c*) Supervises the Rail Transportation Officers.

(*d*) Keeps on file detailed information regarding railhead capacities, etc., and data as to possible future railheads.

(*e*) Operation of the L. C. L. warehouse.

(*f*) Operation and maintenance of railroad equipment at station yards.

(*g*) Technical administration of railway transportation personnel.

4. EVACUATION SECTION.

(*a*) Evacuation of sick and wounded.
(*b*) Record of allotment of bed space in hospitals.
(*c*) Follows movement of all hospital trains serving the area.

5. DISPOSITION SECTION.

(*a*) Disposition and record of all cars arriving at the station.
(*b*) Record of all cars loaded out of the station.
(*c*) Reconsignment of all supplies in the advance which have been misdirected or which have arrived subsequent to the departure of consignee to another area.
(*d*) Keeping of station list and battle order, and giving all necessary information relative to location of consignee of material, supplies and troops.
(*e*) Close liaison with G. H. Q. of the field army and with G. H. Q. of the group of armies operating in zone served by the station.

CHAPTER XIV.

SECTION I.

RAILWAY TRANSPORTATION (BRITISH)—TRANSPORTATION PROGRESS REPORT FOR THE YEAR 1918.[1]

INTRODUCTION.

"The military operations during the year 1918 cast an unprecedented burden upon the transportation services.[2] The rapid and deep progress of the enemy offensive during April and May resulted in the loss of the lateral line between Amiens and Arras, and made precarious the working of the second lateral from Ypres via Chocques and St. Pol; Amiens and other vital points were seriously threatened, thus throwing the main north and south communication upon the coast line.[3] The territory between the front and the sea had been considerably narrowed by the enemy advance; in consequence, considerable congestion arose, and the position was one of the utmost gravity.

With the successful counter-offensive of the Allied Armies in August, the position was relieved, but, in order to keep pace with the advancing armies, a vast amount of construction work had to be undertaken upon a greater and more intensive scale than ever before during the war. Owing to the rapidity of our advance, and to the fact that the fighting was very heavy and of a continuous nature all along the British front, the traffic problems entailed were very complex and difficult to deal with.

After the signing of the Armistice, with the subsequent advance of the British Army to the Rhine, the lines of communication were lengthened considerably. In order to maintain the armies, every effort was made to reconstruct the railways and roads across the destroyed area as rapidly as possible, and to open up the lines for operation. Traffic working was further greatly complicated by the necessity of providing for civil traffic.

During the year under review the railways and ports were constantly bombed by enemy aircraft, thus adding to the difficulties of operation, besides which the enemy, in the course of his retreat, used

[1] Report of Director General of Transportation, British Army, furnished the M. B. A. S. through the British Section of the Board.

[2] Organization of the D. G. T., Chart 1, Chapter XV, Vol. I.

[3] For British railway systems see Chart 2, Chapter XV, Vol. I.

every modern artifice in the thorough destruction of railways, bridges, roads, etc.

All the various departments of the Director General of Transportation (D. G. T.) were affected by the extraordinary fluctuations in the military position, and the work undertaken has been far in excess of anything previously contemplated. The strain upon the personnel has been extremely heavy, and the utmost credit is due to the magnificent way in which all ranks have responded to the call and have carried out their arduous and responsible duties, thus assisting in a most efficient manner in the successful advance of the British Armies.

IMPORTS.

The magnitude of the work at the base ports may be appreciated by the fact that the imports for the armies during the year under review amount to, roundly, 2,250,000 deadweight tons per quarter. In order, therefore, to deal with this vast amount of traffic, the dock equipment and facilities during the past two years have had to be largely increased, and the whole port working thoroughly organized.

The satisfactory working during 1918 is particularly creditable, when it is taken into consideration that the ports have been persistently and heavily attacked by enemy aircraft and bombardments.

The considerable advance of the enemy in March and April, 1918, and the military situation which arose in consequence, caused some dislocation to port working, and a large proportion of the imports of the southern ports had to be transferred to the north.

During the last quarter of the year imports were greatly reduced, as, after the signing of the Armistice, ammunition was discontinued, and all other traffics were reduced as far as possible. In consequence of this reduction, accommodation at the southern ports is being given up, and traffic is being concentrated on the northern ports. During the first three months of the year imports were allocated 50% to northern and 50% to southern ports, whereas, during December, these proportions were 76% to northern and 24% to southern ports.

The total imports for the years 1917 and 1918 have been as follows:

	1917 (deadweight tons)	1918 (deadweight tons)
January–March	2,120,168	2,225,325
April–June	2,748,050	2,317,580
July–September	2,370,452	2,255,644
October–December	2,159,350	2,070,943
Total	9,398,020	8,869,492

During the period of active operations imports of ammunition were very heavy, and reached record figures for the second and third quarters of the year. The total imports of ammunition, included

in the above figures, amounted in 1917 to 2,109,735 tons and in 1918 to 2,068,314 tons.

EXPORTS.

Every effort has been made to increase the shipments of salvaged materials to the United Kingdom, the totals during the past two years being as follows:

	1917 (deadweight tons)	1918 (deadweight tons)
January–March	22,225	64,456
April–June	89,999	111,004
July–September	126,491	142,195
October–December	87,443	93,031
Total	326,158	410,686

PORT EQUIPMENT.

In order to handle the enormous traffic, the port working has had to be thoroughly organized, and the equipment and facilities largely added to. Some idea of this expansion may be appreciated by the fact that, whereas at the 31st December, 1916, the number of cranes working at British accommodation at the ports was 126, the number at the 31st December, 1917, had risen to 290, and at the 31st December 1918, to 369.

V. DISCHARGE OF SHIPS AT FRENCH PORTS.

As the result of the organization of port working, the rate of discharge has shown a remarkable increase. The average tonnage discharged from vessels per hour in port in January, 1917, averaged 12.5, rising in September, 1917, to a maximum of 25.8. In January, 1918, the rate of discharge averaged 25.8, and showed a continuous increase until July then the rate was 34.4. This increase in the rate of discharge represents a very great saving in shipping. During the latter part of this year there has been a decline in the rate of discharge, mainly due to the inability of the railways to supply trucks at the rate ships could discharge. The fall has been further accentuated since the Armistice by a general reduction in the efficiency of labor, with the result that the rate of discharge in December, 1918, fell to 23.2 tons per hour.

The improvement in the port working is also reflected in the substantial decrease in the number of ship-days lost awaiting berth. The average number of ship-days lost during the opening months of 1917 were:

	Per week
January	57
February	100
March	87

But during the remaining months of that year, a considerable reduction was effected, and during 1918 the monthly averages have varied between a minimum in March of 5.8, and a maximum in July of 13.1 ship-days per week.

CROSS-CHANNEL BARGE SERVICE.

The remarkable development of the cross-channel barge service has been an outstanding feature in connection with the imports for the British Army. In January, 1917, the tonnage conveyed to France averaged 1,904 per week, rising in that year to a maximum in September of 14,604 tons per week. During 1918 there has been a considerable expansion, the imports rising in August to 24,977 tons per week. Since the Armistice, owing partly to the suspension of the imports of ammunition, the tonnage carried has fallen considerably, the weekly average for December, 1918, being only 7,688 tons.

The total tonnage carried to France by this service during the past two years has been as follows:

	Total tonnage		Proportion to inland destinations	
	1917	1918	1917	1918
January-March	33, 823	180, 059	32, 785	138, 276
April-June	106, 663	264, 206	95, 883	179, 313
July-September	173, 901	311, 604	156, 045	208, 401
October-December	135, 186	207, 739	117, 024	154, 134
Total	449, 573	963, 608	401, 737	680, 124

The total imports during 1918 represent an increase of 114% over the total for 1917.

The return traffic to the United Kingdom for the year 1918 totalled 156,086 tons, being just under 3½ times greater than the total for 1917.

CHANNEL TRAIN FERRY SERVICE.

This service, which was opened during February last, has proved of inestimable value in conveying railway mounted guns, locomotives, wagons and tanks. The imports and exports by train ferry have been as follows:

1918	Imports	Exports
	Tons	*Tons*
February-March	14, 692	
April-June	60, 077	10, 032
July-September	72, 410	7, 579
October-December	69, 795	4, 194
Total	216, 974	21, 805

One of the outstanding features of the train ferries is the ease and rapidity with which they are loaded and unloaded. During

November, for example, the time loading and unloading of each case averaged only 18 minutes per trip. The handling of traffic by means of the train ferry represents a very great assistance to port working.

BROAD AND METER GAUGE RAILWAYS.

Traffic.—As a result of the advance of the enemy, the railway situation in April and May was extremely difficult, for the following reasons:

1. The territory occupied between the 'front' and the sea had been considerably narrowed by the enemy advance.

2. The lateral line between Amiens and Arras had been occupied by the enemy, and the second lateral from Ypres via Chocques and St. Pol was unworkable through Hazebrouck, was precarious through Chocques and difficult through St. Pol.

3. Communication from north and south of the Somme had been rendered difficult, owing to the loss of Longueau, and the main lines running from the east of Amiens toward Paris. (Chart 2, Chapter XV, Vol. I.)

In consequence, the army railheads, depots, etc., were thrown back into the lines of communication area, producing considerable congestion, which was enhanced by the necessity of finding storage accommodation for material evacuated from the forward areas. The demands upon the railways, therefore, were largely increased, whereas the facilities were greatly reduced.

During this period constant enemy aircraft activity and the repeated interruption of telephone communications made the maintenance of an efficient control of train movements a matter of continued anxiety; movements by night were often temporarily paralysed.

The reduction in the train service between the north and south of the Somme necessitated severe traffic restrictions. These conditions, added to the heavy troop movements thrown on the coast line, caused considerable congestion between Calais and Abbeville, which was complicated by the urgent demands for reinforcements and material for the 'front.'

At the end of May, owing to the enemy offensive against Château-Thierry, a large number of wagons had to be withdrawn from the British zone for the evacuation of military and civil stores from this front and from Paris to the south of France. In consequence, there was a considerable shortage of wagons at certain of the British ports.

Early in July, relief was obtained by the opening of newly constructed lines, and the Allied counter-attack on the Marne on the 18th July resulted in a considerable reduction in the organized air attacks on the railways.

The attack on the Fourth Army on the Amiens front in August, at once changed the whole position by freeing the great railway centres

of Arras and Longueau and enabling the reconstruction and use of the main lines radiating therefrom. Difficulties of communication between north and south disappeared, and every effort was devoted to following up the advancing army, the demands for which were exceptionally heavy, owing to the continuous fighting on all fronts, and the lengthening of the lines of communication.

By the end of September, and during October the railway situation had again changed entirely, and the main features were the difficult problems of keeping pace with the rapid advance of the armies and providing for the needs of the civil population in the re-conquered territory; the expansion of the railway lines, and the necessity for meeting construction requirements, whilst, at the same time, maintaining the heavy demands of the armies for offensive operations, taxed railway resources to the uttermost.

After the Armistice, the advance of the British Army to the Rhine created great difficulties as regards traffic working. In the destroyed area, which in parts was 60 miles in depth, all the railways had been totally destroyed. On the west side of this gap the lines for a distance of 16–20 miles were not in normal working order, whilst on the east side the lines right up to the German frontier had been left in a disorganized and congested condition, and with most of the working facilities out of action.

The resumption of civil traffic in France greatly increased the difficulties of circulation. The French and Belgian railways have been called upon, not merely to carry the essential military traffic, but also to provide for the feeding of the civil inhabitants in the zone recovered from the enemy. At the same time, there has been an abnormal traffic in railway construction material to enable the necessary connection to be made across the gap between France and Belgium.

The difficulties of keeping engines and rolling stock under repair, and the long hours that have had to be worked during the stress of the operations of 1918 have heavily strained the railway personnel.

Some idea of the immensity of the traffic that has had to be handled may be appreciated by the following figures showing the total British military personnel carried on broad and metre gauge lines during the past year:

1918	British E. F., France	To Italy and the East	Total
January-March	4, 339, 770	136, 446	4, 476, 216
April-June	3, 132, 181	52, 044	3, 184, 225
July-September	3, 723, 150	64, 413	3, 787, 563
October-December	3, 535, 696	46, 494	3, 582, 190
Total	14, 730, 797	299, 397	15, 030, 194

The number of loaded trains run for the British E. F., France, during the past two years has been as follows:

	To Railheads	On L. of C.	Total
1917			
January-March (not available)			
April-June	11,573	7,986	19,559
July-September	13,474	8,813	22,287
October-December	13,018	8,440	21,458
1918			
January-March	11,805	8,240	20,045
April-June	11,451	10,323	21,774
July-September	13,116	10,301	23,417
October-December	8,993	9,451	18,444

It will be seen that the total for the September quarter of 1918 is the highest on record, this being due to the heavy traffic in ammunition, personnel, railway and road material.

TRAIN MOVEMENTS TO ITALY AND THE EAST.

In November 1917, when forces were despatched to Italy, the whole of the movements of British troops up to the Italian border were placed under the D. G. T., France. A separate D. G. T., Italy, was appointed responsible for the transportation services in Italy.

The number of loaded trains despatched since November, 1917, has been as follows:

	To Italian Expeditionary Force	To Taranto	To Marseille	Total
1917				
November-December	720	(1)	(1)	
1918				
January-March	316	167	87	570
April-June	214	170	23	407
July-September	291	147	22	460
October-December	104	119	16	239

[1] Not available.

BROAD GAUGE LINES IN FRANCE WORKED ENTIRELY BY THE BRITISH, AND WORKING OVER BELGIAN LINES.

During the past two years the operations of the R. O. D. have been developed considerably. At the 31st December, 1916, the R. O. D. worked, altogether, 160 kilometres of broad gauge line. During that year the kilometrage operated rose consistently, amounting at the 31st December, 1917, to 534 kilometres. After the enemy offensive in the spring of 1918, a considerable proportion of the lines had to be abandoned, and the lines operated fell at the commencement of

May to 334 kilometres. Subsequently, the figures rose rapidly, amounting at the 31st December, 1918, to 1,312 kilometres. The kilometrage operated at the 31st December, 1918, is 8.2 times that at the 31st December 1916.

The loaded wagon-kilometres on these lines during the past two years have been as follows:

	1917	1918
January–March	3,208,980	7,648,315
April–June	4,496,979	6,671,466
July–September	7,842,275	23,368,993
October–December	9,775,791	24,064,469
Total	25,324,025	61,753,243

The total for 1918, represents an increase of no less than 145% over that for the previous year.

BRITISH ENGINES WORKING OVER FRENCH LINES.

At the commencement of 1917, the French requested the British to provide manned locomotives for working traffic over the "Nord" lines, although this liability had never been contemplated previously. In compliance with this request, the Railway Operating Division (R. O. D.) commenced furnishing locomotives during the last few days of February, since when the development of this traffic has been extremely rapid, as will be seen from the following figures showing the loaded wagon-kilometres hauled by R. O. D. locomotives over lines operated by the French:

	1917	1918
January–March	----------	36,577,235
April–June	11,521,328	60,784,922
July–September	17,055,889	55,756,007
October–December	27,946,596	56,595,084
Total	56,523,813	209,713,248

The total for the last quarter of 1918, is 4.9 times that for the second quarter of 1917.

The great and increasing assistance afforded to the French railways by British locomotive power may be appreciated by the fact that, where as during the quarter April–June, 1917, the total loaded train-kilometres hauled by R. O. D. engines represented 25% of the total for British Army traffic, the proportion for the last quarter of 1918 had risen to just under 100%.

BROAD AND METER GAUGE ROLLING STOCK.

Towards the end of 1916, and the beginning of 1917, the French railway authorities put forward demands for assistance far beyond anything that had previously been contemplated and provided for. Extensive orders for locomotives and wagons were placed, and the

great assistance afforded to the French may be gauged by the following figures showing the locomotives and wagons provided by the British at the 31st December 1916, 1917 and 1918.

	At December 31, 1916	At December 31, 1917	At December 31, 1918
Broad gauge locomotives:			
Imported	62	753	1,205
Hired	198	215	229
Captured			6
Total	260	968	1,430
Petrol tractors: Imported		7	8
Wagons (numbers):			
Imported	3,840	34,845	52,597
Captured or built from scrap			67
Equivalent 10-ton units	6,286	46,317	69,146

It will be seen that at the 31st December 1918, the British had on charge 1,430 locomotives, this number being sufficient to meet the whole of British Army requirements for locomotive power. In the case of wagons, the British had provided at the 31st December, 1918, just under 70,000 ten-ton units, this being more than sufficient to meet British Army requirements in France.

In addition to the above, 50 metre gauge locomotives and 1,200 wagons have been imported.

A total of 30 ambulance trains of British stock have been imported into France, and, in addition, there are 11 trains of French ambulance stock on British service.

The leave trains fitted and equipped in France comprise two rakes of covered stock and nine rakes of "Noah's Arks."

Out of the imported locomotives and wagons, 387 locomotives and 14,550 wagons were erected at the Chief Mechanical Engineer's shops in France. In addition, up to the 31st December, 1918, a total of 330 wagons had been erected for the American Army.

The upkeep of this large amount of rolling stock has been a very large undertaking, as will be appreciated by the following figures, showing the output of the various repair shops and out stations during the year 1918:

Broad and meter gauge.

Locomotives and tractors:	
Erected	246
Repairs: Heavy and light	809
Repairs: Shed	5,487
Washing out	25,813

Wagons:	
Erected	3,434
Repairs: Heavy and light	22,639
Ambulance trains repaired	104
Leave train stock: Repairs, conversions, etc	3,318

Owing to the military situation, the forward locomotive repair shops at Borre had to be evacuated in April, 1918, and a considerable portion of the St. Etienne shops had to be handed over to the "Nord" railways to enable the French to cope with their repairs, due to the loss of their northern shops. The subsequent re-organization, which had to be carried out at St. Etienne, together with the loss of Borre, seriously affected the locomotive repair output, and, at that time, a number of locomotives had to be evacuated to England for repairs.

New locomotive shops were erected at Rang-du-Fliers, and by the end of September, work had already commenced there.

In order to cope with the maintenance of British wagons, and, as a reserve in case Audruicq had to be evacuated, an additional wagon repair depot was installed during the year at Oissel. In addition, a large number of out station repair depots have been established at various points to provide for the upkeep of War Department (W. D.) stock.

RAILWAY CONSTRUCTION (BROAD AND METER GAUGE).

The enemy advance in the spring threatened the important railway centres of Amiens, St. Pol and Hazebrouck, and created a situation of extreme gravity, as regards the maintenance of communications in the north of France. To relieve this situation, a comprehensive program of construction, in conjunction with the French was undertaken, to provide, independent of Amiens, for these separate routes for north and south traffic. This involved extensive doublings and quadruplings of existing railways, and the construction of new lines. At the same time, a railhead system had to be developed for the maintenance of the Army on the new front and to prepare for the subsequent advance.

These measures involved the building, with the attendant appurtenances and bridging, of some 200 miles of track during the period from April to July. During this time the situation was made increasingly difficult by the activity of enemy aircraft, which was particularly directed against important junctions, and points on the main railway systems. Special protective and precautionary measures had to be taken on bridges, and deviations were constructed at

junctions for the same reason. As an instance of the justification of these measures, the viaduct at Etaples was damaged by bombing, thus cutting this most important main line of communication. But, fortunately, a precautionary deviation had been linked up the day previous, and only slight delay to traffic resulted in the middle of an important movement of troops.

When the armies fell back railway construction troops effectively destroyed the main lines of communication and cleared rolling stock and guns on railway mountings. By so doing, they assisted in no small degree in hindering the enemy in his advance.

From the commencement of the counter-offensive in August, the situation became reversed. The defensive measures were abandoned, and the energies of all concerned were centered upon the reconstruction of the railway system recaptured from the enemy. As he withdrew, the enemy used every possible artifice in the destruction of railways; nearly all the bridges and water supplies had been destroyed, and a very large portion of the track rendered useless. In certain sectors, delay action mines had been laid in the track, and special steps had to be taken for their discovery and removal. The detection of these mines was very difficult, and those not located, on explosion, blew huge craters, causing havoc to both track and formation and frequently also to personnel.

After the Armistice the work of the railway construction troops was in no way relieved, as it was of the utmost importance that the French and Belgian systems should be linked up as rapidly as possible in order to provide for the armies, and also the civil population.

After the retirement of the enemy it was found that the railways had been totally destroyed on the British front up to a line Sotteghem, Grammont, Ghislenghien, Jurbise, Mons to Fontaine Valmont.

In addition to the destruction caused by delay action mines, extensive damage was wrought on the railways as far back as Namur, by the destruction by fire of rolling stock and the explosion of train loads of ammunition in stations. The most serious damage was caused in this way at Luttre, where approximately 2,000 wagons were blown up, completely wrecking the station and station yard. Considerable damage was also caused at Monceau, another large goods yard in the vicinity of Charleroi.

Some idea of the immensity of the achievements of the railway construction troops may be obtained from the following figures, showing the actual amount of construction work carried out since the beginning of the war:

	New lines constructed	Lines reconstructed	Track dismantled
	Miles	*Miles*	*Miles*
1914	1.5		
1915	104.0		
1916	417.0		
1917			
January–March	226		32
April–June	363		33
July–September	129		18
October–December	96		11
Total	814		94
1918			
January–March	173		16
April–June	334		64
July–September	191	461	59
October–December	61	1,120	106
Total	759	1,581	245

The total bridging executed since the beginning of the war in newly constructed lines and on reconstruction of existing lines amounts to some 37,000 feet run of single track.

The total quantity of ballast used amounts to some 8¼ million tons, and consisted of red and black mine earth, sand, chalk, gravel and ashes. This represents 3½ times the excavation which would be involved in building the Channel tunnel.

The average lead from the numerous pits to works was approximately 50 kilometers, and taking into consideration the cost of loading and transport, but excluding the cost of machinery, this has involved expenditure amounting to some 22¼ million francs, viz: Frs. 2.70 per ton. Including all charges, three francs per ton would be the outside cost of this material,—a particularly reasonable figure taking into consideration the long haulage charges.

During the period from August to the end of December, 1918, no less than 1,581 miles of lines were reconstructed, and this work involved the entire relaying of 589 miles of track, which, together with the new lines constructed, makes a total of 1,348 miles of new track laid during the past year; in addition, 992 miles of damaged track have been reinstated.

During the year under review some remarkable performances have been achieved. As an instance; Lille was evacuated on the 17th October, 1918, and on the 25th October the first train of supplies was taken into the city for the civil population, a new bridge having been thrown across the Lys at Armentières in four days.

On the 11th November, 1918, on the Arras-Douai-Valenciennes-Mons line the destroyed gap consisted of a stretch of 20 miles, and on this line there were 13 bridges, total 650 feet, which had to be

reconstructed. On the night of the 25th to 26th November, 1918, the single track was connected through with Mons, after which through traffic to the armies was first commenced, beyond which point the track was in a fair state of repair, although extensive preparation had been made for its destruction. Double tracking was completed throughout on the 13th December, 1918, and double line working was brought into operation on the 14th December, 1918.

On the 11th November, 1918, on the Lille-Tournai-Ath line the destroyed gap consisted of a stretch of 27 miles. The single track was completed to Tournai, and the station there opened for supplies on the 28th November, 1918. Ghislenghien, from which point eastwards the line was practically intact, was reached by the 2nd December, 1918. Double tracking to Tournai was completed on the 31st December, 1918, and was completed throughout by the end of January, 1919.

On the 11th November, 1918, on the Courtrai-Audenarde-Sotteghem-Grammont line, the destroyed gap consisted of a stretch of 30 miles. The Scheldt river, which is 100 feet wide, had to be spanned with a trestle bridge, and several minor bridges of 30 feet span had to be repaired. The bridge over the Scheldt was completed in 4½ days. The gap was finally sealed on the 6th December.

In the carrying out of the enormous construction program of 1918, the greatest credit is due to the British and Canadian railway troops. These troops have been employed continuously, often day and night, in preparing the lines for the advance of the armies, and their magnificent work made possible the successful advance of our armies. The extent of the work and the rapidity with which it was carried out created a phenomenal record of railway construction."

REPORT OF DIRECTORATE OF CONSTRUCTION AND RAILWAY CONSTRUCTION DEPARTMENT.[4]

"On the 12th of August 1918, an order was issued, DGT/159/180 (D. G. a. 2), establishing a Directorate of Construction.

The reasons for the formation of the new directorate were: (1) To limit the amount of light railway construction. (2) To coordinate and control the supply of labor, both skilled and unskilled, between broad gauge, light railway and dock area construction.

Stages of development: In 1914 Brig. General J. H. Twiss was appointed Director of Railways under the Quartermaster General. (Q. M. G.)

The Director of Railways was responsible for the survey, construction, repair and maintenance of all broad, metre and 60 cm.

[4] Prepared for the M. B. A. S. by Col. D. Lyell, C. R. C. E., Acting Director of Construction, B. E. F.

gauge lines and yards required for the use of the British Army in France. He was responsible for the traffic and operating of the lines and the administration of all railway personnel and the upkeep of all the British rolling stock.

Colonel Waghorn, who was Chief Railway Construction Engineer (C. R. C. E.) and Deputy Director of Railways, was responsible to the Director of Railways for the construction, repair and maintenance of all broad, metre and 60 cm. gauge lines.

On November 22nd, 1916, Colonel Waghorn succeeded Brig. General Twiss and became Director of Railway under the newly formed Director General of Transportation. He was responsible for the construction, repair, and maintenance of all broad and metre gauge lines; for the repair and maintenance of all rolling stock, plant, locomotives, workshops, buildings, etc. His duties included the administration of all railway personnel and the various units maintained for constructing and operating broad and meter gauge lines, yards and depots for the use of the British Army in France.

On November 22nd, 1916, Lieut. Colonel D. Lyell succeeded Colonel Waghorn as Chief Railway Construction Engineer and was responsible for the construction, repair and maintenance of all lines under the control of the Director of Railways.

On the 20th of January 1917, instructions were issued by the D. G. T. (Office Instruction No. 45) that the C. R. C. E., Colonel Lyell, would deal on his own responsibility with all matters connected with broad gauge civil engineering and construction, signing: "C. R. C. E., for Director of Railways." He would, in General Waghorn's absence, report direct to D. G. T. on matters requiring decision by higher authority.

On July 23rd, 1917, the D. G. T. organization was issued and in this Brig. General J. W. Stewart was appointed D. D. G. T. (Construction) to deal with all matters and references concerning work of a civil engineering character on behalf of and in the capacity of Deputy to the D. G. T., and in general to supervise all new construction carried out under the D. G. T. He was to receive information as to what works were required from the D. D. G. T. (T) or the D. Ds. G. T., 1, 2 or 3 as the case may be. Brig. General J. W. Stewart never received information as to requirements from the other Deputies and consequently never functioned as a Deputy to the D. G. T.

In this organization the Chief Railway Construction Engineer (Colonel Lyell) came directly under the Director General of Transportation. He dealt on his own responsibility with all matters connected with broad and meter gauge civil engineering and construction. He assumed all the responsibilities and powers in regard to the duties of his department which had in the past been exercised

by the Director of Railways, including the making of adequate provision for material, etc., required for current as well as for future work. He was to refer to the D. G. T. such matters as had in the past been referred by the Director of Railways.'

On August 11th, 1918, all directorates and departments, D. G. T. were informed by D. G. T. letter DGT/159/180 (D. G. a. 2) that the formation of a Directorate of Construction had been approved under the War Office letter No. 121/Railways/371 (DGMR) dated 5-8-18.

This directorate to include: (1) Broad gauge construction. (2) Light railway construction. (3) New construction in dock areas.

Brig. General J. W. Stewart, C. M. G., to act as Director of Construction from the 12th August inclusive.

This directorate did not function until the 1st October 1918, when the Director of Construction took over from the Director of Light Railways all light railway construction; and by that time light railway construction was practically abandoned as the armies were getting beyond its area, and the greater part of the Canadian troops were then put on to the broad gauge reconstruction. Beyond this the Construction Directorate never functioned except on paper.

On the 25th January 1919, under D. G. T., instructions DGT/1300/94 (P3) dated 22nd January 1919, Colonel D. Lyell took over the duties of Director of Construction vice Brig. General J. W. Stewart, C. B., C. M. G.

No special alterations were necessitated by the offensives, but it would have been an advantage if an extra mechanical company had been sanctioned to deal with the permanent loco water supplies and get them into working order earlier than was possible with the existing establishment. The Germans in their retreat demolished all these supplies, many of which entailed a large amount of pipe laying and other fitting work.

The Railway Telegraph sections supplied by the Director of Signals were not sufficiently strong to cope with the work and keep up with the tracklaying. When a section of line is opened for traffic, the telephones should be ready, and in addition to this there should be an advanced telephone railhead for construction purposes. The non-existence of these telephones caused bad traffic working at railheads.

The main difficulties experienced by the Railway Construction Department were due to faulty organization in army areas. The organization was topheavy with non-executive officers who had not got sufficient technical knowledge. The armies were badly advised and in many cases this entailed a lot of unnecessary construction, and at the same time the armies did not get what they really re-

quired, which was better distribution. Having separate organizations for dealing with broad gauge and light railways was entirely wrong, as there was no co-ordination between the two, and it looked like two competing companies trying to cut each others throats by building lines in competition with each other, with the important difference of not having to satisfy their shareholders.

The organization recommended would be as follows:

Under the D. G. T. there should be a Director of Railways, with a Deputy Director for traffic and operating and a Deputy Director for construction, with their staff at General Headquarters.

On Lines of Communication there should be: (1) A Railway Traffic and Operating Officer responsible for the carrying out of all traffic and operating duties on the lines of communication, up to distributing stations placed inside the army areas. (2) A Railway Construction Officer responsible for the construction and maintenance of all lines and depots in the L. of C. area, up to and including the distributing stations. These officers being responsible to their respective Deputies at G. H. Q.

From the distributing stations the front should be divided into districts, and these districts would be regulated by the contour of the country and the existing main lines of railway. Each district should have a Manager of Railways (or whatever name may be chosen), responsible for getting the supplies to the points arranged for with the army concerned. The Manager of Railways would be responsible for traffic, operating and construction, and would have: (1) A deputy responsible for traffic and operating. (2) A deputy for construction.

The Manager of Railways would be responsible for broad, meter and 60 cm. railways. By this the Manager of Railways could then decide in consultation with G. H. Q. which class of line should be laid to meet the requirements, and do away with duplication. The great failure of the broad gauge system in the forward areas has been lack of distribution. There were many cases where broad gauge lines could have been run off to sidings alongside existing roads or other convenient places for dumps, and consequently saved a vast amount of light railway construction. Light railways have always proved themselves to be an extravagant form of transportation. Labor charges for maintenance under good conditions are very high, and in the shelled areas are ridiculous, taking into consideration the amount of army traffic carried independent of that shown in statistics. Where there is only a limited amount of traffic to be carried, light railways can be of great use if light tractors are used for hauling, and would be of much use if used in conjunction with broad gauge lines.

A very great difficulty experienced by the Railway Construction Engineers (R. C. E.) was in regard to the allocation of labor. In most cases R. C. Es. were given dates on which works had to be completed, and this put them in the unenviable position of having to complete work to date, not knowing the value of the labor likely to be provided. The quality of the labor supplied was so variable that R. C. Es. had to safeguard themselves by putting in large demands. Had labor been permanently allocated to railway construction the man would have got accustomed to that class of work and taken an interest in it, and the Railway Construction Engineers would have been in a position to put in close estimates. At least 30% of the labor was wasted due to the unpractical labor organization enforced upon us.

The organization of having a C. R. C. E. at G. H. Q. with R. C. Es. (lieut. colonels) having charge of districts and being in command of the railway construction companies (commanded by majors) while they were working in their district worked most satisfactorily. The railway construction companies were classified as platelaying companies, maintenance companies, bridging companies and mechanical companies, and were made up with men whose trades were suited for the class of work they were put to. This resulted in a very much larger proportion of useful men on the work, and each company became more proficient in its particular trade and the use of the plant handed over to it.

The organization in force was much hampered when the Canadian battalions, commanded by a lieutenant colonel, were sent for work under the Railway Construction Engineer. All orders had to go through the C. O. of the battalion. This led to disinclination to splitting up the units, and consequently a battalion had very often to be sent to carry out a work which one railway construction company was capable of doing, and the rest of the battalion was used as labor and complaints arose. The Canadian battalions were not constituted for broad gauge work, as they had too many different trades in the companies, and too many headquarters officers in the battalion, which meant waste of skilled men.

The survey sections with the R. C. Es. proved themselves to be invaluable, as the R. C. E. could get his reconnaissances and surveys made directly under his own eye, and the company officers were left free to regulate the construction work and were not robbed to make surveys.

It was found most useful to have several of the railway construction companies living in trains; the company being divided into four sections, each section having its own living wagon and its own tool van so that it could go on detachment at a moment's notice ready for work."

PERSONNEL.

"*Skilled Troops.*—The effective strength of transportation troops in France at various dates during the year under review has been as follows:

Effective strength.

1918	Officers	Other ranks	Total
January 5th	2,290	72,108	74,398
April 27th	2,419	75,724	78,143
June 29th	2,456	75,505	77,961
September 28th	2,455	77,873	80,328
December 28th	2,568	79,965	82,533

Daily average number of men working.

	May, 1918	August, 1918	November, 1918	December, 1918
Roads	25,045	28,592	40,745	34,449
Construction (broad and meter gauge)	13,057	10,680	27,624	18,916
Docks	10,456	10,511	11,063	9,564
Chief Mechanical Engineer (C. M. E.)	671	902	2,713	2,816
Inland Water Transport (I. W. T.)			771	1,022
Railway Operating Division (R. O. D.)	1,323	1,162	1,915	1,797
Light Railways	2,265	5,909	1,541	1,663
Stores	1,552	1,660	2,193	2,084
Chief Engineer Port Construction (C. E. P. C.)	573	953	611	525
Total	54,942	60,369	89,176	72,836

Up to November, there was a very marked increase in the totals, this being practically entirely accounted for by the increased demands for roads and broad gauge construction work. After the signing of the Armistice, demands under these heads declined rapidly, as will be seen from the above figures.

GENERAL REMARKS.

At the end of June, 1918, the transportation services were placed under the control of the Q. M. G. A reorganization was carried out, involving the following changes of the existing organizations:

1. The formation of the Directorate of Construction. The functions of this directorate included broad gauge and light railway constructions, and new construction at the ports. It thus absorbed the Departments of C. R. C. E. and C. E. P. C., and, at the same time, the construction branch of the Light Railways Directorate.

2. The transfer of the responsibility of heavy repairs to light railway rolling stock from Director of Light Railways (D. L. R.) to C. M. E., including the transfer of the light railway repair shops at Beaurainville.

3. The almalgamation of foreways construction and operation with the Directorate of Light Railways."

RAILWAY OPERATING DIVISION.

"From the list of establishments, it will be seen that the organization decided upon when the Transportation Directorate was reformed, provided for a commanding officer and a headquarters staff, and reporting to him, three officers commanding large groups of operating companies and three officers commanding medium groups of operating companies.

It is thought that this organization was decided upon mainly for establishment purposes, as it was only when the unit was working in Belgium and Rhineland that it became necessary to realize a large group, though for the administration of a unit of this size it was considered advisable and desirable to have an additional lieutenant colonel.

The real organization during hostilities in forward areas, was to divide the lines behind the front served by the unit into a certain number of detachments, comprising 1 to 3 companies. These detachments, due to the progress of hostilities, might be increased to 6 or more companies, but as the railway operating work to be carried out was all done on schedules originally determined from headquarters, the officers commanding detachments in the forward areas always reported direct to headquarters, with the one exception referred to.

In the back areas, advantage was taken of the organization provided of appointing officers commanding medium group of operating companies. For this purpose there were two officers with the rank of major who supervised the detachments working at the bases, reporting to the C. O.

The necessary liaison between the shunting services at the bases and the forward areas was afforded by headquarters, who understood all the necessary arrangements with the French for ensuring the passage of trains hauled by the R. O. D. over the lines of communication, which were French operated, as opposed to the forward areas, which were in almost every case British operated.

Thus it will be seen that in the actual working of the unit the logical basis for railway working was adopted, namely, a geographical one, and for this same reason, the Director General of Transportation agreed to the headquarters of the unit, which is an executive one, being mobile, so that convenient positions for headquarters could be chosen to meet the fluctuations of the service geographically, due to changing military conditions.

In all military returns and establishment matters, the company formation of the establishment was adhered to, but in nothing else.

Company formation is quite unsuited for a railway operating unit, and for one like the R. O. D., which until after the Armistice

has always been short of men, its adoption, though possible, would have considerably lessened the work done.

ESTABLISHMENT.

51 Operating companies.
1 Headquarters R. O. D.
3 Headquarters of large groups of operating companies.
3 Headquarters of medium groups of operating companies.
3 Miscellaneous trades companies.
7 Engineer crew companies.

TECHNICAL POINTS.

Method of operation.—It was recognized that no useful purpose would be served on military railways by the employment of fixed signals. Therefore, at the outset, it was decided to take such steps as would render fixed signals entirely unnecessary, and none have ever been used.

That this is possible is proved by the fact that heavy traffic has been worked on lines worked by the British, the best instance to quote being perhaps on the Bergues-Proven line, which at the time of the instance quoted was to a great extent washed away and mainly worked on a single line.

Sixty-seven trains were worked on this section in both directions on one day without any accidents except those due to subsidence of track.

The system of train working was by telephone, block book, and train order, permissive working being allowed except where provisions to the contrary had been made.

The whole of the orders for the railway work of the unit were transmitted by telephone, whether from block to block for the passage of trains between these points on a railway, or whether from headquarters to the French railway authorities or to headquarters of detachments to provide for the working of troop trains (courants) any special service needed, such as tactical moves or the constant modifications in already authorized services.

The difficulties to be overcome were enormous, and were overcome with the greatest possible credit by the officers and men of the Railway Telegraphs Service. Another favorable comment which may be made is that due to the excellence of the service referred to, the hundreds of thousands of messages necessary to direct the operation and secure the safe movement of trains were transmitted day and night with the greatest efficiency.

In addition to this efficient work, the R. O. D. were able to furnish once a day the exact number of wagons standing at a certain

hour, whether empty or loaded, and by classes of wagons. This information, for internal purposes, is available all day, as it forms part of the system of despatching trains, and if it could have been extended, as was at one time proposed, it is thought that it would have rendered unnecessary the employment of so many British wagons nominally in the service of the British Army.

TRAIN REPORTING

From the commencement, the R. O. D., operating as they were in railhead areas, felt the need for a system by which they would know where each train was, its probable time of arrival, number of wagons, and the nature of their contents.

As these railhead areas were always at the ends of lines entirely operated by the French, and as the latter were badly equipped with telegraphs and telephones, it was impossible to get this information. Consequently, trains would often arrive at the exchange points when the railheads were not in a position to accept them, with the result that the exchange stations became blocked. In addition more of certain classes of traffic would arrive than could be dealt with, whereas had it been known that the traffic was coming forward it could have been stopped back at the bases. The lack of pre-advice also prevented any arrangements being made beforehand for the unloading of the wagons immediately on their arrival at the railhead, with the consequence that wagons frequently stood for many hours without unloading being commenced, thus lessening the capacity of the railhead.

Representations were being made with a view to getting telephones installed over the French lines, but it was not until March 1917, when the St. Pol-Arras line was in a state of complete stagnation, at the time of the Battle of Vimy, that sanction was given for a system of train reporting to be commenced.

Reporting posts, manned by R. O. D. personnel, were installed at suitable places on the lines from the bases to the railheads.

Each day the bases obtained a program of the trains to be run the following day, giving their due time of departure, nature of traffic, and number of wagons. The trains were given a code and the whole of the information was telephoned immediately to the exchange point concerned. It was also passed to the first reporting post on the route by which the train would run, and this post in turn passed the information forward to the next, and so on. In this way, each point of passage and the exchange point knew what traffic to expect the next day, and arrangements could be made beforehand for unloading trains immediately on their arrival. In order to know the actual running of the trains, and therefore deter-

mine more accurately the probable time of arrival, when a train left the despatching station an advice was telephoned to the exchange point and to the first reporting station in advance of the despatching point. This reporting post telephoned the information forward to the next in advance. As the trains passed each reporting post, an advice was telephoned forward to the next post in advance, which passed it forward until it reached the exchange point. The code, which was pasted in large characters on the brake-vans of the trains, and the time of passing, were the only information given.

In order that an exchange point may know when wagons would be emptied at railheads and that arrangements may be made for their withdrawal and replacement by further loaded wagons, railheads kept in constant touch with the exchange point.

In addition, by means of the information supplied by the railheads as to the empty wagons which would be worked back to the exchange point, it was possible to arrange in advance for main line power to be ready to promptly take away the empties. By these means it was possible to control the despatch and movements of trains for the British Army in such a way as to meet the needs of the individual armies, and at the same time facilitate the general working of the railway which had to serve the whole army."

Annex "A"—Chapter XIV—Section I.

General report on the Railway Traffic Directorate.[1]

Date of Functioning.—(*a*) This Directorate started as an independent directorate on 23 November 1916, on which date the D. G. T. organization came into being.

(*b*) Prior to the above date, the duties and functions of the directorate were part of the organization of the Director of Railways, which may be said to have come into being on the arrival of Brigadier General J. H. Twiss, C. B., R. E., in France on 29th October 1914.

(*c*) Prior to 29th October 1914, and from the 4th August, 1914, the duties and functions of this Directorate were carried out on a somewhat limited scale by a small body of officers and other ranks, who had come out to France with the original Expeditionary Forces.

Division into three periods.—The history of this directorate may, therefore, be divided into three periods, viz: Period I—From the declaration of war to 29th October 1914, the date Brigadier General J. H. Twiss took up his appointment in France as Director of Rail Transport. Period II—From 29th October 1914, to 23 November 1916, when the railway organization was absorbed by the D. G. T. Period III—From 23 November 1916, up to the present date.

French organization.—Before going further into the history it is desirable to give here as briefly as possible an account of the French organization for the control of railways in war time, because it is primarily for the purpose of establishing a liaison between this organization and the British forces in the field that this Directorate has existed.

The experiences of the War of 1870–71 had taught the French the necessity for establishing a very complete and centralized control over the working of all railways in war time, and they had consequently elaborated a system of control which is fully explained in two volumes published by the Minister of War in 1913 (Nos. 1006 and 1006–bis). Briefly, the system consisted in working each large railway system by a "Commission de Réseau" assisted by "Commissions Régulatices" and "Commissions de Gare."

In each case, the commission consisted of a military officer whose powers were supreme, and a technical railway officer.

[1] Furnished the M. B. A. S. by the British Section of the Board.

All the commissions came under the orders of the "Direction des Chemins de Fer" at the headquarters of the "Direction de l'Arrière."

Under no circumstances could any demand for railway transport be made by the armies in the field on the technical railway officers. Such demands had to be made on the military members of the various commissions and it was by this means, and by this means only, that it was possible to check and regulate and meet the requirements of the armies in the field.

The organization outlined above has been somewhat modified during the last two years of the war, in so far as the higher control is concerned, but its main features remain unchanged.

Object of the Directorate.—It was with the object of paralleling the above organization that the Railway Traffic Directorate had to be organized. Under the original scheme for the Expeditionary Forces, it was apparently anticipated that all railway demands of the B. E. F. would be carried out by the French, and that all that would be necessary would be a small body of staff officers to act as R. T. Os. and liaison officers between the B. E. F. and the various commissions, with a view to coordinating and placing before them in an intelligent form the various army requirements and to assist in the work of entraining and detraining troops.

The enormous expansion of the B. E. F. soon proved that considerably more than this would be necessary, and it was to meet this expansion and the additional work involved that the expansion of the Directorate became necessary.

Period I.

The work carried out during this period by the small body of some thirty officers who came out with the original B. E. F. is wrapped in some obscurity. The bases and fronts were constantly changing and the position was exceedingly kaleidoscopic and the work consisted in entraining and detraining troops and making the best arrangements possible with the French for the maintenance of the B. E. F.

The organization at the time appears to have been somewhat vague. Part of the establishment and work, i. e., the rear and base portion, was controlled by an A. D. R. T. at the Headquarters, I. G. C., L. of C., and the forward R. T. Os, and work at railheads was controlled by a staff officer of the Q. M. G's Branch at G. H. Q.

Toward the end of September, the staff was strengthened by a further batch of R. T. Os from England and by the arrival from India of certain R. E. officers with railway experience.

At this time the railway transport establishments were distributed at Marseille, LeMans, Nantes, Rouen, Havre, St. Nazaire and Villeneuve-Triage.

Villeneuve-Triage, which had been the advanced regulating station, was moved to Abbeville.

Boulogne after being open as a base from 9th August 1914, to 25th August, was reopened on the 17th October 1914, by which time the British Army had moved round from the Aisne to the Ypres front.

Very little more need be said of the history during the period. No stability had been reached—it was not clear under whose orders the staff were, viz., Quartermaster General (Q. M. G.) or Inspector General of Communications (I. G. C.)—and no construction work for the British Army had been necessitated. What work was done, was done under very considerable difficulties, and great praise is due to the small body of officers and men who were working during this period.

Period II.

With the arrival on 29th October 1914, of Brigadier General J. H. Twiss and his appointment as Director of Rail Transport (shortly afterwards changed to Director of Railways) B. E. F., circumstances changed.

It was definitely settled that the Directors' headquarters should be at G. H. Q., and that all railways should come under the orders of the Q. M. G.

The result of this was the A. D. R. T. traffic at Headquarters, I. G. C., came under the orders of the D. R. T., and controlled the rear area, and the Q. M. G.'s staff officer, hitherto in control of the railhead area, was appointed an A. D. R. T., on the D. R. T.'s staff and remained in charge of the railhead area.

This was the real commencement of the organization of the present Directorate.

I. By this time, the expansion of the forces had been so large, that the two appointments of A. D. R. T., H. Q., L. of C., and Railhead Area were on 6th May 1915, converted into Deputy Directorship. Under the former came an A. D. R. T., at Abbeville, for the southern L. of C., viz., Havre, Rouen, Dieppe, Marseille, Abbeville and an A. D. R. T., at Calais, for the northern Lines of Communication—Boulogne, Calais, Hazebrouck, etc.

Under the latter officers two sub railhead areas were formed, each under an A. D. R. T. viz., a northern and a southern, with headquarters at Hazebrouck and Béthune respectively.

II. The only further alteration in the organization of the Directorate made during this period was the opening of two additional

railhead areas, with headquarters at Doullens and Amiens respectively on July 1915, and March 1916, to meet the expansion of the front, consequent on the extension of the British line to the southward.

III. Between January and October 1916, six more Railway Transport Sections (to which name a "railway transport establishment" was changed) were added to the Directorate; at the same time the establishments of Railway Conducting Officers and the Military Forwarding Branch were absorbed in the additional sections.

Period III.

I. The whole of the railway transport establishment existing on the 23rd November 1916, was transferred on that date from under the orders of the Director of Railways and became a separate directorate under the orders of the D. G. T., and thenceforward called the Directorate of Transportation.

II. The main alterations in the previous organization then made were as follows:

(a) The division between the railhead and back areas was abandoned. Both Deputies were concentrated at Headquarters and each Deputy controlled an area extending from the base to the front line. As will be seen later, this reorganization had to be abandoned later, and the original organization of a separate railhead area reverted to.

(b) Assistant Directors of Transportation were appointed in each Army area. The broad and metre gauge working in the railhead areas, hitherto carried out by A. D's. R. T. and the D. A. D's. R. T. being now relegated to a D. A. D. R. T. (Traffic Officer) in each area.

III. The object of this re-organization is explained in the papers issued by the D. G. T. on the subject. It appears to have been the intention for the Director of Transportation and the Assistant Director in Army areas to act as co-ordinators for all methods of transportation, e. g., broad gauge and metre gauge railways, light railways, roads and inland water transport.

In practice, this Directorate, as such, confined itself more and more as time went on to its legitimate functions of dealing with broad and metre gauge traffic only. In fact, the A. Ds. Tn. in Army areas became practically the representatives of the D. G. T. in Army areas, and, moreover, in view of their position became the mouthpiece of the armies without often being in a position to give adequate consideration of the views at Headquarters.

Under these circumstances, a modification of the position became necessary, and this was obtained by appointing in February D. Ds.

G. T. for the forward areas, and by bringing under their orders in April 1917, the A. Ds. Tn, converting the latter in A. Ds. G. T. The work of this Directorate was henceforward confined to its legitimate duties.

IV. A further important change in the organization was made in February 1917. Consequently, on the abolition of the Directorate of Railways and its conversion into a Directorate of Construction, the R. O. D., under the orders of the Director of Railways, was placed under the orders of this Directorate. This question will be referred to later.

V. In May 1917, an additional Transport Section was authorized, making thirteen in all, and at the same time, the two A. S. C. labor companies referred to in Par. 6 (III) above were absorbed into the section establishment.

VI. During the six months, February–September 1917, the organization of the Directorate into two areas, northern and southern, as indicated in (II) above was abandoned. It was found, in practice, to be practically unworkable when the moment arrived for the transfer of large bodies of troops across the front, and the organization in force prior to the 23rd November 1916, viz., one forward area and one back area was reverted to, with effect from 18th September 1917, with markedly satisfactory results.

VII. From this date onward, no alterations were made in the organization. Certain additional railhead areas had to be opened and closed from time to time, such as that for the Fourth Army, at Dunkirk in 1917, in view of the anticipated operations on the coast, and that for the detached force operating in Champagne in 1918.

VIII. On the 1st March 1918, the title of the Directorate was changed to that of "Railway Traffic."

IX. A fourteenth Section was sanctioned in November 1919.

X. The French portion of the Cherbourg-Taranto L. of C. was taken over by the D. G. T. in November 1917, and the responsibility for its working was placed on this Directorate.

Liaison with French organizations and with the armies was necessary in co-ordinating and combining demands of the B. E. F.[1], before turning them over to the French for execution. The following illustrates how this was accomplished.

French Military Railway Organization	British Military Railway Organization	British Troops
D. C. F. (Commissions de Réseau)	D. R. T.	G. H. Q.
Commissaires Régulateurs	A. Ds. R. T., D. A. Ds. R. T.	British service in rear. Armies in front.
Commission de Gare	D. A. Ds. R. T.; R. T. Os.	Local commandants.

[1] British Armies in France and Flanders.

No demand could reach the French unless it passed through the corresponding channel of the British military railway organization.

The British system is necessarily somewhat different to the French system for the following reasons:

(*a*) It has to conform to the different administrative organizations of the British Army.

(*b*) All personnel stores and materials have to be imported into France by sea.

(*c*) The area occupied by the British armies runs parallel to the coast, and is a somewhat narrow strip, with the result that the siting of the various regulating stations, depots and other installations has to be selected to suit the exigencies of the military situation, as decided by the British General Staff. It is not, therefore, possible to arrange for these to be installed in conformity with the most economical requirements of technical railway working, or to always place depots in convenient relation to the regulating stations which they are required to serve.

The rail movements necessary to meet the requirements of the various services of the Army, the eventual distribution of cargoes between the ports, the selection of depots, and general requirements in the way of railway facilities for serving these are all controlled by the Q. M. G.

Advices of the due arrival of vessels at the ports were sent by the D. N. T. O. concerned to the Director of Docks, who arranged for their berthing, after consultation with the administrative services. The Director of Docks is responsible for the dock area, and all M. T. and horse transport required in connection with transportation service is provided for by the base commandant, in accordance with the demands notified to him by the Director of Docks.

The working of traffic within the dock areas is controlled by the Director of Docks in consultation with the Director of Railway Traffic, due regard being made to the requirements of technical traffic operating. All communications in regard to railway movements are made by the Traffic Directorate to the French "Commissaire Régulateur" or his representative.

Under the British system all troops, personnel, material and stores are landed at the various base ports and distributed thence by rail to: (*a*) The local depots in the vicinity of the base. (*b*) Depots further inland, at some distance from the base port. (*c*) Regulating stations, each serving a certain number of formations.

The requirements of the armies in the field are met, either by direct despatches by rail from the depots, or by despatches of formation trains which are made up at the regulating stations.

As regards the base ports, the ideal system is to utilize each port entirely as a transit port, and to despatch material and stores in bulk, as soon as possible after landing, to the depot of regulating stations, all berths in the port being considered as interchangeable between the various classes of stores and material.

In actual practice, however, this is not feasible, as it requires the provision of a "triage" at each port, to which stores and material can be railed by a local service from the docks and at which trains can be classified and made up complete for each separate destination.

In practice, therefore, owing to such "triages" not being in existence, and to the lack of available space for their construction, certain trains have to be loaded complete at the docks for direct despatch to destination, and berths required to be ear-marked to a large extent for special commodities; also, the sheds at the ports have to be utilized as depots instead of as transit sheds.

The Traffic Directorate commences to function at the base ports, and is responsible for co-ordinating and transmitting the demands for rail transport for troops, personnel, animals, stores and material to the French "Commissaire Régulateur" or his representative, and for certain detailed working and reporting in connection therewith.

(*a*) In the case of bread, the British system is to install bakeries in the vicinity of the base ports, importing the necessary flour and coke, as far as possible at the port. Bread is packed and labeled by supply sections and despatched to the regulating stations, either in complete trains, or in a rake attached to some other train of supplies. Bakeries have, therefore, been installed at Calais, Boulogne, Dieppe, Rouen and Havre.

GENERAL REMARKS.

To meet the varied army requirements it has been necessary to create an organization for coordinating all demands from the various services on railways and for transmitting these to the technical operating authorities in a systematic and practical form. This organization has been gradually extended and maintained through the medium of the Railway Traffic Directorate, whose duties include the careful working out of all demands in the manner best suited to meet the organization of the British Army.

The main requirements in traffic working from overseas to the British base ports, and from base ports to depots and railheads are:

1. To import personnel, material and stores at the nearest base to the ultimate destination in France.

2. To arrange all despatches by complete trains from loading point to destination and to avoid small demands.

3. To keep the main lines of railways free for the circulation of through traffic by avoiding (*a*) Utilizing railways for the transport of personnel, stores, or material for short distances. (*b*) Establishing installations and asking for railway facilities for the discharge or loading of traffic at wayside stations situated on these lines.

4. To keep traffic demands at each loading point as uniform as possible and to avoid sudden fluctuations of traffic.

As regards 1, the principle worked on is obvious and needs no comment, but cross traffic is frequently forced on railways due to irregularity in shipping arrivals, and to failure to foresee these sufficiently in advance to admit of the necessary adjustment in stocks being effected.

As regards 2, it is not always practicable for complete trains, but the railway situation in this respect has greatly improved, as the vital importance of this requirement is becoming more readily recognized by all services.

As regards 3, services of this nature are demanded from time to time. It should be borne in mind that a movement by rail, for even 5 miles, occupies a complete "marche," involves the use of an engine and a complete train crew, and locks up rolling stock almost to the same extent as a movement over 100 miles, as the principal delays to rolling stock occur in the off-loading of trucks, and in arranging for their subsequent return to the destination required by traffic working. Further, short local destination requires either the keeping of an engine for a considerable time, or entails light running, as the engine has to return to the nearest depot; whereas in ordinary traffic, with through movements between engine-changing stations, engine power is balanced by being utilized for trains in the return direction.

In the case of despatches to wayside stations on a main double line of railway, it is usually unavoidable that for movements in either the loaded or return-empty direction, both the main lines require to be crossed, which stops the traffic in both directions while such shunting movements are taking place.

As regards 4, the pooling of engine power in order to reduce light mileage, and obtain the most economical distribution of rolling stock involves technical knowledge of a higher order, and economical traffic working is at once upset by fluctuations in traffic demands. In this respect, the working of ambulance trains, ammunition trains and troops "courants" often throw a great strain on railways and adversely affect general circulation and the supply of empties.

From this note, it will be seen that the Railway Service as controlled by the Director of Railway Traffic touches the Army in every point of its organization, and the vital importance of this service being maintained at the highest possible pitch of efficiency is obvious.

Combined technical and military knowledge is required for the higher administrative appointments in the Traffic Directorate in addition to a considerable experience of the special requirements of the French system of working, both military and civil, and a detailed knowledge of the local conditions at the various bases, regulating stations and other main railway centres.

The present methods for dealing with troops, reinforcements, ammunition, supplies and material generally, have been evolved with a view to afford as much relief as possible to the French railways which are being worked under very high pressure, to facilitate the discharge and transport of all material and stores received through the base ports, to keep the general wagon user to a minimum, and at the same time, to provide an expeditious and reliable service both to the Army areas and over the L. of C.

The duties of the Railway Traffic Directorate include the supervision of the supply of empties, the selection of suitable "marches," the arrangement in the most efficient manner for the making up of trains, the prompt discharge and return of trucks, and also a careful watch over the whole system of working and the bringing into effect of constant modifications to meet the varying requirements of the military situation.

In addition to the traffic working, this Directorate is responsible for giving technical advice in regard to the selection of sites and the layouts of all depots, regulating stations, etc., and in regard to the improvement of all facilities at all stations, from bases up to railheads, at which work for the B. E. F. is performed, in accordance with the local requirements. It also has to put forward recommendations for increasing the capacity of both main and subsidiary sections of lines, and for foreseeing and recommending such additional construction as may be necessary to meet general requirements of traffic working.

ANNEX "B"—CHAPTER XIV—SECTION II.

NOTES ON BRITISH RAILWAY TROOP TRAINS.[1]

1. *Composition of Railway Trains.*—The 20 standard train compositions, and various special compositions shown on page 140 of Field Service Regulations, 1914, were given up during the war, and reduced to five standard types only. It was impossible to adhere to the numerous special compositions owing to the frequent changes in the establishments of the units for which they were designed. The adoption of five standard types, although leading on occasions to trains being loaded to less than their full capacity, considerably reduced the shunting and marshalling necessary, and had the advantage of greatly simplified train working.

Details of the formation of the five types, with examples of typical units for which they are suitable, are given in the tabular statement annexed, together with notes on the train types.

2. *Number of trains required for various Formations.*—The number of trains required depends entirely on the establishment of the formations concerned. For example, the number of trains for a British infantry division varied at different times from about 70 to 100 standard trains.

Train types.

Train type	Formation				Typical train loads
	Compartments	Cattle trucks	Vehicle trucks	Brake vehicles	
No. 1	65	5	10	2	One-half Infantry Battalion.
No. 2	10	10	8	2	One-half Battery, R. F. A.
No. 3	15	14	15	2	H. Q. Bde. R. F. A. and One-half Battery, or One-half Battery and Subsection Bde. Ammn. Column.
No. 4	25	11	[1]16	2	Field Co. R. E., or Field Ambulance.
No. 5	15	21	6	2	Cavalry Squadron.

[1]To include three trucks capable of taking pontoon wagons.

NOTES OF TRAIN TYPES.

(*a*) These train formations will be strictly adhered to. If the personnel or material of any particular train load cannot all be accommodated in the train as provided, the officer superintending the entrainment will arrange to

[1] Prepared for the M. B. A. S. by Major General R. S. May, D. Q. M. G. Director of Movements, British War Office.

send on the balance by the next convenient train or make other suitable arrangements.

(*b*) For emergency purposes, accommodation is calculated as follows:

Officers.—Six officers to one compartment. 1st class compartments should be provided. If 1st class not available, then 2d or 3d class compartments, but officers' accommodation will be reserved.

Other ranks.—Not more than 10 men to a compartment. Any class stock may be used.

Horses and mules.—Eight animals to a cattle truck, but as many as possible to be loaded in each truck to prevent animals falling.

Vehicles.—The number of vehicle trucks shown is calculated on the assumption that small trucks are used, but a lesser number of large trucks giving equal accommodation may be provided.

(*c*) When end loading vehicle trucks are used, one vehicle truck capable of end and side loading must be marshalled next to them.

(*d*) The military authorities will use the train as best suits their requirements, e. g., it may be necessary to put men into cattle trucks or brake vans, or bicycles into compartments, and so on.

CHAPTER XIV.

SECTION II.

ORGANIZATION OF MILITARY TRANSPORTATION BY RAILROADS (FRENCH).

At the beginning of the mobilization the railroads passed under military control, in conformity with the law of December 28, 1888, of which the articles 22 and 23 are worded as follows:

"*Article 22.* In time of war, the railway services are entirely under the military authorities.

"*Article 23.* The Minister of War controls the railroads throughout the national territory wherever unoccupied by the Armies in operation.

"The Commander in Chief of each Group of Armies, or of Armies operating alone, controls the railroads in all parts of the territory assigned to their operations."

Placed at the head of each of the great national railroad systems, "Railroad System Committees" (Commissions de réseau) took entire charge, from the first day of the mobilization, of all railway services, under the authority of the Minister of War.

On the railroad systems of the Army, the railway services were directed, under the authority of the Commander in Chief, by a general or field officer who took the title of "Director of Railroads" (Directeur des chemins-de-fer). (Chart 6, Chapter XV, Vol. I.)

Owing to the necessity for the centralization under the same authority of transportation and supply, the "Direction of Railroads" (Direction des chemins de fer) was placed, from the beginning, under the orders of the "Director of the Rear" (Directeur de l'Arrière); later, of the Assistant Chief of Staff (Aide-Major Général) in charge of the "Direction of the Rear." Charts 7 and 7a, Chapter XV, Vol. I.)

The operation of the service was assured:

A) On the lines operated by the national companies, by "Railroad System Committees" (Commissions de reséaux) composed of a staff officer, who was "Military Commissioner" (Commissaire Militaire), and a "Technical Commissioner" (Commissaire Technique). They had under their orders:

1. "Railroad System Subcommittees" (Sous-commissions de reséaux) corresponding generally to the principal "Inspections" of the railroad systems; some of these sub-committees were charged with assuring the transportation of supplies in the zone of one or

more armies and took the name of "Regulating commissions" (Commissions Régulatrices).

2. By "Station Committees" (Commissions de gare), which were local executive agencies.

The railroad system sub-committees and the station committees were composed, as were the railroad system committees, of a military commissioner and a technical commissioner.

The railroad system committees, in addition to the personnel belonging to the system, had military railway engineers and military telegraph troops at their disposal, who were charged with carrying out works required by military operations in connection with the track service of the system (service de la voie du réseau).

B) On the lines which were not operated by the national companies, by "Field Railway Committees" (Commissions des chemins de fer de campagne), which were composed of a staff officer, who was chairman, and a technical agent.

The field railway committees had at their disposal:

1. "Field Railway Sections" (Sections de chemins de fer de campagne) which were recruited from the personnel of the national companies, and charged with the operation of and work on the railroads.

2. Troops from the railway engineer units and from the technical sections of the military telegraphers.

Whatever may have been the modifications brought about in this organization during the course of operations, the technical element was always associated with the military element, either at the "Direction" of the railroads, or in the committees and sub-committees. The military member of each committee always had the deciding vote.

Until December 1916, these dispositions remained unchanged. The Minister of War, on one hand (railroad system of the interior), and the Commander in Chief, on the other (railroad system of the armies), kept the railroads under their orders; the Minister of Public Works intervened in railroad matters only in the case of purely technical or administrative questions.

A decree of December 27, 1916, created an Under Secretaryship of State for transportation (Sous-Secrétariat d'Etat des transports) at the Ministry of Public Works, which was charged with assuring the efficient operation of the railroads.

With the idea of maintaining the authority of the Commander in Chief who, through the law of 1888, controlled the railroad systems of the armies, a further decree was signed on December 31, 1916.

Although under the terms of this decree the Under Secretary of State for transportation was given the powers granted to the mili-

tary authorities over the railroads by articles 22 and 23 of the law of 1888, he was assigned the duty of providing for the transportation of troops and combat material, as well as for the evacuation transportation of wounded. Moreover, these transports were given priority and were to be carried out within prescribed limits of time.

In the Zone of the Armies, he permanently delegated his authority to the Director of the Rear for the execution of the transportation indicated above. (Chart 9, Chapter XV, Vol. I.)

This decree of December 31, 1916, was superseded by that of May 9, 1917, under the terms of which: The Under Secretary of State for transportation was charged with the military railroad transportation service and the military use of the railroads. He was also responsible for the execution of new railway constructions and the maintenance work required for the upkeep or re-establishment of railway traffic. All civil and military personnel assigned to the transportation services was placed under his direct orders.

This personnel consisted of:

A) A "Military Director of military transportation in the Zone of the Armies" (Directeur Militaire des transports militaires dans la Zone des Armées—D. T. M. A.), who held permanent authority from the Under Secretary of State for the execution of military transports in accordance with the orders of the Commander in Chief.

B) A "Director of military transportation in the Zone of the Interior" (Directeur des transports militaires dans la Zone de l'Intérieur—D. T. M. I.)

In addition the Under Secretary of State for transportation, as representative of the Minister of War, administered the funds appropriated by the Ministry of War for the operation of the transportation service.

A strict application of this decree would have taken away the Commander in Chief's authority over the railroads as provided for in the law of 1888. He no longer had authority over the execution of transportation, nor over the organization of the lines of communication.

The Commander in Chief brought this situation to the attention of the Minister of War, particularly the fact that railroads were combat agencies (instruments de combat), and pointed out that it was necessary to bring transportation, supply, and the general organization of communications under a single authority.

On the other hand, he indicated that the program for the upkeep and re-establishment of lines of communication could only be decided by the Command; moreover, that this work required a large amount

of auxiliary labor, taken from the combatant troops, and which could not be directed by two separate authorities.

It was then agreed that in order to enable the Commander in Chief to exercise his functions the Director of the Rear, to whom the decree of December 31, 1916, had given authority for the execution of transportation in the Zone of the Armies, would, at the same time, be "Director of military transportation of the armies."

The Direction of the Rear was then organized as follows:

An Assistant Chief of Staff (Aide-Major Général), in charge of the Direction of the Rear and Director of Transportation.

A Chief of Staff of the Direction of the Rear and of the Direction of Transportation;

A Deputy Chief of Staff of the Direction of the Rear;

A Deputy Chief of Staff of the Direction of military transportation.

The duties of the Director of Transportation of the armies, as regards railroad work, were defined on July 9, 1917.

A decree of September 15, 1917, transferred to the Minister of Public Works the powers which had previously been conferred upon the Under Secretary of State for transportation.

Whatever changes were made in the Direction of Transportation of the armies, the Commander in Chief always retained the necessary authority to enable him to directly control transportation in the Zone of the Armies without recourse to outside authority, to personally order the execution of railroad works in the vicinity of the front, and to cause the immediate fulfillment of works deemed necessary for military operations.

This point of view was clearly defined in a letter from the Minister of War, dated October 14, 1917, which specified that the D. T. M. A. would be responsible (under the authority of the Minister of Public Works, whom he represented at the office of the Commander in Chief) for the entire (ensemble) transportation service.

The D. T. M. A., himself, was to receive direct instructions from the Commander in Chief concerning all military transportation in the Zone of the Armies. Moreover, on the railroad systems of the East and North, in view of the permanent delegation of authority granted him by the Minister of Public Works, the D. T. M. A. would have full authority for the immediate execution of transports over these lines.

The Commander in Chief could demand the execution of all works which he deemed necessary for the needs of the Army and the Minister of Public Works was to take all steps for their execution, either by means of military labor placed at his disposal by the Commander in Chief or, whenever possible, by civil contractors.

By a decree of October 8, 1917, the Director of military transportation in the Zone of the Armies was charged with carrying out the orders which he received from the Commander in Chief, concerning military transportation in the Zone of the Armies over the railroad systems in that zone. For this purpose he received permanent delegation of authority from the Minister of Public Works and Transportation (Ministre des Travaux Publics et des Transports).

The D. T. M. A. ordered the various railroad system committees concerned to prepare plans for all railroad works which were to be carried out on the railway lines of the armies, as prescribed by the Commander in Chief, and which were necessary to assure military transportation. He submitted these plans for the approval of the Minister of Public Works and assured their execution under the authority of the latter.

The decree of July 2, 1918, permanently delegated to the Minister of Public Works and Transportation the authority granted to the military authorities for the operation of the railroads and navigable waterways under articles 22, 23 and 24 of the law of December 28, 1888.

The Minister of Public Works and Transportation was then assisted by:

A general officer, who took the title of "Director General of military transportation" and who was charged with the execution of transportation over the entire system of railroads by means of military transportation orders. He was also responsible for the execution of military works on the railroads. Military needs were given priority.

A general or field officer, who took the title of "Director of military transportation of the armies," was attached to the Commander in Chief of the Allied Armies and received permanent authority from the Director General of military transportation to execute, in the name of the latter, all transportation which concerned the armies, to study projects prescribed by the Command and cause the execution of urgent works.

Finally, a decree of September 18, 1918 placed the "General Direction of Communications and Supplies" (Direction Générale des Communications et des Ravitaillements—D. G. C. R. A.) with the Commander in Chief of the Allied Armies. The Director of military transportation of the armies then passed, from a military point of view, under the authority of the "Director General of Communications and Supplies of the Armies" insofar as the French railroads were concerned; while he was exclusively under the orders of the D. G. C. R. A., from a military as well as a technical stand

point, insofar as the railroads which extended beyond the frontiers of 1914 were concerned.

On February 10, 1919, the Director of military transportation was abolished. The entire French system was placed under the authority of the Director General of military transportation, while the railroad system of the armies, which then consisted exclusively of railroad lines located beyond the boundaries of 1914, was placed under a "Director of the field railways," (Directeur des chemins-de-fer de campagne) under the direct orders of the "Director of Communications and Supplies of the Armies," both from a military and from a technical point of view.

NOTE.—See also Chart 8, Chapter XV, Vol. 1: "Formation of trains."

CHAPTER XIV.

SECTION III.

MILITARY RAILWAY TRANSPORTATION (BELGIAN).[1]

HISTORICAL STATEMENT ON THE DEVELOPMENT OF THE "FIELD RAILWAY COMMISSION" (COMMISSION DU RESEAU DES CHEMINS DE FER DE CAMPAGNE—C. R. C. F. C.)

This commission did not exist at the beginning of the war. According to the "Regulations for the Service of the Rear" in force in 1914, the "Director of Railways of the field army" (Directeur des chemins de fer à l'Armée de campagne) was to assure the railway transportation of the Army, in accordance with the instructions which he was to receive from the High Command. For this purpose he organized a system of daily train services which were to effect all troop movements and the movements of supplies and war materials. He was in command of the "Assembling station" (Gare de rassemblement) and of the "Divisional railheads" (Gares de ravitaillement divisionnaires).

The Belgians were able to operate their railroad transportation under this system as long as they were in their own territory but, when they were driven out of the country and their Army took up its positions along the Yser, it became necessary to extend the Belgian "Service of the Rear" beyond the national territory and to coordinate the Belgian railroad movements with those of the French and British.

A conference was held at Furnes in January 1915, and it was then decided that the French Commander in Chief would prepare general instructions concerning railroad communications. These instructions were to regulate the division of resources, as well as the distribution and use of trackage and railroad material among the Allies. For the execution of these projects, the French Commander in Chief created an "International Executive Commission" (Commission Internationale de Calais), composed of officers and technical railroad men from the three countries. This commisson was to de-

[1] Prepared for the M. B. A. S. by the Belgian Ministry of War (Major Denis), and reduced to the compass of this work by Lieut. Col. Ellery Farmer, Inf., U. S. A., of the American Section.

termine priorities of transports, distribution of railway facilities, and the proportion of repair and construction work to be done by each of the armies concerned.

Railroad operations were organized into three echelons: (1) In the first echelon the railroads were to be operated by the railway troops of the three armies, each in their own zone. In the Belgian Army, these troops were known as the "Battalion of Railway Engineers" (Bataillon de chemins de fer du Génie—B. C. F.). (2) The second echelon extended behind the front, i. e. behind the dangerous zones in which the railway troops operated. The men who worked in this echelon were mobilized (militarized) railway employees. (3) The third echelon was in rear of the zone of operations. Civilian personnel re-established the lines, organized them, and provided for the regular operation of the railroads in this echelon.

An important modification in the organization of the military railway transportation will be noticed here. Instead of leaving the operation of the railways entirely to the civil administration, there is echelonment in depth; the military elements operate directly in the rear of the Army and are followed in turn by the civil elements.

The necessity of coordinating the Belgian system with that of the French and British brought about other modifications, particularly the creation of the "Field Railway Commission" (C. R. C. F. C.), based upon the French system of railroad operation. (The French system provided for the subdivision of the national railways into two zones, each subject to separate authorities: The Zone of the Armies and the Zone of the Interior. The Minister of War had charge of the railroads in the Zone of the Interior.)

In France, there were "Railroad System Commissions" (Commissions de réseau) composed of military and technical commissioners. All executive measures were handled collectively by these commissions, the military members being concerned with purely military questions and the technical members with railroad matters. These commissions organized "railway subcommissions" (regional executive agencies) and "railway station commissions" (local agencies). In addition thereto, "Regulating Commissions" (Commissions régulatrices) were created for the purpose of establishing and maintaining necessary liaisons. Each regulating commission was assigned a section of railway line and had exclusive control over the traffic in its particular section.

The Zone of the Armies, in which the regulating commissions operated, was subdivided into a "zone of the rear" and into a "zone of the advance." In the zone of the rear, which corresponded to the second echelon mentioned above, transports were effected in the same manner as in the Zone of the Interior by the railroad system commissions, subcommissions, railway station commissions

and the regulating commissions. The zone of the advance, in which the combat troops operated, corresponded to the first echelon referred to above.

In so far as commercial traffic was concerned, the line of demarcation of the two systems was between the Zone of the Interior and the Zone of the Armies. In the Zone of the Armies commercial transports were forbidden, while in the Zone of the Interior these movements were effected in accordance with the requirements of the Service of the Rear.

A Belgian "Field Railway Commission" (C. R. C. F. C.) was created in January 1917, for the purpose of inaugurating a similar system of transportation in the Belgian Army. This commission was to provide for the military operation of the standard and narrow gauge railway systems included in what corresponded to the French "Zone of the Armies," that is, in the first and second echelons referred to in the preceding paragraphs.[2]

PART 1.

GENERAL ORGANIZATION OF MILITARY RAILWAY TRANSPORTATION IN THE BELGIAN ARMY.

Belgian military railway transportation was under the direct orders of the Chief of the General Staff (4th Section, G. H. Q.). It was organized as follows:

1. A *directing agency* known as the "Field Railway Commission" (Commission du réseau de chemins de fer de campagne—C. R. C. F. C.), consisting of a military and a technical member; assisted by military and technical personnel.[3] This commission supervised the operation of the railroads serving the Belgian Army in Belgian territory. It was responsible for the procurement of railway supplies of all kinds and for the upkeep of tracks, bridges, shops, etc. It operated directly under the 4th Section of the General Staff at General Headquarters.

2. The C. R. C. F. C. included the following organizations and services:—

(*a*) *The Battalion of Railway Engineers* (Bataillon de chemin de fer du Génie—B. C. F.), consisting of a staff (commandement) and four companies.

The first company was charged with the operation of repair shops, reconstruction work and signals; the second company with the laying of tracks; the third company with the operation and maintenance of the railways, and the fourth company with the operation of the nar-

[2] A detailed statement on the operations of the Field Railway Commission and its sub divisions is contained in the lecture on the "Service of the Rear," delivered at the Belgian War College and a translation of same is in the files of the Military Board of Allied Supply.

[3] The military commissioner was Major Dennis, Assistant Chief of Staff.

row gauge (60 cm.) lines. The personnel of this battalion was composed for the most part of former railway employees of the Belgian State (Government) Railways and included specialists of all kinds, engineers, firemen, machinists, section hands, etc.

First company, B. C. F.: 1st platoon: Mobile repair shops, electrical and signal section; 2nd platoon: repair shops; 3rd platoon: supplies for the construction of railway works, particularly bridges; 4th platoon: same as the 3rd platoon.

Second company, B. C. F.: 1st platoon: section hands for repairs to roadbed; 2nd platoon: same as the 1st platoon.

Third company, B. C. F.: 1st platoon: section hands for repairs to roadbed; 2nd platoon: traction operations, engineers and firemen, service operations, station masters; 3rd platoon: care and supply of tools and equipment.

Fourth company, B. C. F.: operated the railway stations of the narrow gauge (60 cm.) railways. It was also responsible for the movement of trains and for the supply of material, as well as for the construction and upkeep of the railways and the repair of breaks in the lines.

(b) *The Field Railways Section* (Section de chemins de fer de campagne—S. C. F. C.), consisting of a staff (commandement) and three groups.

The Operation Group was charged with the organization of trains and was subdivided into 6 brigades, each composed of 320 railway employees (agents) under the direction of a brigade chief. Theoretically, each brigade operated 12 railway stations, but the exigencies of the service often required them to operate more than 12 stations. This was especially true during the German retreat in 1918.

The Trackage and Maintenance Group (V. T.), consisted of a staff (commandement) and 4 construction brigades, one signal brigade and one depot brigade. The work of this group was in charge of an engineer, chief of the group, with the necessary technical and administrative personnel at his disposal.

Each construction brigade was composed of an engineer, brigade chief, and 413 skilled technical assistants. One of these brigades had additional personnel and was especially used for bridge work.

The signal brigade was responsible for the installation and upkeep of telephones, telegraphs and electrical signals, and was particularly charged with maintaining telephone communications between railway stations. It consisted of an engineer, brigade chief, with his aides and 44 technical assistants.

As far as the unemployed rolling stock permitted these brigades were quartered in railway cars and a number of cars were also used as mobile workshops for carpenters and adjusters. In addi-

tion, the brigades were also provided with motor trucks and bicycles.

The Traction and Material Group (T. M.) consisted of a staff (chief engineer and aides) and seven brigades, each composed of directing personnel and engine crews (locomotive engineers, firemen, railway men). Each brigade was responsible for the traction service on part of the lines of communication and their personnel included the necessary specialists for minor repairs to locomotives and cars. The tools were pooled and served to equip the workshops of each brigade.

Chart 3, Chapter XV, Volume I, shows the locations of the railway depots, work shops, and water tanks in the Belgian zone. In France, there was a depot at Marck (T. M.), one at Oissel, a supply establishment at Coudekerque and a construction shop at Oissel.

The personnel of the groups and brigades of the Field Railways Section was largely composed of former employees of the Belgian State (Government) Railways who had been called into the military service and included experts of all kinds. The Battalion of Railway Engineers and the Field Railways Section cooperated together and supplemented each other. The B. C. F. operated, constructed, and re-established the railway lines in the zone nearest the enemy.

(c) *The Narrow Gauge Railways Section* (Section Vicinale des chemins de fer — S. V. C. F.). This section was charged with the operation and maintenance of the one-meter gauge light railway systems. It should be noted, however, that a section of one-meter gauge railway line east of Furnes was operated by the B. C. F. The construction of narrow gauge (one-meter) lines was carried out partly by the B. C. F. and partly by the S. V. C. F., during both the stabilization on the Yser and the advance of the Belgian Army in 1918.

The Narrow Gauge Railways Section consisted of two platoons. The first platoon included all traction and operation personnel, while the second platoon included the personnel for the trackage and maintenance service. Originally the personnel of the S. V. C. F. comprised only 150 men and 3 officers, but it was subsequently increased to meet the requirements of the service and, on July 1, 1918, there were 345 men in this section.

(d) *The "Regulating Commission"* (Commission régulatrice), with personnel for the operation of the railway stations. The Regulating Commission was composed of a military commissioner and a technical commissioner, with their assistants. Its functions were analogous to the French regulating commissions. The military

personnel of the commission operated the railway stations in conjunction with the technical personnel of the "Operation Group" of the Field Railways Section.

PART 2.

OPERATION OF THE RAILWAYS.

Standard gauge lines.

As previously stated, these lines were operated by the B. C. F. and the S. C. F. C.; the B. C. F. operating the lines in the zone nearest to the enemy. This railway system comprised all standard gauge lines in the uninvaded portion of Belgium north of a line running, approximately, from Proven to Ypres. On the northern side it connected with the French "Réseau du Nord" (Northern system), on the line from Dunkerque to Adinkerke. On the south it connected with the railways which had been established by the British Army in southern Flanders. In September 1918, the S. C. F. C. took over the portion of the line Dunkerque-Adinkerke, located in French territory.

The standard gauge railroads operated by the Belgian Army are shown in Chart 3, Chapter XV, Volume I. In addition, sidings and various installations were constructed in France at the following places: Marck, Haeghemeulen, Boomkens, Loon-Plage, Frethun and Oissel.

It is estimated that the standard gauge railroads operated by the Battalion of Railway Engineers transported 1,495 tons of material and 512 passengers daily, while the portion of these lines operated by the Field Railways Section carried 9,000 tons of freight and 2,571 passengers per day.

During the German advance in 1914, a large number of locomotives and railway cars were sent to France. Of this rolling stock, 445 locomotives and 1,000 cars of all kinds were reserved for the use of the Army. Until September 1918, 128 locomotives were in use by the Army and the remainder was placed at the disposal of the French railway lines.

Reserve trackage material was stored in the depots of Adinkerke, Marck and Audruicq. An advanced supply depot for the use of the B. C. F., was located at La Panne, near Furnes. Each of these depots was under the direction of a military official of the Trackage and Maintenance Group of the S. C. F. C. In these depots the Army stored all the material necessary for the maintenance work which was to be executed by the B. C. F. and the S. C. F. C.

For general transportation purposes, the railway cars of the Belgian State (Govt.) Railways and of certain French railway companies were ordinarily employed. In addition a number of railway cars were rebuilt and converted for special use, such as cars for the evacuation of the sick and wounded, armored railway cars, refrigerator and construction cars. These cars, which totaled about 1,000, included passenger coaches, freight cars, flat cars, wrecking cars, etc.

Narrow gauge lines (1-meter gauge).

The "Narrow Gauge Railways Section" (Section Vicinale des chemins de fer—S. V. C. F.) was organized March 1, 1915, by ministerial decree and had for its object the operation of the narrow gauge (1-meter) lines. A small section of narrow gauge lines was operated by the Battalion of Railway Engineers.

Until February 2, 1917, the Narrow Gauge Section was under the direct orders of the 4th Section of the General Staff at G. H. Q. From thence on, it operated directly under the Field Railways Commission (C. R. C. F. C.).

Previous to the 1918 offensive, this section operated the narrow gauge (1-meter) lines in the uninvaded portion of Belgium, namely: From Furnes to Ypres, as far as Elverdinghe; from Furnes to Poperinghe; from Furnes to La Panne; from Furnes to Nieuport; from La Panne to Coxyde; from Poperinghe to Dixmude; and the section from Elverdinghe to Merckem, as far as the branch at Steenstraete. Moreover, several new lines were constructed and operated during the war. The Klein-Leysele line was constructed in December 1915; the Nieuw-Herberg-Linde line in April 1918, and the Leysele-Nieuw-Herberg line in July 1918. Most of these lines were constructed by the Battalion of Railway Engineers.

During the 1918 offensive, the Narrow Gauge Section (S.V.C.F.), with the aid of the B.C.F., constructed a connecting line between the Belgian and German fronts. This line left Luyghem and went in the direction of Clercken-Zarren.

Fragments of old Belgian lines and German strategical lines were joined together, thus establishing connections with the Bruges line via Clercken-Zarren-Wercken and Couckelaere. Upon arrival at Bruges, all lines radiating from that city were requisitioned.

After the Armistice, the lines from Bruges to Ursel-Eecloo and Urselscheut were reconstructed. The Narrow Gauge Railways Section ceased to exist on December 24, 1918 and the narrow gauge (1-meter) roads were taken over by the companies which operated them before the war.

The personnel and tonnage transported by the S. V. C. F. from May 15, 1915 until December 31, 1918, is shown below:

Year	Number of kilometers covered	Belgians	Number of railway cars used by—	
			French	British
1915	166,608	30,625	7,150	----------
1916	271,753	55,212	4,944	----------
1917	259,961	62,004	10,416	1,633
1918	343,830	49,777	1,002	1,348

Year	Number of troops transported	Number of railway cars used	Belgians	Tonnage transported for—	
				French	British
1915	845,156	26,955	172,491	34,507	----------
1916	1,108,779	40,054	372,496	35,507	----------
1917	505,296	17,418	467,947	89,216	11,244
1918	958,709	35,462	405,188	7,127	9,285

Besides the locomotives and cars in use on the narrow gauge lines at the beginning of the war, 9 special type cars were purchased in 1916, and 40 low-sided trucks and 20 box-cars in February 1918. All of this material was manufactured in Spain.

All of the rolling stock, with the exception of the few cars purchased from Spain as mentioned above, belonged to the "National Narrow Gauge Railways Company" (Compagnie Nationale des chemins de fer vicinaux) when the war began. Of this material, the following was in use on November 11, 1918: 39 baggage cars, 173 passenger cars, 655 box cars (plus 20 in 1918), 7 flat cars, 250 low-sided truck cars (plus 9 in 1916 and 40 in 1918).

The material for the upkeep of these lines was furnished, as needed, by the B. C. F. New material was purchased by the Belgian Government, either in France or in America.

The S. V. C. F. laid two and a half kilometers of track; the B. C. F. constructed 35 kilometers in Belgium and 21 kilometers in France. The B. C. F. and the S. V. C. F. laid 12 kilometers of track during the offensive of 1918.

60-CENTIMETER GAUGE LINES.

These lines were operated by the 4th Company of the Battalion of Railway Engineers. The total length of trackage laid with material of the Belgian Army was 200 kilometers. The total length of 60-cm. lines operated by the Belgians was 160 kilometers. The approximate total of traffic handled daily amounted to 940 tons of material and 1,435 passengers before the offensive of 1918. A small supply

of traction material was kept in stock, in addition to that captured from the Germans.

The following rolling stock was in operation on November 11, 1918:

5 gasoline locomotives (Belgian)
8 gasoline locomotives (French)
10 gasoline locomotives (British)
9 steam locomotives.
128 railway cars or trucks (Belgian)
165 railway cars or trucks (British)
37 railway cars or trucks (French)

The 4th Company of the B. C. F., which operated the 60-cm. lines, was organized into five sections. One section of about 40 men operated the railway stations; 2 sections were responsible for the operation of the trains and 2 sections were charged with the upkeep of the lines.

NOTE.—The original source of information on the above subjects is the 4th Section of Belgian G. H. Q. and the C. R. C. F. C., 13 Rue de Louvain, Brussels.

CHAPTER XIV.

SECTION IV.

RAILWAY TRANSPORT (ITALIAN).

In Italy, the Transportation Service was responsible for the successful operation of the railways under war conditions. This technical military organization made it possible for the Transportation Administration to extend its jurisdiction over the entire railway system, while at the same time enabling it to indirectly maintain order and discipline throughout the system without interfering with the activities of the various technical organizations.

It is difficult to make a distinction between the administrative and executive agencies of the military railway transport service, as the administration and coordination of railway transportation devolved almost entirely upon military elements while technical operation, on the other hand, devolved almost entirely upon the technical (civil) branches of the State (Government) Railways.

The Italian military railway organization was relatively simple. The complex State Railway organization remained unchanged and the Military Transport Service was formed by the addition of a few special organs which, working in conjunction with certain State Railway agencies, were charged with the direction and coordination of the enormous military traffic on the railways during the war.

The organization of the Military Transport Service had long been foreseen and was put into effect at the beginning of hostilities. It fulfilled its duties satisfactorily and retained its initial organization throughout the war.

The most important organization was the Transportation Administration (Direzione Trasporti) at the General Commissariat, which controlled all military transports and directed the preparation and execution of all railway operations in the "military railway zone", either in the Zone of the Armies or in the Zone of the Rear.

Under its direct orders were:

a) A *Transportation Commission*, located at Rome, which provided for and carried out all transports on the railway systems of the interior.

b) Nine *Military Railway Line Commissions* with the traffic divisions of the State (Government) Railways at Turin, Genoa, Milan, Venice, Bologna, Firenze, Rome, Naples, and Palermo. They remained in close and constant contact with the railway authorities, for the purpose of assuring the prompt execution of military transports ordered by the Transportation Administration and by the Transportation Commission at Rome.

These commissions supervised and facilitated loading and unloading operations and movements of troops and materials. With the exception of the commission at Venice, they disposed of necessary means for carrying out transports in their respective traffic divisions. The Venice division was entirely in the Zone of the Armies and was therefore directly controlled by the Transportation Administration.

c) A "*Transportation Delegate*" (Transportation Officer) with each Army Commissariat) who received all requests for transportation from the army to which he was assigned. These requests were assembled, coordinated, and sent to the Transportation Administration, which took the necessary steps to satisfy them.

The Military Railway Line Commissions (di linea) controlled:

The *Military Railway Station Commands*, established in the principal railway stations and in stations which, although of minor importance, were of military value.

The Military Railway Station Commands were either permanent or temporary. Seventeen permanent "Military Railway Station Commands" were in existence before the war, while the number of temporary commands varied according to circumstances.

The functions of these commands varied but were very important. They maintained order and discipline among troops in transit; supervised the loading and unloading of troops and materials; issued necessary transportation orders to casuals, and provided shelter and refreshments for troops being moved by rail.

Certain Military Railway Line Commissions maintained liaison officers with the superior administrations of the central depots.

The Transportation Administration also controlled:

a) The *Regiment of Railway Engineers.*

b) *Military Railway Sections*, composed of mobilized State (Government) Railway personnel.

The Regiment of Railway Engineers executed emergency railroad works in the Zone of the Armies and the Military Railway Sections took over railroad lines which, on account of the military situation, were so located as to necessitate military instead of civil control.

THE TRANSPORTATION ADMINISTRATION AND THE STATE (GOVERNMENT) RAILWAYS.

(Chart 10, Chapter XV, Vol. I.)

The relations which existed between the Army military railway organization and the military and civil organizations of the State (Government) Railways, have already been outlined.

From the start the Transportation Administration endeavored not to interfere in the technical operation of the railroads and, in collaboration with the State Railways, sought to evolve a military organization which by proper interpretation of the orders of the Supreme Command and knowledge of the Army's transportation requirements could regulate and control all railway traffic.

Although, insofar as military transportation was concerned, the military organization did not attempt to supplant the existing railway organization, the fact was recognized that the Army's transportation requirements were paramount and the military authorities were empowered to intervene in civil transportation matters.

For this reason, during the mobilization and throughout the war, the Supreme Command was authorized to issue special railway traffic rules and regulations. The Railway Service was duly informed of the decisions of the Supreme Command and these had to be complied with by all concerned.

To strengthen relations and improve coordination between the military and civil transport organizations, officials of the State Railways were attached to military organizations in proximity to the theatre of operations and military organizations were established alongside the civil railway organizations.

A number of State Railway engineers and officials were therefore attached to the Transportation Administration and assisted the military organization by their technical knowledge. The Military Railway Line Commissions and the Military Railway Station Commands assisted the State Railway traffic divisions and station-masters by transmitting military orders and cooperated in the preparation and execution of military transports.

RAILWAY SYSTEMS—EMPLOYMENT OF SECTIONS OF RAILWAY ENGINEERS.

Throughout the war, the railways continued to be operated by the State (Government) Railway services and by the private railway companies which had operated them before the war.

However, railway stations which were under enemy fire were operated almost exclusively by military railway engineers, assisted by volunteer State Railway personnel. In addition, to meet the con-

stantly increasing requirements of personnel for the State Railways as well as for the secondary companies, a Railway Operating Section (Sezione esercizio linee) composed of military railway specialists was organized and its personnel assigned to the above mentioned companies. The personnel of the Railway Operating Section increased from 250 to 1,000 men.

A second railway operating section was organized for the operation of certain railroad lines located beyond the Isonzo and which were exposed to enemy artillery fire. The second section had an average strength of 350 men and operated 8 locomotives. Although it could only work at night, on account of its dangerous position, it operated on an average five trains per day in each direction. These trains was composed of 35 cars at a maximum and carried the supplies for the troops operating beyond the Isonzo, in the zone between Gorizia and Monfalcone.

After the retreat to the Piave, the second section was particularly charged with the operation of the terminal stations of all lines leading toward the front. This made it possible to unload trains (at night) within less than 8 kilometers from the firing line (Chart 11, Chapter XV, Vol. I).

INFLUENCE OF THE COAL CRISIS ON RAILWAY TRANSPORTATION DURING THE WAR

Due to the absolute lack of national coal resources Italy was obliged to import coal from abroad, especially from Germany, Austria, America, England and France.

In 1914 coal importations amounted to:

8,349,000 tons from England.
837,000 tons from Germany.
67,000 tons from France.
66,000 tons from Austria.
287,000 tons from America.
11,000 tons from other sources.

9,617,000 total number of tons.

These figures covered the maximum annual requirements, viz, 9,600,000 tons.

In 1915, upon Italy's entry into the war, importations of coal from Austria stopped immediately while imports from Germany diminished noticeably, and ceased altogether the following year when Italy declared war on Germany. The loss of coal imports from these countries was compensated by increasing importations from America. In 1915, America furnished 1,714,000 tons of coal and the total coal importations for that year amounted to 8,242,000 tons, or, slightly less than the average annual requirements.

The real coal crisis occurred during 1917 and 1918 as a result of the intensive submarine warfare waged by the Central Powers, which rendered sea transportation very uncertain.

The importations of coal for 1917 amounted to:

4,563,000 tons from England.
20,000 tons from France.
451,000 tons from America.
4,000 tons from other sources.

5,038,000 total number of tons.

Italy's coal importations for 1917 were below her average annual minimum requirements and only represented the average annual consumption of the Italian State Railways. It became necessary to draw upon the reserve supplies existing in the country, but the consumption of coal was so great that, from January to September 1917, these reserves decreased from 1,000,000 to 250,000 tons.

France and England became Italy's only reliable sources of supply for coal, and even then the delivery of coal from England could only be assured by avoiding shipment by sea.

It was then agreed that the greater part of the coal from England destined for Italy would be ceded to France and the latter would furnish the Italians with equal quantities of French mined coal in exchange.

During 1919, importations were divided as follows:

4,321,000 tons from England.
1,467,200 tons from France.
47,700 tons from America.
5,100 tons from other sources.

5,841,000 total number of tons.

The coal crisis remained very serious on account of the increased railway activities resulting from military operations and due to the fact that the French coal was inferior in quality to the British and produced less energy (rendimento).

To meet the irreducible coal requirements for railway transportation purposes, civil and commercial railway traffic had to be reduced to a minimum and a large number of passenger and freight trains were therefore suppressed.

Distribution of coal to industrial plants also had to be strictly limited and private concerns were obliged to have recourse to substitutes. Finally, coal substitutes were also used by the troops for heating and other purposes.

Notwithstanding the rigid economy practised in the use of coal for other than military purposes, the coal crisis affected the Army's transportation and it was solely due to the admirable organization

of the Railway Service that it was possible to overcome the difficulties resulting from the fuel shortage.

The gravest inconveniences resulting from the coal crisis were:

1) Irregular operation and frequent delays in railway transports on account of the poor grade of coal used.

2) The greater deterioration of locomotives owing to the inferior quality of the coal received from the French.

3) The low fuel value of the coal itself, requiring greater coal consumption in tons per kilometer, often necessitating doubling locomotives on many portions of the lines and even breaking the trains in half.

4) In 1917–1918, the employment of the Modane and Ventimiglia railway line for the importation of coal from France greatly interfered with the regular operation of trains by the Railway Service, and this at a time when it was necessary to effect the movement of inter-allied troops and supplies between the French and Italian fronts.

IMPROVEMENTS CARRIED OUT DURING THE WAR.

Extensive railroad construction was undertaken during the first period of the war, May 1915–February 1916, to improve conditions on the railroad systems running from the Tagliamento to the Isonzo. These conditions resulted from the fact that the plans for the strategic employment of these railways, in case of war with Austria-Hungary, only provided for the concentration of the Italian Army on the line of the Tagliamento river and through the railway stations located on these lines. New double track lines were constructed, existing lines were completed and doubled, numerous stations were enlarged and additional unloading facilities installed to adequately handle the Army's requirements.

As a result of these measures the capacity of the railways to and from the Veneto region was greatly increased and it was possible to operate 90 trains per day over these lines. However, the duration of the war and the increasing military transportation requirements resulting therefrom, rendered this operating capacity insufficient. It was deemed necessary to attain a capacity of 140 trains daily and, in February 1917, a second system of railways was constructed in the Veneto region.

After the Austrian offensive in the Trentino and the capture of Gorizia and the first lines on the Carso, the stations on the railroad lines serving both of these fronts had to be organized so as to provide for the rapid loading and unloading of troops, in order to effect the transfer of units from one front to the other. The project

was studied and necessary construction carried out during the period August 1916 to 1917.

To improve the traffic on the Modane-Turin; Turin-Genoa; Naples-Foggia; Foggia-Bari-Brindisi and Bari-Taranto lines, which had been seriously hampered by the continual passage of interallied troop and supply trains destined for the expeditionary forces operating in the Near East, the capacity of the Busoleno-Modane electric railway system was doubled, certain stations were enlarged, new ones constructed, and British and French bases were established at Brindisi.

Finally, during the period March 1916 to November 1917, the principal railway systems in Northern Italy were improved for the purpose of facilitating communications between France and the ports of Genoa and Savona. Steps were also taken to guard against a possible German-Austrian offensive through Switzerland.

The situation which arose after the retreat of the Army to the Piave seriously affected and changed military transportation plans, particularly with reference to unloading operations in the zone of the operations and in the rear (retrovie).

The following new railway works were therefore immediately undertaken:

1) Reorganization of the unloading zone for the supply of the armies, from the Altipiani to the sea.

2) Enlargement of certain stations in the zone between the Mincio and the Bacchiglione to serve the advanced depots of the armies.

3) Enlargement of stations behind the line Mincio-Po and the construction of new unloading points.

4) Further enlargement of certain stations on the Piedmont, Lombardy and Emilia systems, to serve the numerous reserve establishments which had been established in these regions as a result of the expansion of the Army.

5) Reorganization of the zone of procurement and of the supply bases for the Allied units.

EMPLOYMENT OF RAILWAY BATTALIONS.

The "Railway Battalions" were at first employed by the Army to repair the railways which had been damaged by the enemy in May 1915. Subsequently, they were employed to enlarge the railway stations and construct new trunk lines in areas under enemy artillery fire. Finally they were employed in the construction of new stations and trunk lines in areas outside the zone of fire. The Railway Battalions worked alone or in conjunction with State Railway employees and civil laborers.

These battalions also constructed railway works in connection with the emplacements of the heavy artillery batteries mounted on special railway cars.

CIVIL LABORERS.

Railway works in the zone of the rear were executed by civil laborers under the direction of the State Railway labor divisions. In the other zones, this work was accomplished by the railway battalions with the assistance of civil personnel. Civil personnel was generally employed for excavation and masonry work, while track construction on the State Railways was done by squads of railway personnel and detachments from the Railway Sections; other railroad works were executed by the personnel of the Railway Battalions.

MODIFICATIONS CARRIED OUT IN THE TRANSPORTATION SERVICE DURING THE WAR.

As already stated, the Railway Line Commissions controlled railway traffic in their own, or adjoining, railway traffic divisions. They were also authorized to carry out small transports, involving single carloads destined for the front. All other transports in the Zone of the Armies were handled in the military traffic stations by Railway Transport Officers working in conjunction with the Railway Line Commissions. Transports, after being formed into classified trains, were forwarded under the direction of the Transportation Administration.

On account of the daily increase in the number of trains dispatched to the front, the classified grouping of trains became more and more difficult and finally threatened to congest the military traffic stations.

As an experiment it was prescribed that the railway authorities at certain principal stations, in agreement with the Military Commands of the respective stations, would proceed without delay with the assembling of single cars and other detached transports, with the exception of shipments of munitions, and that these should be forwarded direct by attaching them to the classified supply trains.

This decentralization rendered the transportation system much more flexible and gave such good results that authority was extended to include therein transports of five cars, then ten and, finally, supply trains of fifteen carloads. The duties of the Transportation Administration, insofar as these concerned the movement of supplies and ammunition, were greatly lessened by this policy and the administration was thus enabled to devote itself entirely to its real functions, that is, the strategical and tactical transportation of troops.

As long as the industrial mobilization transportation was limited, the railway authorities could utilize such rolling stock as was not required for the use of the Army and assign it either to military or

civil traffic as desired. With the increase in the requirements for industrial mobilization purposes, the available number of cars became absolutely insufficient and the Transportation Administration had to control the assignment of railway material.

This control was not directly exercised by the Transportation Administration, but through the Transportation Commission at Rome and the Military Railway Line Commissions.

The regional committees for industrial mobilization received the requests for railway transportation for the shipment of raw materials and manufactured products for military purposes. They transmitted these requests to the Transportation Commission at Rome or to the Railway Line Commissions concerned. The latter coordinated the demands, determined priority in accordance with prevailing railway traffic conditions, and assigned available transportation so that, as far as possible, each would have sufficient rolling stock at their disposal to assure continuous operation.

TRANSPORTATION OF SMALL UNITS AND DETACHMENTS

To maintain the centralization of railway transports under the Transportation Administration and to provide for the movement of small units and detachments, it was prescribed that the military authorities, in conjunction with the railway authorities, would be authorized to move such units in the Zone of the Armies as long as these transports did not involve more than one carload. The Military Railway Line Commissions were only authorized to handle transports within their own, or adjoining, railway traffic divisions. All other movements were directed, in the zone of the interior, by the Transportation Commission at Rome and, in the military railway zone, by the Transportation Administration.

The increasing number of casual troops together with increasing needs for emergency transportation necessitated a rational decentralization of the transportation agencies operating in the Zone of the Armies. It was possible to accomplish this gradually, without disorganizing the service, because the Military Railway Line Commissions and the Military Railway Station Commands were continuously acquiring greater freedom of action. The Military Railway Line Commissions were finally authorized (in urgent cases, required), by the Transportation Administration to carry out such transports themselves, and were to provide for their movement from one railway division to another until their arrival in the Venice division. The latter being located at a vital part of the front, movements therein passed under the direct control of the Transportation Administration.

This system was the only one practicable and found its fullest application during the transfer of French and British Armies into

Italy. This was a most trying period, the railways and stations were congested and many lines were absolutely paralyzed. Intervention by the Transportation Administration in movements on lines so far removed from its seat would have been untimely and ineffective. Transports arriving from France never adhered to the original itineraries which had been prepared for them and, from the start, it was evident that the plans evolved by the Transportation Administration for the movement of these transports would be useless. A new transportation agency was therefore established at Turin to direct railway traffic over the Piedmontese and Ligurian railway systems. This agency, in agreement with the Military Railway Line Commissions at Turin and at Genoa, despatched the trains from the frontier to the Military Railway Commissions at Milan and at Bologna; the latter, in turn, forwarded them to the railway stations of the Transportation Administration. It was only through the employment of this flexible system that the two Armies were transported from the French border to the Italian Zone of the Armies without serious delay, and during the most critical period in the operation of the railroads.

Whether concerning the transportation of materials or of troops, the decentralization of the military transport organizations progressed slowly but surely. As the number of transports increased and railway difficulties augmented, the need was felt for greater flexibility in the organization of a system which, at the beginning, was rather rigid. Subsequently, this system became so flexible that the military railway organizations could readily execute all movements. However this was only attained after long experience and practice.

SUPPLY AND REPAIR OF ROLLING STOCK.

Army railway movements required a large and increasing amount of railroad material. This was largely due to the fact that, on account of the dangers incurred by sea transport, many shipments were sent by rail which in normal times would have been transported by water.

It therefore became necessary to order new rolling stock and speed up repair work on existing railroad equipment.

As Italian manufacturing establishments were already engaged in producing arms and munitions, they were unable to undertake the construction of new railway equipment. An order for 3,000 ordinary railway cars was placed in America and, subsequently, 10,000 more were ordered. These cars were shipped in sections in order to utilize ship space to the best advantage and reduce the assembly work in Italy to a minimum.

The number of cars available was still insufficient and 13,500 additional cars, (wood or mixed construction), were ordered jointly by the State Railway Administration, the Ministry of Communications and the National Fuel Commissariat. For the construction of part of these cars material from unserviceable cars, stored in various railway yards, was salvaged and used. This reduced the quantity of iron used in the construction, as well as the time required for the manufacture of various parts and mountings.

As only part of the cars ordered in Italy and from America were available for service during the war, repair work on the old rolling stock was speeded up as much as possible.

This production work had to be undertaken by the Railway Service in addition to its numerous other tasks, such as the creation of hospital trains, etc.

CHAPTER XIV.

SECTION V.

RAILWAY TRANSPORTATION (AMERICAN).[1]

The great instrumentalities of transportation have been made to serve the purpose of war in recent years to an extent never before dreamed of. Germany had for years developed her railroads with an eye to their strategic setting for military operations. So also had France. With millions of men to be moved from place to place and to be kept constantly supplied, the railroads on both sides of the long battle line were used to their utmost capacity. The fact that our operation plans contemplated a strategic thrust against the great German railroad system leading from Metz through Mezières upon which nearly half of the German forces were depending, demonstrates forcibly the great importance of railroad transportation in modern warfare. If we could succeed in cutting this system a very large portion of the enemy's battle line would be rendered powerless for want of supplies. As a matter of fact, the success of the Argonne-Meuse drive in seriously threatening this railroad contributed in large measure to the German High Command's decision to appeal for terms. Before the Armistice was actually signed the railroad was under the fire of our guns.

The organization necessary to the proper functioning of these great battle adjuncts were large and complex. In the Zone of the Interior railroad management could be developed largely upon peace time principles, but in the Zone of the Armies there were added to the complex problems of ordinary management the difficulty of meeting the varying situations of military operations, and the railroads of the interior and those of the zone of the advance had at all times to be brought into perfect co-ordination. The same general principle of flexibility that controlled the development of a supply system must control also the development of the railroad system. The two are inseparably connected. The location of the supply depots to meet eventualities on any part of the front, meant the development of railroad facilities for the same purpose.

The extension of the railroad by means of the narrow gauge and the 60 cm. lines played an important role in solving the transporta-

[1] Extracted from Chapter V of General Moseley's report to the C. in C.

tion problems of the war. Narrow gauge systems had existed in France before the war. These were adapted to meet the new conditions, and then the more mobile and less costly 60 cm. was developed and used to within a very short distance of the fighting line.

This war also brought about the development of the motor truck as a great instrumentality of transportation. Its highest efficiency is but a recent evolution through its latest organization. Its effective use entailed the development of extensive plans for maintenance and operation and for the improvement and construction of suitable roads. The French and English had attained to a high degree of efficiency in the use of the motor trucks in military operations previous to our entry into the war. The successful defense of Verdun in 1916 was, from the supply point of view, wholly due to motor trucks. With the railroad lines cut off or seriously threatened, the only approach was by road. Fifteen hundred trucks a day rolled over the carefully kept roads, carrying fresh troops and supplies of all kinds into the salient. It was only through a high degree of organization that this was possible.

In spite of the development of the railroad and of the motor driven vehicle, the Army horse and Army mule have been as important as ever before in which may be called "close in transportation." Experience was not lacking in the handling of this form of transportation, but the magnitude of modern operations presented many problems for General Staff solution.

As in the case of supply it is not the intention here to go into the details of the organization of the transportation services, but only to indicate how their development was necessarily controlled and supervised by G–4, G. H. Q. The different classes of transportation are hereafter considered separately.

Before the advance guard of the A. E. F. started from America, the importance of the part that railroad transportation was to play in the war was realized and, as early as May 1917, a railroad commission composed mostly of railroad men had been sent to Europe to study at first hand the railroad situation. The results of this study, the manner in which it solved and handled its later problems, the extent it controlled French railroads and the extent to which it was subordinate to the control of the French, are interesting details and form part of the report of the Transportation Department.

Nevertheless, during the period of solution, the department functioned and although there were at times disagreements as to the limit of control of the Transportation Department, it never failed to get the supplies from the base ports to the point where its control ceased and that of the Army began.

As previously stated the report of the department covers details of the operations, but it should be pointed out that all new policies

and projects of the department, as in the case of the other supply services, had to be submitted to G–4, G. H. Q., to be brought into co-ordination with the whole scheme of supply. Especially were the co-ordinating functions of this section of the General Staff needed when problems of transportation in the advance zone were to be solved.

At times prominent officials of the Transportation Department insisted that they should be given the same independence in the Zone of the Armies as in the rear, but in so doing they did not fully appreciate the basic principles of the military organization. The Regulating Officer, in their conception, should be nothing more than a bureau of information as to the location of units. They forgot that, in the zone of operations, the man responsible for the tactical and strategic situation must control everything. They contended that they were still held responsible, but were interfered with by an agency with authority and no responsibility. This was obviously an erroneous impression. Their responsibility was to perform the orders of the Supreme Commander as transmitted by his representatives who, in turn, were held up to a very high degree of responsibility by him. Authority without responsibility is a thing which does not exist. When the Regulating Officer was made the commanding officer of everything connected with his station, including the Transportation Department personnel on duty there, many of the difficulties caused by the misunderstanding on the part of the Transportation Department of the nature of this responsibility disappeared.

The two distinct phases of the transportation problem are that of the advance zone and that of the base and intermediate sections. Back of the advance zone problems are much the same as those in times of peace. In the Zone of the Armies, military control must dominate. Up to the advance depots the Transportation Department properly controls everything pertaining to railroad operation and technique, co-ordinated by the Commanding General, S. O. S., but beyond that the control must be in the hands of the men who control military operations. Even then the technical handling of the railroads remains in the hands of the Transportation Department. The Transportation Department carried the supplies from the seaboard to the railhead. Its responsibility is continuous throughout, but from the regulating station and the advance depot forward the Supreme Commander must control its operations.

When once the transportation enters the advance zone, where the movement of the troops is more or less generally known and the necessity of secrecy is uppermost, the need for the exercise of this control becomes obvious. It is accomplished by the Commander in Chief

through the Regulating Officers, as has been previously pointed out. They speak in his name and are held to a high degree of responsibility by him. The responsibility of the Transportation Department does not change. It is still responsible to the Supreme Commander that its functions be properly and completely performed. The Regulating Officer merely gives orders in the name of the Commander in Chief in the zone where control must be centralized. The situation is exactly analogous to that of a colonel of a regiment directing a major to march his battalion to a certain point from which he will attack a certain position, but that when he arrives at the point indicated the adjutant of the regiment will give him further instructions in regard to the battle plans. The major has full independence of action up to the point of rendezvous. He is responsible only that he gets his battalion there at the appointed time. He then receives the further instructions in regard to the attack, but continues to be responsible to the colonel for the proper performance of his orders. The adjutant may remain on the ground and as the battle progresses, having a wider view of the whole situation and knowing the will of the colonel, may give still further instructions in his name. The major's responsibility never changes and the adjutant is responsible to the colonel for the exact transmission of the orders and for a proper interpretation of his will.

Again, in this division of control between the advance zone and the rear, the Transportation Department stands somewhat in a similar position to the other services. There is on the staff of the army commander a chief quartermaster. The Chief Quartermaster at Tours was in close liaison with him, but not for a moment is it to be assumed that the chief quartermaster of the field army is responsible to any one, or controlled by any one except the commanding general of the army. In the case of the Quartermaster Service the division of responsibility and control is complete, as the army commander's authority sharply intervenes. But in the case of the Transportation Department, with its continuous trackage from seaboard to railhead, the close inter-relation of all parts and the fact that a particular system of railroads may be serving more than one army, involving difficult questions of priority and economic use of rolling stock, the control must be exercised by the Supreme Commander. The Regulating Officer is therefore on his staff and not on that of the commanding general of the army. The principle is, however, the same. Beyond a certain line the military situation must dominate whether the control is exercised by the army or by the Supreme Commander. Inasmuch as the regulating station may be serving more than one army, experience has demonstrated that the Regulating Officer must represent the Commander in Chief.

The railroad lines in the Zone of the Armies are taxed to the utmost and are therefore susceptible to congestion. With thousands of cars that move backward and forward every day, the movement must be effected with absolute regularity, in order that the railroad systems may meet the great demands made upon them. During changing battle conditions, emergency shipments, sudden transfers of troops by rail, the hastening forward of replacements and the increase of wounded to be evacuated, all the services are clamoring to have their shipments given priority. In fact all emergency calls come simultaneously. While always there must be sustained the regular flow of food, forage and gasoline without break or setback.

As everything cannot be done at once the authority for establishing priorities is vested in the Regulating Officer, acting under the instructions of G–4, G. H. Q.

These were in general the difficulties of the Transportation Department. The details of its problems will be found in the report of the D. G. T., which follows.

Transportation Service at the Date of the Armistice.[3]

GENERAL ORGANIZATION.

(Chart 4, Chapter XV, Volume I.)

The Transportation Corps at the date of the Armistice was one of the separate staff departments functioning under the direction of the Commanding General, Service of Supply. The Director General of Transportation was the head of this Corps and maintained his headquarters offices at Tours, the Headquarters, S. O. S. The Director General of Transportation, through his staff officers, controlled directly all transportation activities in the rear of the regulating stations.

The Transportation Service in the zone of the advance was under the direction of the Assistant Chief of Staff, G–4, at G. H. Q. A deputy D. G. T. was a member of G–4 and served as Transportation Corps representative in that body. The only way in which the D. G. T. could control activities in the zone beyond the regulating stations was by issuing instructions to his deputy at G. H. Q., who in turn could have these instructions issued under the authority of the Assistant Chief of Staff G–4.

Liaison with the French Transportation Service was maintained through the medium of the Deputy D. G. T. in the office of the French Ministry of Public Works at Paris. This Deputy received

[3] Prepared by Transportation Corps, Historical Bureau, American E. F.

all requests for information as to transportation from the French Transportation Section of the General Staff and transmitted them to the D. G. T. at Tours. Through the same medium the D. G. T. dealt directly with the French on all transportation matters which did not involve the alteration of any established policy of the American E. F. The D. G. T. was also a member of the Inter-Allied Transportation Council and through the weekly conferences was able to keep in touch with the general allied transportation situation. All matters affecting allied transportation as a whole could be taken up at these conferences and in this manner settled at once.

Liaison with the British Service was maintained by a Deputy D. G. T. located in London, who had entire control of all transportation matters, both water and rail, in the United Kingdom. This officer's function in connection with the British Ministry of Shipping and the British General Staff was similar to that of the Deputy with the French Ministry of Public Works.

PERSONNEL.

The final organization of the Transportation Corps was based on General Order No. 52, S. O. S., dated November 12, 1918. Although this order was dated the day after the signing of the Armistice, it may be stated that the organization then outlined was in effect at the time of the Armistice. The authorized Transportation Corps of the A. E. F. consisted of 200,000 enlisted men and 6,000 officers under the command of a brigadier general who was known as the Director General of Transportation. The commissioned grades in the Transportation Corps were not based on any definite table of organization but were fixed by a ratio grade to grade. The enlisted force was organized in companies according to two tables of organization, one for a stevedore company and one for a railway company. Though not prescribed, the stevedore companies were almost all colored troops and the railway companies were all white troops. In addition to these companies, there was a Transportation Corps-at-large of 5,650 individuals proportioned in various non-commissioned grades. All the senior non-commissioned officers were members of this Transportation Corps-at-large. These men were not part of any fixed table of organization but were assigned to duty according to the needs of the service.

At the time of the Armistice the Transportation Corps was composed of 1,810 officers and 46,976 men. They were classified as follows.

	Officers	Men
Operating Troops	433	16,589
Maintenance Troops	100	3,831
Mechanical Troops	267	8,693
Stevedore Troops	651	15,895
Crane Operating Troops	10	4,417
Inland Waterway Troops	21	970
Clerical and Miscellaneous	328	581

INTERNAL ORGANIZATION.

(Chart 2, Chapter VIII, Vol. I.)

The Transportation Corps was organized in six divisions reporting to the D. G. T.

The Railway Department of the S. O. S. comprised all railway activities in the zone between the ports and the advance section line.

The Army Transport Service controlled all port operations and ocean transport between France and England and through European countries. It also controlled the Inland Water Transport Service.

The Business Department was responsible for procuring supplies, keeping accounts and the compiling of statistics for the Transportation Corps.

The office of the Engineer of Construction was responsible for the designing of the various facilities and instructions to insure the proper construction of various projects.

The Department of Military Affairs was responsible for the procurement of personnel and the military administration of the Transportation Corps.

The railway organization of the Transportation Corps was based on the division system in vogue on American railroads at home. The railway lines of France operated by the American E. F. were divided into six "Grand Divisions" in the S. O. S. and two "Grand Divisions" in the zone of advance. They were in turn subdivided into one or more railway divisions. The General Superintendent of a Grand Division was the military commander of all Transportation Corps troops assigned to duty in his territory, and in addition was responsible for the technical operation of these troops. Each General Superintendent reported direct to the General Manager. The various staff officers of the General Manager, such as the General Superintendent of Motive Power, Engineer Maintenance of Way, etc. carried on all their negotiations with the various subordinates in the various Grand Divisions through the General Superintendent and by authority of the General Manager.

Each of the three large shops, Nevers, St. Nazaire and La Rochelle, was considered as a separate Grand Division under the control of the Superintendent of Shops. In a similar way each of the large ports constituted a military and technical command under the control of its General Superintendent, A. T. S.

RAILWAY DEPARTMENT.

(Chart 5, Chapter XV, Vol. I.)

Operation.

The regular lines of communication assigned to the Transportation Corps to operate over were as follows:

P. O. Railroad from St. Nazaire east to Saincaize.

P. L. M. Railroad from Saincaize northeast to Is-sur-Tille.

Etat Railroad from La Pallice and Rochefort north to Saumur.

P. O. Railroad from Bordeaux north to Vierzon and Pont-Vert.

Etat Railroad from Brest east to Tours.

P. O. Railroad from Bourges north to Cosne.

P. O. Railroad from St. Pierre-des-Corps northeast to Montargis.

P. L. M. Railroad from Montargis to Sens.

P. L. M. Railroad from Cosne to St. Florentin.

Est Railroad from Sens through Troyes to Neufchâteau.

Est Railroad from St. Florentin to Troyes and from St. Florentin through Ravières to Neufchâteau.

Est Railroad from Is-sur-Tille to Neufchâteau and Epinal.

P. L. M. Railroad from Marseille to Chagny.

A total of 5,831 miles of rail. The average haul from port to railhead was 580 miles. Not one of these railroads was completely turned over to the U. S. Army and operated as a military railroad. The American Government operated over the French railroads on a system of modified trackage rights. Our traffic was carried over the French lines as an overload additional to the regular French military and commercial traffic. What practically occurred was this: The American Government, in the character of shippers, told the French Transportation Service that they would have to transport a certain amount of supplies. The details of the transportation charges were left to be settled at a future date. In return the French Government informed the United States that their available facilities and personnel would not permit them to carry this amount of traffic and requested assistance in the way of equipment and personnel. The American Government agreed to loan to the French a certain amount of personnel. The details of the rental charges to be left to be settled at a later date. In other words, the profit accruing to the French railroads would be the difference between the transporta-

tion charges settled upon a future liquidation board and rental charges for motive power, rolling stock and personnel furnished by the American Government. The operation of the French railroads was always under the control of the French.

The average number of American trains per day in each direction during the month of November was as follows:

	East.	West.
Montoir-Saumur	12	7
La Rochelle-Saumur	7	5
Saumur-Gièvres	15	15
Gièvres-Marcy	7	5
Marcy-Is-sur-Tille	14	11
Gièvres-Cosne	9	6
Brest-Rennes	4	4
Rennes-St. Pierre-des-Corps	4	4
Bassens-Périgueux		4
Périgueux-Montierchaume	5	4
Montierchaume-Marcy	4	4
Cosne-St. Florentin	8	5
Montargis-Sens	2	3
St. Florentin-Châtillon	3	2

The main difficulty which was encountered in solving the American transportation situation was that due to the congested state of the French terminals and yards, and the shortage of cars and locomotives which continued throughout the war, but which could have been relieved by arrangements of the Transportation Corps. In order to relieve this congestion, the U. S. decided to construct its own terminals for the use of solid American trains. These terminals handled the American traffic and kept it out of the congested French yards.

At the time of the Armistice, the Americans were operating five Grand Divisions on the railway lines in the S. O. S. and one Grand Division in the zone of the advance. Each one of these Grand Divisions was subdivided into two or more divisions. The terminal yards for these divisons were located at Montoir, Saumur, Gièvres, Cercy-la-Tour, Is-sur-Tille, Liffol-le-Grand, Miramas, Châteauroux, St. Sulpice and Aigrefeuille.

The French railroads had no system of central train dispatching such as is used at home. The Transportation Corps, therefore, in order to introduce this method, had to install a complete system of communication. At the time of the Armistice a "selector" telephone system had been installed from St. Nazaire to Is-sur-Tille; from Bourges to St. Florentin and Liffol-le-Grand; from Bordeaux to Bourges and Vierzon. By means of this system the chief dispatcher on each grand division kept track of the movement of the American trains. In addition to the selector telephone system, telegraphic communications had been established on all lines over which Amer-

ican trains were operated. This system of communication rendered more satisfactory service than obtained from many similar systems established on railroads in the U. S.

The French used no air on their freight trains up to the advent of the American troops in France. All the American equipment that was brought over was equipped with air brakes. According to the French rules it was not permissible to use air. However, by the date of the Armistice not only had permission been secured to operate all American trains with the use of air, but authority had also been secured to operate trains consisting of mixed French and American equipment, where the French equipment did not amount to more than one-third of the train. In the case of mixed equipment, it was stipulated that the American equipment should be placed at the head of the train.

The French also had no system of central car record in practice on their commercial railways, nor was there any centralized control of car distribution. Both of these needs were felt by the Americans and to meet them the Railroad Department had organized, and in operation at the time of the Armistice, a car record office and a car order office which kept track of the movement of all U. S. A. equipment and also provided for the ordering and distributing of empties to the various points where they were needed.

The Superintendent of Passenger Transportation acted in a supervisory capacity over the transportation of all A. E. F. personnel. Under him was organized a Troop Movement Bureau which arranged with the French for all schedules of troop movement. Two bureaus were established; one at the Headquarters, S. O. S. and the other at G. H. Q., the first making arrangement for movement within the S. O. S. and the second for any movement taking place in the zone of advance. For the transportation of wounded, the Transportation Service had 16 hospital trains completely equipped with ward cars for officers and men.

A distinctive feature of the railway organization in France was the establishment of the R. T. O. Service. This system was patterned after the one in use in the British Army where railway transport officers were placed at the more important freight and passenger stations to keep trace of freight shipments and to aid the members of the army passing through. The difference in language made it very difficult for officers and soldiers to get proper information regarding train schedules and the handling of baggage and freight. The R. T. O.'s were installed with the view to assisting them and consequently taking off the hands of the French the burden of dealing with a great number of passengers unfamiliar with the language and customs. For this purpose a number of officers were secured in the United States who had railroad experience and, whenever pos-

sible, some knowledge of the French language. Upon arrival in France they were sent to the school which had been established at Angers, where they were instructed in French railroad methods and the way shipments of troops and freight were made. About 220 of these officers were stationd in France in the more important stations and terminals. In addition to making all arrangements for troop movements and supervising all detrainment and entrainment of men and material as mentioned above, the R. T. O.'s rendered important service in furnishing information and handling baggage. They were also required to keep permanent record of all shipments arriving at and leaving their station, and were the only authorized intermediaries between the French railroads and the Army Service. The R. T. O.'s were not confined to the main line of communication, but were stationed all over France at leave areas, at important junctions, and several were stationed in England and Italy.

In addition to the personnel which we had operating "All-American" trains between American terminals on the lines of communication, there was quite a portion of the Transportation Corps personnel, that was used in French commercial service. The load had become heavier than the French could bear and it was necessary that they receive assistance or else the general slowing up of transportation would have congested the lines to such an extent as to have reacted upon the whole Allied transportation situation. For this reason therefore, American personnel was furnished to provide relief.

Maintenance of way performed in the Transportation Service was largely limited to the maintenance of tracks at American terminals, and furnishing sometimes a few men to assist the French. The most important maintenance work was that done on the Etat Railway, between Le Mans and Rennes and between Tours and Le Mans.

MECHANICAL.

To provide the equipment and motive power necessary to move the supplies which the American Army would require, it was necessary to bring a large number of cars and locomotives from the United States. These had to be brought over either entirely knocked down or only partially assembled and erected in France. To carry on this work, two shops were erected, one at St. Nazaire for the erection of locomotives and one at La Rochelle for the erection of cars. The car shop at La Rochelle was turning out, at the date of the Armistice, about 90 cars a day and the locomotive shop at St. Nazaire could turn out about 3 locomotives a day. On November 11th, there were 90,960 cars on order in the United States, 1,475 on the sea, and 1,542 in France awaiting erection. There had been erected by the A. E. F. up to and including November 11th, 13,939 freight cars.

	Cars Erected.
Box	4,594
Box, Dyle & Baclain	
Gondola—Low side	2,229
Gondola (Br. Audruicq)	276
Gondola—High side	1,728
Gondola (Middletown)	242
Flats	1,600
Rwy. wagons for combat tanks—England	182
Railway wagons, U. S.	
Spanish cars—20 tons	750
Tanks	502
Erected petrol tanks (England)	41
Refrigerator	949
Ballast	400
Dump 6 yd. (Gièvres)	148
Dump 12 yd.	48

Of locomotives there were 3,575 ordered, 107 on the sea and 77 in France awaiting erection. There had been erected up to and including November 11th, 960 locomotives. In addition to this number of locomotives received from America, 350 Belgian locomotives which were the property of the Belgian State Railroad, had been turned over to the A. E. F. and were in switching service. In addition to this service rendered directly for the American Government, the Transportation Corps lent assistance to the French in maintaining their rolling stock and motive power in good repair. This was done by furnishing Transportation Corps troops to the various French shops located at various points around France and also by repairing French equipment sent to repair shops located at Nevers. This was the largest mechanical plant of the Transportation Corps in France and was intended as a heavy repair shop for the maintenance of motive power and equipment belonging to the U. S. A. in France. The total number of freight cars repaired by American labor up to and including November 14th, (the nearest date to which an estimate could be made) was 40,771 and the number of locomotives repaired by American labor was 1,188.

STORAGE.

To carry out plans for storing supplies, it had been decided from the beginning to establish depots at base ports, at intermediate points, and at advance points. Depots were designed to include receiving, classification and departure yard facilities, with engine, storage, water and special facilities, such as bakeries and refrigerating plants. The so-called "herring bone", a system for the layout of the warehouses and tracks to serve same, was adopted. This allowed for great facility and ease in operation, since by having tracks on each side of the warehouses, with the intervening space to be utilized for open storage, materials could be loaded and unloaded to and from the warehouses at the same time, and the short groups of houses permitted a large number of cars to be placed where needed without interference with another group.

PORT STORAGE YARDS.

MONTOIR, was chosen as being the best available to serve the port of St. Nazaire. At the signing of the Armistice there had been installed 125 miles of track with 400 turnouts and storage aggregating 2,066,000 sq. ft. in area, and approximately 7,000,000 sq. ft. of open storage space.

ST. SULPICE, served the port of Bassens. When construction work was cancelled there had been completed 91 miles of track and 305 turnouts, covered storage space amounting to 2,341,000 sq. ft. of open storage area, totaling 3,000,000 sq. ft.

AIGREFEUILLE, at the junction of the main line from La Pallice and Rochefort, was recommended for a port storage depot. Only a small portion of the work was completed.

MIRAMAS, was selected for a storage depot to serve the port of Marseilles. Only a small percentage of the proposed work was completed when the project was cancelled.

PLEYBER CHRIST, was designed for a storage depot for the port of Brest. Work had not been started when the war ended.

ST. LUCE, was selected as a port storage for the port of Nantes. At the time of the cancellation of the work, 15 miles of track had been completed with 125,000 sq. ft. of covered and 556,000 sq. ft. of open storage.

INTERMEDIATE STORAGE DEPOTS.

GIÈVRES was the largest of the A. E. F. depots and is located on the main line of the Paris-Orléans Railway between St. Nazaire and Saincaize, 208 miles from the former port. When the Armistice was signed, 132 miles of track with 3,553,000 sq. ft. of covered and 6,000,000 sq. ft. of open storage had been completed.

MONTIERCHAUME, is located near Châteauroux and approximately 227 miles from Bassens. At the time of the cessation of hostilities 49 miles of track and 305 turnouts, covered storage amounting to 1,123,000 sq. ft. and about 5,000,000 sq. ft. of open storage space was completed.

ADVANCE STORAGE DEPOTS AND REGULATING STATIONS.

IS-SUR-TILLE, is located at the junction of the Paris, Lyon, Mediterranée and the Est Railroads, and is approximately 436 miles from St. Nazaire. By November 11th, 1918, 95 miles of track with 1,355,000 sq. ft. of covered and 4,186,000 sq. ft. of open storage had been completed.

LIFFOL-LE-GRAND, is located on the same line of communication, 467 miles from St. Nazaire. When work was cancelled there had

been completed 42 miles of track with 180 turnouts and warehouses amounting to 408,000 sq. ft., with 594,000 sq. ft. of open storage.

ENGINE TERMINALS.

Engine terminals were designed and afterwards constructed at Saumur, Cercy-la-Tour and at Périgueux and also at the storage depots of Montoir, Gièvres, Is-sur-Tille, St. Sulpice, Montierchaume and Liffol-le-Grand, as well as at the storage yards at Aigrefeuille and St. Luce and the proposed storage depots at Pleyber Christ, Rugles, Troyes, and Tavaux. Work was started on engine terminals on the secondary line of communications at St. Germain-du-Puy, Etais and Poinçon. All of these, however, were cancelled before much work was done. Smaller installations were also provided for the ordnance and ammunition storage yards at Mehun, Issoudun and Jonchery. At all of these plants, provisions were made for inspection, ash and repair pits, storage, coal and water facilities, the necessary standing tracks, a loop or wye for turning locomotives, and also for machine shops, for the making of minor repairs. The layouts were made so that cross movements could be avoided and the engines turned and made available for the next run as expeditiously as possible.

ARMY TRANSPORT SERVICE.

The Navy mans and operates all Army transports. Liaison between the Navy and the A. T. S. was established through the Naval Communications Officer, a member of the staff of the D. A. T. S. This officer would be informed by the Naval Commanding Officer in Brest of the position at which a convoy could be expected at a certain date and of the ships in the convoy. The A. T. S. would then assign the ships to the various ports. Ports used by the A. E. F. were grouped for administrative purposes as follows.

CHANNEL GROUP.

Le Havre, two berths trans-Atlantic and four cross-channel, both used mainly for troops, but in addition handled a large amount of coal and general cargo, the bulk of which was shipped by barge to Paris and thence by rail.

CROSS CHANNEL.

Rouen, no specifically assigned berths for the A. E. F. but four or five cross-channel vessels could always unload with existing facilities; ammuition cargoes.

Caen, handled engineering material from England.

CHERBOURG, used almost exclusively for the debarkation of troops from England. Facilities were available for two or three cross-channel vessels, at all times.

HONFLEUR, for discharge of Engineer, Chemical Warfare, Ordnance and Q. M. cargo from chartered Swedish vessels.

UPPER COAST GROUP.

BREST, principal port for the direct movement of troops from the U. S. to France. The A. T. S. was assigned a lighterage wharf 760 ft. long and for the first six months of its operation, all troops and cargo were unloaded by lighter. Later, a moderate draft vessel berth was obtained, followed four months later by the assignment of a similar berth.

ST. MALO, coal, with a small quantity of engineering material from England was practically the only cargo handled. Two berths partially equipped assigned to A. T. S.

LORIENT, a few A. E. F. vessels with special cross-channel cargo were unloaded at this port with existing facilities. The tonnage was small.

GRANVILLE, one berth was used for handling cross-channel coal facilities.

LOWER LOIRE GROUP.

ST. NAZAIRE, fourteen berths, crane equipment and warehouses. Locomotives and guns in addition to troops and general cargo were unloaded at this port.

MONTOIR, situated directly opposite the large Montoir storage yard. Work was well along on the construction of an 8-vessel pier to be equipped with 32 five-ton single-track steam gantry cranes at the time of the Armistice, following which it was decided to complete only enough of the pier for three vessels.

DONGES, to have been provided with certain wharf construction suitably located with regard to ammunition storage. Work was abandoned at the time of the Armistice.

UPPER LOIRE GROUP.

NANTES, a total of eight permanently assigned berths in the Nantes territory were usually available. The principal cargo handled was coal, general merchandise, munitions and heavy artillery.

CHARANTE GROUP.

LA PALLICE and LA ROCHELLE, principal ports for handling cargo. The principal cargo handled was car parts, locomotives, lumber, rails, horses, forage, oil and general cargo, with deck loads of auto trucks and tractors from England. Five berths.

ROCHEFORT, coal principal cargo, handled and a small amount of general cargo. Four berths.

TONNAY-CHARANTE, coal port, could handle two or three cross-channel coal vessels.

MARANS, operated as a coal port. Facilities were available for the discharge of at least one vessel at a time.

GIRONDE RIVER GROUP.

BASSENS, used for the handling of both troops and cargo, principal cargo handled being horses, coal, construction material, explosives, subsistence and general cargo. Twenty berths available with crane equipment.

BORDEAUX, a few cross-channel vessels were handled at this port and a considerable number of troops debarked.

SURSOL (Bordeaux), some coal and general cargo was unloaded here. No permanent assignment of berths.

BLAYE, to have been coal port.

FURT, small port on the north bank of the Gironde River, used for unloading coal.

ST. LOUBES, ammunition wharf and storage port, 750 ft. lighterage wharf with sorting sheds and storage yards.

ST. PARDON, no A. E. F. cargo handled.

PAUILLAC, two berths assigned to A. T. S. and used jointly with Navy.

TALMONT, work was never started on this project.

MEDITERRANEAN GROUP.

MARSEILLE, a general cargo port, handling mainly subsistence, clothing, forage, motor vehicles, air craft, machinery, railroad steel, oil, gasoline and a few locomotives. Nine berths.

TOULON, three deep water berths. As these were not in condition to operate by November 11, 1918, project was abandoned.

CETTES, no use was made of this port by the A. E. F.

OPERATED INDEPENDENTLY.

BAYONNE, principal cargo handled was coal, one ship-load of railroad ties from Portugal, and deck loads of tractors and wagons from England. Facilities were available for handling up to four of five cross-channel boats at well equipped existing berths.

LES SABLES D'OLONNE, three berths suitable for light draft cross-channel vessels. Work abandoned following Armistice.

MAJ. GIUSEPPI DE STEFANIS

Italian Member of the Board, October, 1919-October, 1921

INLAND WATER TRANSPORT.

(See Chapter XXVI, Section V.)

ENGINEER OF CONSTRUCTION.

The ramifications of modern warfare made a broad field to be covered in the designing of transportation facilities. In the case of the American Army, the designing had to include storage depots, engine terminals, car shops, hospitals, ammunition storage depots, engine terminals, wharves, piers, railroad classification yards, repair shops, remount depots, forestry operations and passing sidings, station facilities, etc. Plans had been made and approved by this department covering installations for 316 separate projects by the time the Armistice was signed. The principal project designed, constructed and turned out by the Americans in France, was the port of American Bassens.

THE BUSINESS DEPARTMENT.

The personnel assigned to the Business Manager's Department was organized in three sections as follows:

1. A Statistical and Accounting Section, to have jurisdiction over the compilation of statistics regarding operations under the jurisdiction of the Director General of Transportation, as well as the handling of any accounts in connection with these operations.

2. A Requisition and Material Section, to handle all demands for transportation supplies, keep record of the receipt and distribution of supplies ordered for the department in the United States, as well as a record of stock on hand and other details in connection with supplies.

Note: All materials ordered from the United States by requisition and cable for use of the department were handled through the Corps of Engineers and paid for through Engineer appropriations and were consigned to the Chief Engineer, A. E. F.

3. A Contract, Claims and Adjustment Section, to supervise the preparation of contracts, keep record thereof, and handle all matters in connection with any claims arising through the requisitioning of land, damage to property, etc., and to establish a record of the service rendered by the Transportation Department to the French railroads, or materials furnished or services rendered by the French to the American Transportation Department. It was necessary that this department be equipped at all times to furnish statistical data relating to the detailed operations of all branches of the transportation service.

CHAPTER XV.

SECTION I.

D. G. T.—LIGHT RAILWAYS (BRITISH).[1]

(a) DATE OF FORMATION OF DIRECTORATE AND CAUSES WHICH LEAD TO IT.

The Directorate of Light Railways was formed on the 20th of October 1916. (Chart 1, Chapter XVI, Vol. I.)

In September 1915, the first definite policy with regard to 60 cm. lines was laid down by the Quartermaster General. Prior to this, isolate and disconnected systems had been laid down without regard to uniformity of type or weight of rail, these lines being operated by man or animal haulage.

It was then decided, in view of the indications that the front was likely to be stabilized for a considerable period, that broad gauge railheads should be advanced as far as possible, and that tramways for man or animal haulage were to be laid down from the trenches back to the most forward position which road wagons could reach. This practice essentially involved the intermediate use of road transport between broad gauge and trench tramways and only where such transport beyond broad gauge railhead was impracticable was it intended to extend the 60 cm. line back to the broad gauge railhead.

The plan was based on the idea of a French system working backwards, with road transport an integral part in the scheme, connection with broad gauge railhead being rare and entirely accidental, and only considered necessary when the roads would not allow of transport in front of the broad gauge railhead.

A very light rail (9-lb. per yard) was used for the trench tramways.

In February 1916, the increasing difficulty of road repairs forced the question of light railways into the foreground, and a new policy was laid down which sanctioned the construction of 60 cm. "feeder lines" from broad gauge railheads, where the necessity for their connection was clearly demonstrated.

In March 1916, the 60 cm. policy was further considered, and it was decided to provide for additional requirements in 60 cm. lines beyond the points which horsed transport could reach, and a heavier

[1] Prepared for the M. B. A. S. by the Director of Light Railways, B. E. F., through the Quartermaster General, B. E. F. (British Armies in France and Flanders).

rail was to be introduced to allow of mechanical traction being used as expedient.

A limited number of locomotives, box and bogie wagons was ordered for the heavier track.

In August 1916, the Commander in Chief expressed the desire that light railways should be extensively used along the whole British front, in order to eliminate as far as possible the employment of road transport with its heavy wear and tear on vehicles and roads, and also to lessen the manual labor falling on the troops in the line.

This was the clearest enunciation so far of the scope of light railways, and it was laid down that the 60 cm. lines were primarily intended to carry: (1) Heavy gun ammunition. (2) R. E. stores. (3) Light gun ammunition. (4) Supplies and Ordnance stores.

At the end of September 1916, 130 kilometers of track were in operation, and other 60 cm. lines were being operated as purely local concerns, without any definite policy.

In August 1916, the whole question of transportation in France was brought under review by a special commission, and it was decided to inaugurate complete system of light railways and combine the systems already in existence under a definite policy and control, and the Directorate of Light Railways was formed for this purpose.

(*b*) Establishment.

On the earliest establishment the principal officers whom the Director of Light Railways had at General Headquarters (G. H. Q.) were a Deputy Director charged with the supervision of mechanical and operating matters, and Assistant Director responsible for construction, and an Assistant Director for general duties. Later, with the increasing expansion of light railways traffic, a re-arrangement was made in the Headquarters Staff. The Deputy Director became responsible for general duties only, and there were four Assistant Directors at G. H. Q., responsible respectively for mechanical matters, operations, construction and forward areas.

In each army there was an Assistant Director, whose two principal officers were a Superintendent of Light Railways with charge of operation and mechanical matters, and a Light Railways Construction Engineer. Later, the establishment of the Assistant Director in each army area was extended, a Forward Area Officer being added.

A corps Light Railway Officer was attached to each corps, with the duties of liaison between the corps and the A. D. L. R. of the army.

Twenty-four light railways operating companies, 5 trains crew companies, 4 workshops companies and 2 miscellaneous trades com-

panies were raised. Twenty of these companies were raised in England from Imperial troops; 7 were raised in England from Dominion units, and 8 companies were composed of skilled men who were combed out of the other services. Each of these companies provided approximately 250 effective. The 4 workshop companies and the 2 miscellaneous trades companies were permanently stationed at the workshops, and the other companies were distributed as required among the armies. The percentage of personnel under the various employments in an operating company is as follows:

(1) Train crews	34%
(2) Permanent telephone operators and train control staff	16%
(3) Station yard and other traffic duties	12%
(4) Shed duties, repairs and maintenance of rolling stock	23%
(5) Non-effective	15%

Schools and shops.—Early in 1918, a school was established at Savy for giving instruction in mechanical and operating matters.

In August 1918 the school was amalgamated with the foreways school of instruction, and a lieutenant colonel was placed in charge. There were 7 other officers on the establishment, the total establishment of all ranks being 115.

In January 1917, the erection of the central light railways workshops was begun.

The Signal Services were not carried out by light railways personnel, but by personnel attached to the Assistant Director Light Railways from the Director of Army Signals, and controlled by the Director of Army Signals (D. A. S.). This practice proved satisfactory.

(*c*) STAGES OF DEVELOPMENT OF THE DIRECTORATE OF WORKS

The primary and pressing needs which the new Directorate set out to meet were:

(I) To relieve the roads of the enormous amount of extra traffic which was then passing over them. There was, in addition to wear and tear of mechanical transport and heavy consumption of petrol, the resulting wear on the roads, leading to unduly heavy additional demands for road repair material to be carried by the railways. A large amount of labor also was taken up in these roads repairs.

(II) To assist in the rapid advance over a shelltorn area in which the roads are found by experience to become completely obliterated over considerable distances, rendering them impossible for mechanical transport, and little, or no better than the surrounding country for horse transport.

(III) To convey roadstone for the rapid repair of roads in the destroyed zone, so as to render possible the passage of guns, and the

re-establishment of normal road traffic at the earliest possible moment.

At this time, the roads could not deal satisfactorily with all the traffic which was being put upon them, and it was felt that in the future, when transport demands would be still further increased, the difficulty would become even more acute.

It was estimated that when the tonnage of ammunition for the armies reached its maximum, roughly 200,000 tons of traffic per week would have to be delivered beyond broad gauge railheads, quite apart from the tonnage involved in the movement of dumps etc., in advance of broad gauge railheads.

This traffic not being evenly distributed over the whole front, but being directed to the areas in which preparations were being made for extensive fighting, or where intensive fighting was actually taking place, rendered the problem more complex.

During intensive fighting, 2,000 tons per day was the figure calculated per mile of front. Later the figure of 2,000 tons was taken as the requirement per corps per day.

It was on December 23rd, 1916, that responsibility for the construction and operation of light railways was actually assumed by the new Directorate. 96 miles of light railways were then being operated and 7,500 tons were being carried per week. The chief difficulties which had to be surmounted in the early days of light railways were:

(*a*) A new organization had to be set up in each army area to carry out a highly technical service, and the possibilities and limitations of light railways were not generally understood.

(*b*) Insufficient track material was available in France, and the material ordered from England, came forward slowly, and was not available in any quantities until March.

(*c*) Construction troops were ear-marked and were under provision, but unskilled labor had meanwhile to be procured for construction work.

(*d*) The necessary skilled personnel required for mechanical and operating work could only be obtained by combing out large numbers of men from the armies, and this process was slow.

(*e*) 60 cm. lines for efficient working require to be well ballasted. Only small quantities of ballast were obtainable locally, and the transportation of large quantities of ballast over broad gauge railways could not be undertaken.

(*f*) Considerable difficulty was met in minor matters, such as the setting up of the telephone communications.

(*g*) The weather in the early part of 1917 only allowed of construction being carried out with great difficulty. For a considerable

period all the labor available had to be devoted to the upkeep of existing lines, which were taken over in bad condition.

The history of the British light railways in France has generally been shaped by the course of military operations.

In the early part of 1917, it was desired to develop the railway systems generally in the Somme area more rapidly than any other. In the area then occupied by the Fifth British Army particularly, the railway developments both of broad gauge and light railways were very meagre. The task of improving the existing 60 cm. lines, which were in exceedingly bad condition, proved very considerable. Labor was very difficult to arrange, and the supply of ballast uncertain. A long spell of frost, which began at the beginning of February and continued for about five weeks, practically brought all construction work to a standstill.

At the end of February, on the enemy withdrawal on this part of the front, the railway policy laid down was to push forward broad gauge railways as far as possible, and the scheme which had been prepared for using light railways as distributing lines along the whole front was abandoned, certain main 60 cm. lines only being pushed forward. The enemy retirement proved to be so extensive that 60 cm. lines became reduced in utility, and as at this time the pending operations made the Arras district a priority front, stock and power were moved northwards by broad gauge railway.

When the offensive took place at Arras, on 9th April 1917, light railways had only begun to operate in that area, and nothing like a fully completed system had been developed. Arrangements had not been made for gun positions, to be served direct by light railways. However, a considerable traffic from broad gauge railheads was delivered at light railway railheads to road transport, thus easing the strain on the latter.

The period between the Arras offensive at the beginning of April and the attack on the Messines Ridge on June 7, 1917, saw a considerable development of the light railways system. By this time, it was found definitely necessary to lay out the light railways scheme in such a way as to give alternative routes, preferably having two main lines forward per corps, these twin forward main lines being joined by laterals, one approximately 3,000 yards from the front, one 4,000 to 5,000 yards for medium artillery, and the back lateral for the heaviest types of artillery between 5,000 and 6,000 yards. Thus, in case of traffic interruptions through shell fire or other causes, the points could be reached by alternative routes, and in normal times circulating traffic was obtained. In addition, it was found advisable for each corps to have a line running to a main dump a mile or two miles from the railhead.

On this policy, from April until October, an average of 110 miles per month were laid.

About September it became obvious that lateral communications by 60 cm. between armies was essential not only to facilitate the movement but with a view to the development of lateral traffic generally, one of the main points contemplated being the rapid movement of guns on specially constructed trucks from their positions in one army to their positions at their new destination, thus saving transshipment and a large amount of unnecessary broad gauge haulage.

The forward lateral running at a minimum distance of 6,000 yards from the front was completed about the middle of March, but by this time a defensive policy had been decided upon, and the work was started on a lateral 12,000 yards from the front line, to replace the forward lateral in case of a retirement in any part of the front. Further, lines running back from this back lateral were constructed with a view:

(*a*) to tapping army reserve dumps and railheads.

(*b*) providing an outlet for power and rolling stock in the event of a withdrawal to considerable depth.

This latter phase was never finished in its entirety as the operations in March 1918, altered the whole method of warfare, and from this time on, with the gradual cessation of trench warfare the scope of light railways became materially changed.

In addition to the work done in army areas for the fighting troops, a number of small light railway systems were constructed and operated on the Lines of Communication, principally for the exploitation of forests.

The policy of light railways generally was based on the stabilized front. It was not found desirable to attempt to push broad gauge railheads nearer the front than 7 miles, and the average distance behind the front lines of these railheads may be put at about 10 miles. Light railways were definitely regarded as a means of transport from the lines beyond which broad gauge cannot normally and regularly pass. The early policy laid down was that, in the event of a small advance, the light railways system would be deepened by approximately the depth of the advance. If the advance were strictly limited, broad gauge railhead might not be advanced, but in the event of successive advances, the broad gauge railhead would be moved forward to a position relative to the front, similar to that occupied before the advance. It was considered, in view of the difficulty of constructing suitable broad gauge railheads, that the light railway system should be allowed to grow considerably in depth before the broad gauge railhead was advanced.

A separate policy was, however, laid down later for a considerable advance and it was definitely decided that broad gauge railways

were to be the means of supplying the armies in such a case, light railways as feeders to the armies dropping out with an advance of great depth.

Although light railways work approximately to the trench tramway "base line" the trench tramway systems formed no part whatever of the light railways scheme. Trench tramways were run under divisional and corps arrangements, and the early policy laid down was that there should be no physical connection with light railways. Physical connections were considered inadvisable for a variety of reasons. A lighter rail was in general use by trench tramways, which was incapable of carrying standard light railway stock. Traffic regulations on trench tramways could not be guaranteed, and there was a possibility of loss of, or damage to, light railway stock taken on to trench tramways. The normal circulation of light railway stock would have been seriously interfered with, and traffic control would have been made more complex.

The disadvantages of refusing physical connection with trench tramways were soon realized. The points of transshipment were, in some cases, under observation, and the establishment of transshipment points presented great difficulties. With the development of light railways and trench tramways, these disadvantages assumed greater cogency, and the original policy of "no physical connection" was abandoned.

In considering the relation between light railways and trench tramways, or other means of transportation in the extreme forward area, it must be borne in mind that light railways were organized in army systems under the control of G. H. Q., whereas trench tramways were domestic systems. Cumulative experience in the Spring and Summer of 1917 showed very clearly that, detailed distribution along battery spurs, etc., in the forward area, should be considered as a separate link in the chain of transportation. As these spurs were of varying lengths and were of a purely temporary nature, they could not be considered part of the railway development proper. It became increasingly apparent that the links in the chain of transportation should be:

1. Broad gauge transshipment to light railways.

2. Light railways transshipment to group stations to serve heavy siege battery groups and the bulk delivery points for transshipment or transfer to tramways. It may be emphasized that group stations and bulk delivery points are not dumps.

3. Delivery to final destination by the various means of transportation available in front of light railways. The number of short distribution spurs enormously complicated light railway operation and interfered with the flow of bulk traffic. Light railways power and stock is more visible and vulnerable than push

trollies. The use of group stations obviates the ballasting of short spurs to take bogie stock, and when it is realized that approximately 800 tons of ballast are required per mile, it will be seen how much capacity was taken off main lines, thereby reducing the ammunition capacity generally at the most critical time.

Towards the end of 1917, the relation between light railways and trench tramways became closer. Large numbers of small, one-ton, four-wheeled box wagons were ordered for trench tramways and a considerable number of low powered tractors were placed at the disposal of tramways by the Director of Light Railways. The principle of physical connection was extended, and arrangements were made by "Light Railways" to issue to "Tramways" a certain amount of 20-lb steel for the construction of main tramways, which would allow in some cases of the main tramway lines being eventually absorbed by "Light Railways" and put into condition to carry bogie stock without being relaid, especially in case of an advance.

In November 1917, a "Forward Transportation" scheme was adopted. An Assistant to the Engineer in Chief was placed in control, and he was charged with taking bulk deliveries from light-railways and ensuring detailed delivery. The means of transportation which this officer was to use were petrol tractors, push trollies, ropeways, and monorails.

The scheme was to be worked by divisions and corps under the guidance of the Assistant Engineer in Chief (Foreways), G. H. Q. The point at which bulk delivery was effected on any line was variously conditioned. Foreways and light railways were overlapped so that bulk delivery points could be readily moved as the tactical situation permitted. Arrangements were made by the Engineer in Chief for the provisions of work-shops, etc., for light repairs but heavy repairs to tractors were to be undertaken by the Director of Light Railways.

This "Forward Transportation" scheme had only begun to work when it was forced into abeyance by the German advance in March, and in August 1918, light railways and foreways were amalgamated. The following policy was now adopted:

(*a*) Light railways proper were to be run as hitherto under technical control of G. H. Q.

(*b*) The forward working was to be decentralized and made domestic to the fighting troops.

The general principle laid down was that light railways operating companies were to work the traffic as far as the limits of effective traffic control, and that foreways companies were to take on from this point. An A. D. L. R. (Foreways) was appointed to supervise forward area working from G. H. Q.

It early became apparent that for the smooth working of the various means of transportation in advance of broad gauge railheads, the closest possible liaison should be maintained between the controllers of power operated lines and the controllers of push lines, etc., and it is considered that the "Forward Transportation" scheme would, in full working order, have gone far to solve the problems which arose in connection with the coordination of light railways proper and the various transportation expedients used in advance of light railways.

NOTES ON "FORWARD TRANSPORTATION."[2]

There can be no doubt that ropeways would have rendered service of the utmost value. Their lightness, mobility and practical invisibility from the air, together with the rapidity with which they can be erected—are invaluable for forward area work. They might be of great utility in other than stationary warfare, particularly in mountainous country.

Signal personnel, both for construction and operation, form part of a light railway establishment. It is possible that in future wars, the Signal Service will be a separate unit or corps. If this be so, supplies, spares, etc., could be drawn from stores of such service in the field.

It is suggested that in the future a heavier section rail be adopted, say 30-lbs. per yard rolled to section.

This section is a slight modification of the B. S. S., but it is not anticipated any difficulty would arise in regard thereto, but if this anticipation proves incorrect, the B. S. S. could be adhered to.

The adoption of this heavier section would greatly reduce the maintenance and necessity for a great quantity of ballast without increase in cost of actual track laying, and traffic could be carried over the track sooner than is possible with the present lighter section, without crippling the rails.

The actual initial cost of rails will be more than the 20-lbs. section, the heavier section can be produced and sold at a less cost per ton, but of course the weight required per mile would be increased from about 31 tons to 47 tons, but such additional cost would soon be compensated for by the advantages detailed above.

It also considered that some simple form of chair or clip and key instead of dogspiking the rails, would be of advantage, the sleepers could be prepared in an assembling depot and taken out ready to receive the rails. It is believed that time would be saved in laying as it is easier for unskilled or skilled labor to drive a key than to properly dogspike rails. The wastage in dogspikes is very great and this would be obviated.

[2] By Lieut.-Col. F. Newell, British Army.

There is considerable scope for improvement in traction power units, and it is suggested that consideration be given to the development of loco-tractors consuming heavy fuel oil, and petrol electric tractors of suitable design and power.

The question of gauge is a controversial one, but it is believed that in the future a 2′-6″ gauge could, with advantage, be adopted instead of the present gauge of 1′-11″, which it is understood was decided upon because the Germans were using this gauge and it was considered advisable to adopt the same in case of an advance with a view to coupling up to enemy lines. This argument applies to both sides, as was evident in March 1918 and subsequent months, and in any case the transformation from one gauge to another is not a long process, the main portion of the work being the formation and ballasting. The advantages of the wider gauge are, briefly, at least 50% increase in axle load, increased haulage power and speed, greater stability, less maintenance.

It is of course pure speculation to try to visualize conditions pertaining to a future war, but it is extremely improbable that British troops will be able to land on the shores of an allied great power and find railway facilities such as existed on the western front during the War of 1914–1918. It is more probable that operations will be carried on after the landing of troops on a coast devoid of railways, or through a country lacking these essentials to successful military operations on a large scale. It would appear, therefore, that light railways would prove of great advantage, both strategically and tactically, and for that reason it is suggested that the nucleus of a light railway unit consisting of construction, operating, signal and repair personnel, be formed and trained with suitable power and rolling stock, and so made available for future operations. With a nucleus so trained, considerable expansion would be possible in a short period of time.

More use should be made of light railways for transport of heavy artillery. During the last war, this has been almost entirely confined to 6″ and 8″ howitzers, but 7.5 naval guns have been carried from one position to another, two or three miles apart, over country inaccessible to road transport, and the guns were firing in a few hours after leaving the original emplacement. There seems to be no reason why heavier pieces should not be so handled and in view of the fact that the lighter weapons, as now known, are being displaced by "Infantry Artillery" such as: T. M. B. and Stokes Guns, it would appear that mobility of heavies will prove an important factor in future operations in which they are employed.

The question of carriage of aeroplanes and movement of observation balloons is also worth consideration, the latter with special regard to moving to advance positions for night observation.

Bridging timber is always an important factor in all temporary railway construction and, during the latter operations of the recent war, some difficulty was experienced in obtaining logs of suitable size. Such difficulty and much expense would have been obviated if reinforced concrete structures had been used. A small stock of bearers, trestles, etc., could be moulded and retained at home and when required transferred to the scene of operations, being supplemented as required by others manufactured at some convenient depot near the scene. The material for such construction, with the exception of cement and re-inforcing material, is to be found in most countries, and cement and re-inforcing material has and will form an item of stores for service of the magnitude in which light railways could be economically employed.

CONSTRUCTION.

The amount of track ordered for light railways was based mainly on French practice. The front was divided into two portions:

(*a*) Where intensive fighting was likely to take place, and this was calculated to be 62 kilometers in length.

(*b*) Where operations were normal, i. e., the remaining 83 kilometers of the British front.

Provision was made for the intensive front at the rate of 10 kilometers of track per kilometer of front, and for the normal front at half this rate.

This involved 650 miles of track, and with an allowance of 25% for contingencies and the setting aside of 200 miles as a strategic reserve, 1,000 miles were required, and this quantity was ordered. Increasing demands for facilities and greater depth, together with development of lateral lines made it necessary to increase the material ordered.

The rail for light railway use weighs 20-lbs per yard, most of the rails being supplied in 5-metre lengths, a limited number being of 2½ and 7½ metres in length. The French track of a similar weight is rivetted on to steel sleepers, but the English track is supplied loose and the rails are clipped on to steel sleepers before the track is laid. The rails are capable of being used with either steel sleepers or being spiked down to wooden sleepers like the broad gauge track.

No definite figures can be laid down for the rate of construction, but as a general rule, provided no unusual difficulties in the way of earthworks or bridging had to be overcome, 2,000 man-days was found to be a sound estimate for laying and ballasting one mile of track; a quarter of the labor being skilled construction troops and the remainder unskilled.

The sharp curves which can be operated generally make heavy earthworks unnecessary, and rather than undertake big earthworks, considerable deviations are made.

On an intensive front the number of breaks in the line from shell fire may be very great, and it is necessary to provide as many alternative routes as possible. The greatest care has to be taken of course that the result is not too complicated as a system, for this means difficulties for a locomotive or tractor driver. It is found in practice that the maximum number of alternative routes, with the minimum amount of track on ground, is provided by laying each light railway system in a series of "balloons."

Maintenance, especially on intensive fronts, is always a heavy item, and in forward areas sometimes required 15 to 20 men per mile.

MECHANICAL.

The amount of rolling stock ordered for light railways was based previously on the French practice. The increase in traffic density, however, made it necessary to add to the equipment, which may be taken on an average over all the systems, as 5.5 wagons and the equivalent in tractive power of 1.2 of the larger locomotives.

Rolling Stock Repairs.—The French Army authorities would appear to have decided on the principle of having one repair shop in each army, and one more completely equipped workshop for each group of armies, of which normally they had three. The principle which the British authorities adopted was one central workshop, and from experience it is thought that this is the preferable principle. The main objection to one central workshop is that all rolling stock for repairs must perforce be brought back on standard gauge wagons, unless inter-army lateral lines are constructed and a feeder line put in from the workshops to the lateral. In the case of the British light railway system, no feeder line was constructed and all rolling stock was brought back from, and returned to, armies on standard gauge.

The site of the central workshop was selected in December 1916 and the first bargeload of building material was delivered in the following month. Machinery commenced to arrive in February and a limited amount of repair work was being performed in March. In the same month of the following year, the works were in danger of occupation by the enemy and in April, 1918, they were dismantled and the rolling stock and machinery evacuated.

After a lapse of some months the workshops were re-erected at Beaurainville. The works were practically completed in August, and in the following month, at which time the British armies were advancing rapidly, it was found necessary to withdraw the greater

part of the light railway construction and operating personnel in armies for use with the standard gauge. This automatically resulted in a temporary reduction of light railway usefulness and the workshops were placed under the Chief Mechanical Engineer, to be used to the advantage of all Directorates.

In addition to the central workshops, a repair shop was carried on a permanently fitted broad gauge train. Later, another train was added, and these trains were allotted as necessary to an army for a period to undertake heavy repairs to tractors.

A repair train on 60 cm. stock was allotted permanently to each army.

These repair trains proved of great value and they obviated to a large extent the necessity of sending light railway stock by broad gauge to workshops.

OPERATION.

The following table briefly outlines the development of light railways:—

	Tons.
The average tonnage weekly during 1917 was	121,000
The average weekly tonnage January to March 1918 was	189,000
During July 1917, 137,000 tons per week were carried.	
The average weekly tonnage during March to September 1918 was	130,000
The total rolling stock (actual wagons) in January 1917 was	1,068
The total rolling stock (actual wagons) in January 1918 was	5,170
The total power (locos) in January 1917 was	76
The total power (tractors) January 1917 was	44
The total power (locos) January 1918 was	492
The total power (tractors) January 1918 was	419
	Miles.
The route mileage in operation January 1917 was	102
The route mileage in operation January 1918 was	794
The route mileage in operation March 1918 was	920
The route mileage in operation Sept. 1918 was	820

A continuous increase of traffic occurred in 1917, reaching its maximum for that year in September. Traffic fell off in the winter months, gradually increasing again up to a culminating point in March 1918, when 262,000 tons were carried during the week just prior to the launching of the German offensive. After that time both tonnage and route miles dropped rapidly off, gradually increasing once more, when the military situation stabilized, till the end of August 1918 when the Allied offensive carried the armies beyond the light railways systems. By the end of November the tonnage had dropped to 46,000 tons, just prior to starting on salvage operations on a rather more extensive scale.

In the early days of light railway working, the British control system was based on the French practice.

A light railway operating company worked a given length of line, from 20 to 30 miles, and a "box to box" system of passing trains was then in force. Orders for traffic from corps and others were received direct and inter-working with adjoining systems and central control by the A. D. L. R. were not very clearly defined. This soon led to the adoption of the central control system.

In each army a central control was established, whose duties were to coordinate the traffic requirements of the various corps, and to see that sufficient rolling stock was available in each district. District controls were established and they were concerned with the actual movement of traffic.

Boards in the central control office showed the position of all power and wagon stock in the army, and boards in the district control offices set out the movement of each train diagrammatically, and at any moment the position of each wagon in any army was known exactly.

As traffic developed in intensity it was found necessary to decentralize, rather more than before, the functions of the district control, and to provide separate telephone circuits for train movement and traffic control. With the increasing traffic, the demands on the signal facilities increased, and eventually a separate signal maintenance section was allotted to each operating company.

The Central Traffic Controller received demands for truckage from the various corps Light Railway Officers. It was his duty, before passing orders to district controls, to satisfy himself that they were in a position to deal with the traffic offered. The central control readjusted the transfer of empties between districts as necessary.

District controls were concerned with train ordering and wagon distribution in their own area, appealing to central control when necessary.

Stations reported to district control at stated intervals the number of wagons on hand, and district control maintained a wagon register in which this information was summarized and transmitted to the Central Traffic Controller.

Train and shunting engine "journals" were maintained in the district control and also traffic records, these being passed daily to the Central Traffic Controller who compiled the statistics for Army traffic each week.

In forward areas where no telephones could be maintained, traffic was placed under the orders of one man, either an officer or a non-commissioned officer, and all operations were directed by him according to circumstances.

The closest watch was kept on demurrage, which started 4 hours after unloading should have begun.

The close control obtained by these methods enabled the turn around of stock to be brought down from one and a half days to two thirds of a day, thereby doubling the carrying capacity, or equivalent to an increase of over 100,000 tons per week. The work got out of power units was increased 200%, and of wagon stock 100%, between November 1917 and August 1918.

Traffic was almost entirely self-contained within the boundaries of each army; but, with the provision of an inter-army lateral in the early part of 1918, G. H. Q. traffic control, to deal with lateral inter-army traffic, was installed over the army self-contained traffic controls. This super-control worked through the central control of armies.[3]

DELAYS.

The principal, and almost inevitable, cause of delay in traffic is connected with the inter-working of light railways with broad gauge. Congestion takes place owing to all units requiring light railway wagons on which to off-load material from the broad gauge at the same time. The alternative would be to dump the material off the broad gauge, but this, even if possible, is not desirable at railheads, though it was the practice with the French, and is fundamentally sounder, from the point of view of the fighting troops, as the work can be done to time-table.

Delay is also caused by the uncertain times of arrival of broad gauge trains. Light railway wagons placed in position occasionally remain idle if the broad gauge train is behind time.

Other causes of delay are wagons being kept under load waiting off-loading parties. Breaks in the tracks and damage to telephone systems by shell-fire and bombing are very frequent on intensive fronts, and even on quiet fronts are constantly disorganizing traffic working, especially in the more forward areas. In many cases damage was done to the line by the passage of tanks and motor transport at other than authorized crossing places, and the use of light railway track by troops as a pathway causes enormous damage to the formation and renders maintenance heavy.

LOADING AND UNLOADING.

The best method of expediting loading and off-loading has been found to be by means of military instructions given on the matter by armies to corps and other users of the light railways. The object has been to ensure that the requirements of the corps should be spread as even as possible over the 24 hours of the day and over

[3] See Chart 2, Chapter XVI, Vol. I.

the seven days of the week. Units are asked to accept times for traffic offered by the corps Light Railway Officer, who is aware when wagons are available. This enables arrangements as to loading and off-loading to be made accordingly. If a wagon is not off-loaded within four hours after being placed, it comes under demurrage, is reported, and the reasons investigated.

TRAINING SCHOOL.

A school of instruction in traffic working was established at Savy, early in 1918. It moved later to Beaurainville, and was reestablished at Savy again in September 1918. Instruction was given in all branches of light railway working, and a model control system was installed for the purpose.

It was early found difficult to ensure an adequate number of skilled operators for all types of work, and the training school was of great assistance in maintaining the standard of efficiency, more particularly in the operating personnel.

CHAPTER XV.

SECTION II.

ORGANIZATION OF THE 60 CM. RAILWAY SERVICE IN THE FRENCH ARMY.

PART 1.

GENERAL PRINCIPLES.

The function of the 60 cm. Railway Service is to transport matériel and supplies in the advance zone, conjointly with motor and animal transportation.

The 60 cm. Railway Service was organized as an army service, and operated under the orders of the army commander in the same manner as the Motor Transport Service (Chart 5, Chapter XVI. Vol. I).

As the 60 cm. Railway Service is a technical service, its technical organization and functions were determined, for the entire Army, by the Commander in Chief (D. A.—Bureau de la Voie de 60 cm.).

COMPOSITION OF THE 60 CM. RAILWAY SERVICE UNITS.

In October 1918, the 60 cm. Railway Service consisted of 93 units, divided as follows: 36 construction batteries, of 250 men each; 47 maintenance batteries, of 171 men each; 8 repair batteries, of 310 men each and, in addition, 2 depot batteries, with a varying personnel. A total of 20,000 men at the disposal of the armies.

All the batteries were, as far as command and discipline are concerned, under the orders of a colonel located at General Headquarters. The batteries were divided into "groups" of varying strength, and one group or more could be assigned to an army. Each group was placed under the orders of a "Chief of railway system" or unit (Chef de Réseau) who had authority to command, as well as technical direction.

TECHNICAL SERVICE.

At General Headquarters, the technical service was centralized at the Office of the 60 cm. Railways, which was attached to the "Direction of the Rear" (D. A.). It was composed of: 1 officer, who

was chief of the service, 3 other officers (assistant chiefs) and a clerical force.

In each army, the service was directed by a "Chief of the army system" (Chef de Réseau), assisted by two or three officers, acting as assistant chiefs, and a clerical force. This "Chief of the system" belonged to the 4th Section of army headquarters (4ème Bureau de l'Etat-Major de l'Armée), from which he received all instructions pertaining to the construction and improvement of 60 cm. railway lines.

When the construction of a light railway line was requested by an army, the "Chief of the system" was charged with making a study of the project and submitting same, together with the necessary sketches, for the approval of G. H. Q. (60 cm. Railway Service). When the plan was approved, the "Chief of the system" directed the execution thereof with his own personnel, augmented by details placed at his disposal by the army concerned. According to the importance of the work to be done, the number of construction batteries assigned to that army was increased or reduced.

Transportation was regulated by the "4th Section," which kept the "Chief of the system" informed daily as to the nature and number of the transportation requests ordered for the following day, and taking into account the distribution of transportation tonnage between the 60 cm. railways and the Motor Transport Service. Theoretically, the transport of munitions devolved upon the 60 cm. Railway Service. The "4th Section" indicated loading points, places of delivery and secured the necessary operating personnel.

With this information, the "Chief of the system" determined the train schedules for the following day and transmitted his orders to the commanding officers of the batteries (units) concerned.

In principle, the 60 cm. Railway Service only concerned itself with transportation by means of mechanical traction. If a light railway system or line was prolonged towards the front by animal traction, the operation of these advanced lines was assured by the army or division in that area.

The necessary rolling stock and track material for each line, as well as the personnel, were furnished by G. H. Q., upon the request of the "Chief of the system." These requests were subsequently modified according to actual needs. The Office of the 60 cm. Railways at G. H. Q., apportioned the personnel as well as the material.

RECRUITING OF OFFICERS.

Most of the officers assigned to the 60 cm. Railway Service belonged to the Artillery (Reserve and Territorial) and were not prepared by former occupations for this special service.

An "instruction center" was created during the war for the training of construction and maintenance officers for the 60 cm. Railway Service. This school functioned first at Boissy-St. Léger, then at Jouy-en-Josas and, later, at Epinal. The courses of instruction varied from two to six months and student-officers received theoretical as well as practical training, which enabled them, afterwards, to carry out their duties in the batteries (units).

RECRUITING OF SPECIALISTS.

Most of the mechanics, firemen, and locomotive engineers received special training to prepare them for service with the 60 cm. Railways. Schools were therefore established for the instruction of the men who had been selected from the batteries for that purpose.

UPKEEP AND REPAIR OF THE MATÉRIEL.

Owing to the duration of the war, the matériel suffered great deterioration and it became necessary to organize repair establishments.

Normally, each army maintained a repair shop and, in addition thereto, there existed three central shops which corresponded to the "group of armies."

The repair service was composed of:

Administrative personnel, designated as "Sub-Inspectorate of matériel" (Sous-Inspection du matériel), which supervised the work in the repair shops and batteries (units); controlled the supply of stores and spare parts and the purchase of matériel.

Working personnel, consisting of repair batteries or units. One repair battery was assigned to each workshop.

SCHEME OF ORGANIZATION OF A 60 CM. RAILWAY SYSTEM (RÉSEAU).

A 60 cm. railway system (réseau) consisted essentially of a main or base line, which was connected with one or more standard gauge lines and, from these points of contact, branch lines extended towards the front. The contact points with the standard gauge lines corresponded to the locations of transshipping stations, in the neighborhood of which were located large depots for munitions, engineer supplies, macadam, etc. Each of these depots was served by a spur of the main line and a grid of 60 cm. lines.

An operating battery was located near each transshipping station, as these stations were the points of departure for all traffic upon the 60 cm. railway systems.

A section of line, from 20 to 25 kilometres in length, was generally assigned to a maintenance battery. The battery was responsible for:

The ordinary upkeep of the line. (On an average two men were assigned to each kilometre of line for this purpose.)

The operation of the line, including stations, posts, switches, telephone installations.

The traction service: Locomotives and loco-tractors.

The upkeep of and minor repairs to the rolling stock by means of the battery and depot workshops.

In general, the personnel strength of the maintenance batteries (171 men), was found to be insufficient for these purposes and had to be supplemented by means of detachments from the construction batteries. In fact, the personnel of a battery should be determined according to the number of engines and, allowing 12 men per engine, a "battery" which looked after 20 engines and to which 25 kilometres of line had been assigned, would therefore require 240 men.

Throughout the war, the policy was followed of keeping the maintenance batteries separate from the construction batteries. The construction batteries specialized in grading and track laying work and supervised the auxiliary labor furnished by the armies. Certain officers have stated that in their opinion the adoption of a single type of battery, which would carry out both construction and maintenance work, appeared advisable, however, specialization seems preferable and leads to a better utilization of the personnel.

NOTE.—See Chart 9, Chapter XVI, Vol. I.

Part 2.

Operation of the 60 cm. railway service (French).[1]

I. THE 60 CM. RAILWAYS IN POSITION WARFARE.

Before the war, Germany had planned to use 60 cm. railways for the supply of the armies in the field. For this purpose Germany had assembled light railway material and rolling stock, and had organized special units for the construction and operation of narrow gauge lines.

In France, stocks of light railway material existed in various military establishments, but the use thereof was only foreseen in the defense or attack of fortresses.

Previous to the stabilization of the front, which followed the battles of October and November 1914, 60 cm. railways were not used. With the advent of winter, on account of the bad weather and due to the enemy's artillery fire, the roads began to deteriorate rapidly and soon became impassable, and this at a time when it was of prime importance to supply the troops in the front lines, not only with food and ammunition, but also with the materials which were indispensable for strengthening their positions (barbed wire defenses, etc.).

Short sections of 60 cm. railways were then employed to connect the roads with the places where such materials were to be used. At that time, however, it was merely a question of small cars propelled by man power. It was only at a later date that narrow gauge lines were constructed, between the front and certain standard gauge railway stations, which were capable of bearing the weight of locomotives (lines extending from Les Islettes, Suippes, Vienne-la-Ville).

These isolated feeders (antennes) were of small capacity and lacked flexibility, but it should be remembered that these lines had not been constructed to handle heavy traffic and were simply intended to remedy the insufficiency of roadways.

Military operations during the winter of 1914 and the early part of 1915, demonstrated the need for long and intensive artillery preparations to open a passage for the infantry. These preparations involved a considerable consumption of ammunition which, in turn, necessitated intensive transports between the standard gauge railway

[1] Prepared for the M. B. A. S. by the French Section of the Board.

stations and the batteries. (Thus, on a front of attack of 20 kilometers, the daily consumption of ammunition during an artillery preparation was estimated at 18,000 tons.)

This tonnage was far in excess of that which could be transported by motor trucks or by animal drawn transportation. The French then had recourse to 60 cm. railways with mechanical traction and, instead of isolated lines, regular light railway systems were constructed which were capable of handling heavy traffic and which were very flexible in their organization. In connection with the above it is interesting to note that for the attack of September 25, 1915, in the Champagne, a 350-kilometer 60 cm. railway system was built.

The results obtained were so satisfactory that the use of 60 cm. railways became general.

Thereafter, for each operation, whether offensive or defensive (Somme, Flanders, Verdun, Argonne, Chemin-des-Dames), extensive light railway systems were constructed, so that at the end of hostilities the greater part of the front was equipped with 60 cm. railways.

These numerous constructions made it possible to establish a set of regulations which were followed by the French Army in the organization of 60 cm. railway systems in stabilized zones. Extracts from these regulations follow.

All materials, munitions and food supplies required by the armies are brought up from depots which are located in the interior, or from the regulating stations, by standard gauge railway. In order to avoid being at the mercy of a tie-up—or even of a lessening in standard gauge traffic—it is necessary to establish dumps, containing different kinds of materials, within the armies and in close proximity to the standard gauge stations. These dumps ("stockages" and "dépôts") are served by 60 cm. railways which connect them, on one hand, with the standard gauge stations and, on the other, with the front line troops and establishments. The whole (ensemble) of the lines so constructed forms the army 60 cm. railway system.

Theoretically, an army system therefore consists of feeding lines (lignes de pénétration), running from the standard gauge railheads toward the front and serving the depots of heavy artillery, field artillery and trench artillery ammunition; the engineer parks; the advanced depots of engineer material and the batteries. These feeders are generally connected by two shuttle lines (lignes de rocade), one running at a short distance from the main standard gauge line and connecting the light railway operating batteries or units, while the other is an advanced shuttle line.

In addition, each army system comprises a narrow gauge line running toward the rear and terminating by facilities for rapid loading upon standard gauge railway cars or trucks (and, if possible, upon

boats also), so that, in case of necessity, light railway rolling stock can be withdrawn and transported toward other parts of the front. A repair shop is established at the end of this "recoil line" (ligne de repli) and equipped with motive power and machine-tools for the repair of the rolling stock of the light railway system (réseau).

The general plan of an army light railway system, as described above, is shown in Chart 6, Chapter XVI, Volume I (Diagram I).

It should be noted that in a light railway system, the whole (ensemble) of the feeder lines (lignes de pénétration) and the two shuttle lines (lignes de rocade) form circuits over which traffic can attain a large degree of expansion. These circuits are in all cases superior to the needs of the army. However, between the advanced shuttle line (rocade) and the front, it is admitted that each feeder (antenne) cannot discharge more than 800 tons every twenty-four hours. If, on account of a very close grouping of batteries or of large demands for engineer material, the traffic at the end of a certain feeder should exceed 800 tons, a second feeder (antenne) should be built, extending from the advanced shuttle line, or the feeder concerned should be doubled. However, in zones close to the front, the last mentioned procedure is not deemed advisable, because of the difficulty of hiding a double-track road-bed from enemy observation.

The tentative plan of different lines is shown by lines offering the shortest routes for serving the whole (ensemble) of the various emplacements. The actual plan may differ slightly from the above owing to slopes, curves, etc., to which the 60 cm. lines must conform.

DETAILED ORGANIZATION OF A FEEDER LINE (ANTENNE DE PÉNÉTRATION).

(Chart 6, Chapter XVI, Vol. I.)

In general a feeder line comprises:—

At the standard gauge railhead (gare de ravitaillement): Spurs or junctions connecting it with the following dumps or depots: Heavy artillery, field artillery, and trench mortar ammunition, engineer material, macadam, salvage material and 60 cm. trackage.

In close proximity to the railhead: A gridiron-track for the formation of trains and a round-house, with a small repair shop attached.

In advance of the railhead: Connections with heavy artillery ammunition dumps, intermediate depots for field artillery and trench mortar matériel, intermediate engineer parks, macadam dumps.

In the advanced zone: Stations for the delivery of heavy artillery ammunition to the firing batteries and connections with the advanced engineer material depots.

All along the line: Sidings for switching trains and, before arriving in the zone exposed to enemy observation, a station called

"changing station" (gare d'échange) where gasoline tractors are substituted for the steam locomotives.

A special telephone system connects all important points of the feeder line (stations, sidings, dumps, etc.).

Although it is impossible, on account of local conditions such as formation of the terrain, proximity to the enemy, etc., to determine in advance the precise plan of each of the above mentioned junctions, the description of certain installations which have given good results during periods of intensive movement are given below.

Railhead.—At the railhead, special tracks are provided for unloading heavy artillery, field artillery, and trench mortar ammunition, engineer material, macadam and food supplies. To avoid the immobilization of either standard or 60 cm. gauge rolling stock, direct transshipments from car to car are, in principle, deemed inadvisable. However, whenever the 60 cm. Service has a sufficient number of empty cars at its disposal, there should be no hesitation in carrying out direct transshipments.

The independence of the two systems of transportation (standard gauge and 60 cm. gauge) can be obtained by constructing a dirt platform between blind spurs (culs-de-sacs) of the standard gauge and 60 cm. gauge railways, upon which materials to be transported toward the front can be unloaded and stored.

This connecting arrangement between the 60 cm. and standard gauge lines can also be applied to the various standard gauge blind spurs (culs-de-sacs) at the railheads.

For the rapid unloading of 60 cm. rolling stock and artillery matériel mounted on railway gun carriages (affûts-trucs), one of the blind spurs at the railhead, that assigned to the 60 cm. railway, should have a platform (quai en bout) at one end.

Heavy Artillery Depot.—The heavy artillery ammunition depots should include very complete 60 cm. railway installations so as to permit simultaneously: (1) The unloading of ammunition trains coming from the standard gauge railheads. (2) The loading of ammunition trains for the supply of field batteries.

Intermediate Depots for Field Artillery and Trench Mortar Ammunition, Engineer material and Macadam.—In most cases a railway grid with three branch lines will suffice to serve these establishments.

For the macadam depots, the blind spurs for unloading the cars should be parallel to the road, and at a sufficient distance therefrom to permit widening the road and storing a stock of macadam between the widened roadway and the unloading track.

Station for the delivery of ammunition to the batteries.—The best procedure, in so far as the receiving parties are concerned, would be to establish a 60 cm. railway spur for each battery, as is done in the

case of batteries of 270 mm. calibre or over, thus making it possible to bring the ammunition right up to the battery itself. However, this solution cannot be carried out readily, on account of the shortage of traction matériel and rolling stock and because of the exaggerated expansion in the use of mechanical traction which would result therefrom.

It is therefore necessary to organize delivery stations so that these will serve a certain number of batteries. The batteries are connected with the delivery station by 40 cm. railway.

To avoid the immobilization of 60 cm. railway cars, each delivery station has a corduroy platform upon which munitions are unloaded immediately after the arrival of the 60 cm. train. These munitions are then transported to the batteries by 40 cm. railway.

Changing Station (Gare d'échange).—In principle, this station, which is established at the advanced limit of the zone in which locomotives can circulate during the day, comprises a three-way gridiron and sidings; it also includes inspection-pits for loco-tractors.

Whenever the amount of traffic requires it the number of spurs or branches of the gridiron is increased, as well as the siding capacity for loco-tractors.

Station for the formation of trains.—This station comprises a railway gridiron, the number of ways being determined by the amount of traffic. It is established at the exits of standard gauge railheads and of establishments where much loading is done.

Round-house for Locomotives.—This installation is established at the base of the feeder line (antenne), close to the railhead and near the gridiron for the formation of trains. It consists of: A series of blind spurs parallel with the inspection-pits, a repair shop, sidings for engines, ash pits (drains), installations for water supply, facilities for washing engines, dumps of "briquette" coal, a sand blast and a small shop for the repair of cars.

Telephone communications.—The office of the chief of the 60 cm. railway system, the "traffic offices" (bureaux de mouvement) of each operation battery, and all stations on the feeder lines, are connected by telephone. These telephone connections form a special circuit (system), reserved for the 60 cm. Railway Service, and it is connected with the special telephone circuit (system) of the standard gauge railway service.

To obtain closer liaison between the 60 cm. Railway Service and the units or services affecting shipments, the office of the chief of the system (Chef de réseau) and the "traffic offices" of each operating battery are connected to the general telephone system.

It is also recommended that the offices of commanding officers of engineer parks and of heavy artillery ammunition dumps be

connected by telephone with the railway stations which supply these establishments.

In like manner, the Artillery telephone services should connect the "post of command" (P. C.) of the commanding officer of the group of batteries with the railway station for the delivery of ammunition.

The construction of the 60 cm. lines which constitute the light railway "system" (réseau), devolves upon special units known as "construction batteries" (batteries de construction). These units, numbering 250 men each, are placed under the orders of the chief of the army light railway system (réseau). They are directly subordinate to the Commander in Chief, who assigns them to the armies according to needs.

For construction work, the "construction batteries" are reinforced by auxiliary troops which are furnished by the armies. Good results are obtained when, under working conditions, one railway specialist is assigned to three auxiliary laborers. Under these conditions and on average ground, lines can be constructed at the rate of 0.75 meters per man per day.

Lines which have been constructed must be operated, and this task devolves upon units composed of specialists, i. e.: "operation batteries" (batteries d'exploitation). These batteries consist of 171 men, under the orders of the chief of the army light railway system (réseau). They are directly subordinate to the Commander in Chief, who assigns them to the armies according to the amount of transportation which is to be effected.

An operation battery can undertake work corresponding to the placing in service of fifteen locomotives and loco-tractors.

In order to determine the amount of rolling stock required for the operation of a light railway system, the average loading capacity of a car is estimated at 6 tons and it is assumed that each car can make only one trip per day. Insofar as the traction matériel is concerned, it is estimated that each locomotive or loco-tractor can carry 600 kilometric-tons per day on lines where the grade does not exceed 25 mm. per meter, which is generally the case on the 60 cm. railway lines in the French zone.

From the study of the total daily tonnage requirements, the number of cars and tractors which will be required can be determined. The figures thus obtained should be increased by 10 per cent for the cars and, by 25 per cent for the tractors, to allow a necessary margin for upkeep and repairs.

The number of "operation batteries" to be assigned to an army is determined by the number of locomotives and loco-tractors required to effect the transports on the railway system of the army concerned.

"Operation batteries" are established near the transshipping points, from standard to narrow gauge railway, of the line to which they have been assigned.

When 60 cm. lines which are to be operated jointly by two or three batteries become involved, it is advisable to establish an "operation center" (centre d'exploitation). The senior battery commander then assumes command and apportions transportation and matériel among the batteries assigned to this center.

The rolling stock is kept in condition by the "operation batteries" and is sent for repairs, according to the nature of the work to be done, either to the shops of the system concerned or to the central repair shops.

The railway repair shops of a 60 cm. system (ateliers de réseau)—(as a rule one per army) are established near the end of the "recoil" feeder line (antenne de repli) and are equipped with machine-tools to enable them to make repairs to the running gear or chassis (tightening of bearings, play of wheels, replacement of smoke pipes, etc.). These shops are under the orders of the chief of the army 60 cm. railway system.

The central workshops (ateliers centraux), located in the zone of the rear, are directly under the Commander in Chief and are equipped to undertake all repairs. They are particularly charged with important repairs to boilers, the replacement of essential parts (cylinders, stays, fire-boxes, tubes, etc.), and the tightening of wheels and cranks.

For each repair shop (system or central) there is a corresponding "repair battery" (batterie de réparation), composed of mechanics and laborers. In addition thereto, the central workshops, which are located at more than thirty kilometers from the front, also employ detachments of specialists composed of prisoners of war.

On account of the lack of raw materials the upkeep of the matériel assumed a great importance, because locomotives, loco-tractors and cars could only be replaced with difficulty and therefore had to remain in service for a long period. To supervise the work of upkeep, officer-specialists (three for the French Army) were permanently detailed to inspect the railway matériel in use in the armies, as well as that undergoing repairs in the shops. These inspectors were under the direct orders of the Commander in Chief.

SOME OF THE RESULTS OBTAINED.

The total length of the lines constructed since the winter of 1914–1915, exceeded 3,500 kilometers. Concerning their use, it should be noted that during the offensive of August 1917, the "Army of Verdun" transported more than 100,000 tons of ammunition and

engineer material by 60 cm. railways, i. e., more than half of the total amount of material used during the course of those operations.

The same year, during the offensive at La Malmaison (October), the transports effected in the Sixth Army attained 70,000 tons.

In quiet sectors the 60 cm. railway lines effected five-sixths of the total transports of the Army.

These accomplishments are interesting, not only on account of the large amount of tonnage transported, but also because of the possibility of thus freeing a large number of motor trucks which can be used by the High Command to transport troops rapidly, thereby enabling it to surprise the enemy and secure one of the principal factors of success.

II. THE 60 CM. RAILWAYS DURING THE ADVANCE.

During a forward movement, in the area between the new enemy positions and those which he has just abandoned, is found a devastated zone in which roads and standard gauge railways cannot be used immediately.

Although roads can be repaired quickly, such is not the case with standard gauge railways and, insofar as the latter are concerned, progression in excess of 1,800 meters per day is generally impossible. On the other hand, the relatively small capacity of motor transport makes it necessary to reserve this means of transportation for the intensive movement of personnel and food supplies. It is therefore advisable to carry on the construction of 60 cm. railway lines simultaneously with the repairing of roads and the reestablishment of standard gauge lines.

The use of 60 cm. railways during an advance presents new conditions.

It is no longer a question of constructing light railway systems with numerous feeder lines (antennes) and serving establishments along a fortified front. The problem is now to establish lines capable of large output (consequently double track), built at a rate equalling the advance of the troops (5 to 6 kilometers per day) and able, during their construction, to transport the necessary supplies.

Plan of a 60 cm. field railway line (ligne de campagne).—The field line should extend from an existing light railway system. The point of departure of the field line should be chosen so that supplies will converge there upon several feeder lines (antennes) of the existing system and each of these feeders should be connected with the standard gauge line. Under these conditions it is unnecessary to establish new transshipping stations (gares de transbordement), inasmuch as those which have already been established for the existing system will suffice to supply the field line. However, to facilitate operation, it is

advisable to establish a "field railway regulating station" at the base of the line. This regulating station should include sidings for empty rolling stock and for loaded trains, as well as a depot for locomotives and stores.

The field line follows the army in movement. As the field line advances it establishes connections with: (1) The standard gauge railway stations encountered. These will subsequently become transshipping stations and operating centers for the field line, when traffic over the standard gauge railroads is reestablished. (2) With the highway (roads) system, at the points designated as supply centers.

In addition the field line comprises, at intervals some distance apart, necessary installations for operation purposes (sidings for rolling stock, sidings for mobile repair shops, facilities for supplying locomotives with water,[2] etc.); at closer intervals (about 500 meters) cross lines (diagonales) to facilitate construction work and, at its operation terminus, a delivery station (gare de livraison). The daily advance of the latter corresponds to the progress in the construction.

The ideal to be attained being the construction of a field line at a speed approximating the advance of the troops, it is necessary that the heads (têtes) of each of the five main labor parties (chantiers) engaged in the construction of a line, i. e.: Reconnaissance (survey), laying out of the line, roadbed construction (platforms), laying of tracks and ballasting, advance from five to six kilometers daily.

The construction and operation of a field line are delicate operations which require thoroughly studied and well planned organization, experienced, methodical, directing personnel and well trained troops.

For each line, the directing personnel should consist of: An officer, chief of the line; an officer, chief of construction, with two assistants; an officer, chief of operation, with one assistant; an officer, chief of traction, with one assistant.

This personnel constitutes the staff of the field line (Etat Major de la ligne de campagne).

RECONNAISSANCE (SURVEY).

The chief of the line receives general instructions from the command concerning the areas which are to be served by the field railway line. Reconnaissance comprises two essential operations: Study of the map and study of the ground.

[2] It is advisable to only employ gasoline loco-tractors, if possible, because of the difficulties sometimes encountered in establishing water supply stations for steam locomotives.

The study of the map permits the determination of obligatory points of passage (existing bridges, etc.) and the general conformation of the ground (grades, depressions, contours, etc.). As far as possible, this study should be made with the aid of a 1/20,000 or 1/50,000-scale map, and should also take into consideration the information furnished by the geological map concerning the nature of the terrain to be traversed.

The object of the study on the ground is to verify the results obtained by studying the map and definitely determine the line which is to be adopted. This is done by one of the assistants to the chief of construction, assisted by the officer in charge of the crew for the construction of engineering works (bridges, etc.), and by the officer detailed to locate sources of supply for ballast.

In determining the line to be followed, the reconnaissance officers take the following considerations into account:

The field line, which is to take the place of the standard gauge line while the latter is being reconstructed, will cease to operate when the standard gauge railway system has been re-established. The field line should therefore be constructed rapidly, otherwise it will be of no use. Consequently, reconnoissance should be conducted so as to avoid grading, and other work which requires a long time to accomplish, even though this necessitates a slight lengthening of the line. For the same reason, bad terrain should be avoided and an endeavor made to cross lands in which supplies of ballast are available.

Highways (roads) should not be utilized except to take advantage of existing works (for instance, bridges). The side paths of roads, providing they are sufficiently wide, may be followed by the 60 cm. railway.

The reconnaissance officer should go over (or at least have seen) the entire zone in which the line will be staked. For this purpose, he should be furnished means of transportation and should use instruments permitting rapid calculations (compass, clinometer, etc.). Under these conditions he can reconnoiter about 20 kilometers daily.

OUTLINE (TRACÉ).

The object of the outline is to determine the position of the axis of the road-bed (plateforme), in plane and in height, and to mark out on the ground the limits and levels of grades.

The order for outline work, which is drawn up by the reconnaissance officer, contains the following indications:

Which portion of the line is to be staked.

Obligatory points of passage.

Special points (crossings of roads, railways, waterways, inhabited places, sidings, etc.)

The approximate difficulties of the different sections of the line.

The chief of each "outline crew" should be particularly advised as to the most difficult part of the line which he has to lay out, and the outline for this portion of the line must be gone over as carefully as possible in order to reduce obstacles to a minimum.

The chief of the outline crew should not lose sight of the fact that it is necessary to construct field railways rapidly and, consequently, he should seek lines requiring the least grading-work (utilization of paths, ways evacuated by the enemy, etc.)

UPKEEP.

Inasmuch as field lines are rapidly constructed, they require constant attention to maintain them in condition and it is estimated that their upkeep requires 5 men per kilometer. The maintenance rules are the same as for the single track lines.

SPECIAL ARRANGEMENTS.

The various installations required by the field lines (sidings for rolling stock, switch yards, water tanks for engines) are of the same type as those adopted for the single track roads.

The 60 cm. railway station at each supply center includes a number of sidings, established along the roads to facilitate the loading of motor trucks and animal drawn vehicles. The extent of the delivery tracks of such stations is determined by figuring that, during a period of 24 hours, one meter of track suffices to load 3 tons of supplies (six 60 cm. railway trains, with a carrying capacity of ½ ton per meter of train).

During the forward movement, the most advanced railhead is moved forward each day to a distance corresponding to the rate of progress of construction. For this purpose, three classes of stations are established and these function, successively, as follows:

1. Stations in use, (discontinued the next day).
2. Stations under construction, (handle supply the following day).
3. Stations which are being discontinued, (will serve to establish new railheads).

A special construction crew is organized, with necessary trackage material and rolling stock, to establish these stations. The personnel strength of this crew depends on the amount of supplies to be handled.

OPERATION DURING THE PERIOD OF CONSTRUCTION.

The chief of construction has the necessary rolling stock (light tractors and flat cars) for carrying out ballasting operations. The operation service of the field railway line forms the trains and op-

erates those containing track material up to the head of the line. These trains make 26 or 31 scheduled "runs" (marches), according to the daily progress of construction (i. e. whether 5 or 6 kilometres). It is also advisable to provide about 10 additional "runs" for auxiliary or emergency transports, giving a total of 40 "runs" for construction transportation purposes. The difference between this figure and the number of *actual* "runs" (marches) which can be made over the line, gives the *theoretical* number of "runs" which can be used for movement of supplies.

FINAL OPERATION OF THE FIELD LINE.

In principle, traffic runs on the left hand track. The track is normally free and every obstacle to traffic must be indicated by a "stop" signal.

Each section of line included between two telephone stations constitutes a "block," in which only one train is admitted in each direction. With the stations 2 kilometers apart, the capacity of the line is 6 trains per hour or, about 200 tons per hour, in each direction. If the intensity of the traffic requires it, this number can be increased by simultaneously admitting several trains into the same block.

The traffic control chief of the "block" in which the heavy traffic originates, informs the engineers of the trains which have entered the engaged "block" concerning traffic conditions. The engineers should advance with caution and must carefully regulate their speed.

Each station operation which engages one of the two tracks in a direction opposite to that of the traffic, must be communicated by telephone to the neighboring "blocks." The covering signals must be put in place before the operation has begun.

CHANGES IN THE ORGANIZATION OF THE 60 CM. RAILWAY SERVICE.

It has already been said that at the beginning of the war, the French Army only employed 60 cm. railways in the fortresses.

The complete equipping of the front with 60 cm. matériel was undertaken by sectors, according to the importance of the operations in the various sectors, and not simultaneously along the entire front.

The first system to be constituted in a homogeneous manner was that established in the Champagne sector for the operations of 1915.

Then began the equipment of the Verdun fronts and of the Somme, for the operations of 1916; followed by that of the Aisne, for the operations of 1917.

In order to complete the total organization of the front, from the end of 1917 until January 1918, (when the British extended their

lines as far as Noyon), the French Armies of the Vosges and of Lorraine were furnished the necessary means to equip their sectors with 60 cm. railways. However, these light railway systems were far from completed when the German "March offensive" began.

The characteristics of the various 60 cm. railway systems in operation at that time may be summed up as follows:

Certain army light railway systems were completely organized, (Aisne, Champagne and Verdun sectors). Others were being developed, (Lorraine and Alsace sectors).

The above mentioned light railways were not connected with each other by 60 cm. lines. All of the French Army's available matériel was assigned to the army systems and there were no reserves of light railway matériel, except those which existed in certain army systems.

All repairs were effected in the work-shops of the army light railway systems (one or two shops per army).

The requirements of 1918, led to a better organization of the 60 cm. Railway Service.

Indeed, the German advance of March 21, and particularly the advance of May 27, resulted in the loss of considerable quantities of matériel. The principal causes for these losses were:

a) The various army light railway systems were not connected by 60 cm. railway, either with the rear or with the neighboring systems, so that it was impossible to evacuate the matériel.

b) No light railway reserves had been provided for outside of those in the army systems. Nearly all the reserve matériel, as well as matériel undergoing repairs, was located within the systems, close to the front and therefore within easy reach of the enemy.

In May and June 1918, the following measures were taken:

1. *Reduction in the matériel at the disposal of the army systems.*—The surplus rolling stock and track material was grouped in three reserves at: Gudmont, Chartres, St. Loup-sur-Semousse.

2. *Establishment of new work shops.*—The two best equipped shops (Jonchéry and Basoches, belonging to the light railway system in the Aisne sector), had fallen into the hands of the enemy. This loss necessitated the establishment of work shops further to the rear, namely at: Pont-Ste. Maxence, La Maltournée (near Châlons), Lisle-en-Barrois, Toul, Belfort.

In addition, three central shops were established still further to the rear. These were at the disposal of the Commander in Chief and were located at: Chartres, Etigny, St. Loup-sur-Semousse.

This organization was much more flexible and was maintained until the end of the war.

It may be of interest to note the effort made by Industry, in order to supply the 60 cm. Railway Service with matériel.

Total amount of material delivered to the Army during the campaign:

60 cm. track (kilometers)	4,100
Locomotives	525
Loco-tractors (Schneider, Crochet, Baldwin)	295
Cars (2 bogies)	6,700
Light cars	1,900

The retreat of the German armies furnished the following material:

60 cm. track (already laid down) (kilometers)	2,555
60 cm. track (in stock) (kilometers)	300
Locomotives	374
Gasoline loco-tractors	243
4 wheeled cars	3,000
Light cars	2,820

CHAPTER XV.

SECTION III.

ORGANIZATION OF THE 60-CENTIMETER RAILWAY SERVICE IN THE BELGIAN ARMY.

I. GENERAL.

The 60-centimeter railway system constituted a prolongation of the standard gauge railroad. Materials which had been brought within 15 kilometers of the front by standard gauge railroad, were transferred to the 60 cm. railways and transported to the vicinity of the first line or to the artillery emplacements, even up to the positions of the 75 mm. rapid firing (75 T. R.) guns.

The aims of the 60 cm. railway service were: In the first place to reduce traffic on the roads, which were winding, very narrow, and muddy in winter. Later, as transportation requirements increased, it became the only means of transporting heavy caliber ammunition and stone material. A third aim had been foreseen in case of an advance, i. e., the transportation of standard gauge material into the devastated areas. However, on account of the lack of personnel and the rapidity of the advance, the 60 cm. railways were not used for this purpose.

The organization of this service[1] was very difficult because: 1. The personnel had to be recruited from among former railway men, who were scattered throughout the other units; 2. The rolling stock had to be obtained from the Allied armies, hence lack of uniformity and complications in making repairs; 3. The same remarks apply to track material. (The French track material was of 9 kilogs. to the meter, while the British trackage was of 12 kilogs. to the meter, moreover, the curved tracks ceded by the French had to be altered to allow the passage of the British locomotives.) 4. Supplies of material and spare parts were obtained very slowly.

The "Railway Battalion" (Bataillon de chemin de fer—B. C. F.) to which the new service was attached, assisted greatly in overcoming existing difficulties. The nucleus of the new service was formed by withdrawing personnel from the companies of the B. C. F. The Railway Battalion also constructed new lines and provided for the repair of the rolling stock with material from its own shops.

[1] Chart 3, Chap. XVI, Vol. I.

General Headquarters issued regulations governing the operation of the service. Strict compliance with these regulations made it possible, in certain cases, to attain up to nine trips per day with a single train, although the length of time required for the round trip averaged about two hours.

The organization of the 60 cm. railways in the sector occupied by the Belgian Army will be described in the following paragraphs, here, the ideas set forth above will be more fully developed and, in so far as this general statement is concerned, the construction of new lines remains to be considered.

The new lines were constructed by the "trackage and maintenance" units (unités de voies et travaux—V. T.) of the B. C. F. Similar units which had been organized in the "60 cm. railway company" (Compagnie de voie de 0.60) were exclusively assigned to the maintenance of existing lines.

The lines were established so as to avoid the bermes of existing roadways (highways). The planning and grading of the road bed (plateforme), as well as the construction of the line itself, were done in accordance with the methods used in the construction of standard gauge lines. The ballasting of the line was done most carefully. All lines were single track and were provided with turn-outs (évitements), at regular intervals, to allow the crossing of trains. The lines constructed with rails of 12 kilogs. to the meter, with wooden cross ties and clamps, gave the most satisfactory results.

II. ORGANIZATION OF THE 60 CM. RAILWAY SERVICE IN THE SECTOR OCCUPIED BY THE BELGIAN ARMY.

In so far as transportation by 60 cm. railway by means of mechanical traction is concerned, the front of the Belgian Army was subdivided into three zones and each of these zones was served by a system (réseau) of 60 cm. lines.

These zones were bounded approximately as follows: The first zone, by transversal lines passing through the boundaries of the British "Ypres sector," on the south, and through the village of Noordschoote on the north; this was the "southern system" (Réseau Sud). The second zone, by a transversal line passing through Noordschoote and the canal from Wulpen to Nieuport; this was known as the "central system" (Réseau du centre). Finally, the third zone included the area between the above mentioned canal and the North Sea and was called the "northern system" (Réseau du Nord).

The "zone railway systems" (réseaux de zone) were not independent. Theoretically, they were connected together by transversal

lines to permit the transfer of rolling stock between the various sectors. As a matter of fact, the connection between the "Northern" and the "Central" systems was never completed and the ending of the war stopped the work which had been undertaken.

ORGANIZATION OF TRANSPORTS WITHIN A ZONE.

1. *Plan (trace) of the Lines.*—A system usually consisted of two main lines (antennes), whose general plan was normal to the front which was to be served, and which branched out from some important "formation station" (gare de formation) where all of the rolling stock was assembled. These two main lines (antennes) were connected by one or two transversal lines, whose location was determined by the position of the lines of batteries which it was desirable to approach as closely as possible. The establishment of these transversal lines formed closed circuits which were very useful in case of interruption on one of the main lines.

In no case could the main line cross important depots, such as depots of ammunition, engineer material or road service material. The line must remain independent. These various establishments were served by private branch lines which were designed so as to provide for direct trans-shipments from the standard gauge railroads which normally serve such depots.

2. *Operating Service (Service d'exploitation) for the organization and supervision of train movements.*—In each railway system, the operation service functioned under a "traffic chief" (Chef de mouvement) who was located at the traffic center, that is, at the "formation station" (Gare de formation). For the operation of the trains the traffic chief had the following personnel at his disposal: stationary personnel, consisting of "station masters" (Chefs de gare), assisted by telephone operators and railway employees and, travelling personnel, which accompanied the trains and acted as "train masters" (Chefs de trains).

As the light railway system was single track, the trains generally passed each other at the stations. These stations were connected with each other and with the formation station by a complete telephone circuit, either by means of direct wires or "omnibus" wires, belonging to the 60 cm. railway service proper.

The traffic chief recorded in registers, 'ad hoc', all information received, controlled the movements of the trains and verified the time-sheets (feuilles de travail) of engineers and firemen. He received all requests for transportation direct from the office of the 60 cm. railway service and formed the necessary trains in compliance therewith. The maximum speed allowed for these trains was eight kilometers per hour.

It is self evident that steam locomotives could not be used for the traction of trains of material operating in proximity to the lines, as the tufts of smoke and the glare of the fire-boxes revealed their location too clearly. Hence the necessity of employing two means of traction and the establishment, in suitable places, of "changing stations" (gares d'échange) where steam locomotives were replaced by gasoline loco-tractors.

3. *Traction and Material Service* (*Service de la Traction et du Matériel*)—Traction and upkeep of the rolling stock.—The personnel assigned to this service consisted of a "depot chief" (Chef de dépôt), an assistant chief (sous-chef) and a few locomotive engineers, firemen, drivers of gasoline loco-tractors, railway men, engine cleaners and inspectors.

Theoretically, the sector depots for rolling stock were only to undertake minor repairs, and such as could be made with the portable equipment belonging to the engines and by the engineers themselves.

In connection with the depot for material which was established at the formation station there were: an inspection-pit, a storehouse for railway material, stores of oil, lubricants, coal-oil, etc., in other words, all necessary supplies for the upkeep of the locomotives, as well as a storage depot for coal, a depot of gasoline and roundhouses or sheds for locomotives and cars.

The employment of two means of traction, gasoline and steam, brought about the organization at the "changing station" of a secondary branch depot, for the gasoline loco-tractors. These secondary depots were organized as were the central depots at the formation stations; they were branches of the latter and generally operated under the orders of an "assistant chief of depot."

All repairs to rolling stock, particularly the washing out of locomotives, were effected in a central workshop which operated for all sectors in rear of the front and which was connected by 60 cm. railway with the various railway systems.

These repair establishments were located at Molentje. As connections between the "northern system" and the other light railway systems were never completed, the washing out of locomotives and the repairs to the rolling stock in the northern sector were effected in the formation station of St. Idesbald, which was equipped with facilities for washing out engines and which maintained a few small repair shops.

The supply of water for locomotives is a very important factor and this was provided for by the installation of elevated reservoirs or tanks at certain stations and the establishment of water points or wells (puisards) along the railway lines, where the locomotives could supply themselves by means of the appliances with which they were equipped for that purpose.

CHAPTER XV.

SECTION IV.

LIGHT RAILWAYS AND AERIAL TRANSPORTING CABLES (TELEFERICHE) (ITALIAN).

No light railway service or special depots for light railway material existed in Italy before the war.

During the war the armies first began to construct light railways in their own zones to facilitate local supply. Later, these railways having attained a considerable development, they passed under the control of the Transportation Administration at the "General Commissariat" (Decauville Office), which constructed and operated light railways by means of special detachments from the Regiment of Railway Engineers Decauville Companies.

PRINCIPLES FOLLOWED IN THE ESTABLISHMENT OF THE LINES.

Narrow gauge railways were generally employed as secondary lines to connect the various unloading stations on the standard gauge lines with the depots and advanced establishments at the front. In the plans for the establishment of narrow gauge lines, the policy was adopted of employing and adapting or extending existing light railway lines as much as possible. Whenever possible, new lines were constructed so that they could be utilized after the war. Temporary installations were only constructed when, for economic or technical reasons, it was found inadvisable to construct permanent ones.

All lines, including temporary ones, were constructed for use with mechanical traction by means of steam engines but, in special cases and where the configuration of the terrain rendered the use of such traction impracticable, lines were constructed for use with animal traction.

The type of track to be employed in the construction of temporary lines was determined by the necessity for rapid and economical construction. The principles followed in the construction of light railways included adaptation to terrain conditions, elimination of grades whenever practical, reduction to a minimum of bridge spans (luce) over waterways and level road crossings and, finally, avoidance as much as possible of rocky or marshy land. An endeavor was also made to have the lines pass near gravel and stone quarries.

The construction of narrow gauge lines over ordinary roads (excepting those for animal traction) was not permitted, as this would have impeded motor transportation and subjected the lines to damage by the motor traffic. No curves inferior to 30 meters or grades superior to 25% in the sense of loaded journeys (including resistance due to the curve) and of 30% in an inverse sense, were allowed.

60 cm. gauge lines were adopted for the construction of temporary lines, as this gauge was more generally used by the industrial plants of the region. This fact facilitated the procurement of the light railway material by requisition. A 75 centimeter gauge was adopted for the construction of new permanent lines.

DEVELOPMENT OF THE SERVICE.

The development of narrow gauge railways on the Italian front comprises two distinct periods:

1st period: From the beginning of operations to the retreat on the Piave;

2nd period: From the retreat on the Piave to the date of the Armistice.

During the first period the construction of permanent 75 cm. gauge railways developed gradually. The light railway systems consisted of short, separate, lines connecting the advanced positions in the Alpine valleys with the standard gauge unloading points. These lines attained a total length of about 110 kilometers.

The temporary 60 cm. gauge lines attained a total length of about 400 kilometers and consisted of separate lines assigned to each army. Light railways attained their maximum development in the zones of the Second and Third Armies, and in this region they consisted of a single line which followed the course of the Middle and Lower Isonzo.

As a result of the retreat on the Piave all the 75 cm. lines, as well as most of the 60 cm. lines, had to be abandoned and at the beginning of the second period there remained only about 50 kilometers of light railways.

During the second period, on account of its shorter duration and the lesser necessity for the construction of new means of communication along the new front, the construction of narrow gauge lines only attained 20 kilometers of permanent lines and about 200 kilometers of temporary lines.

In addition to the lines constructed on the Italian front, 60 cm. narrow gauge lines were also constructed in the Albanian theatre of operations, where they attained a development of about 60 kilometers and connected the base at Vallona with the advanced depots. The Armistice stopped the work on the additional 150 kilometers which

were required to complete the narrow gauge railway system on this front.

After the Armistice, many lines which had been captured from the enemy were again put into operation and completed.

A total of about 800 kilometers of temporary lines were constructed and operated during the war. (Chart 7, Chapter XVI, Vol. I.)

CONSTRUCTION AND OPERATION.

The "Decauville Office" of the Transportation Administration was responsible for the construction and operation of the various lines and special detachments, known as "Decauville companies," composed of personnel from the Regiment of Railway Engineers were employed for this purpose. There were nine "Decauville companies" at the date of the Armistice. These troops were specially organized for the construction and operation of light railway lines and were assisted by civilian labor. They were composed of trained construction, traffic, traction and administrative personnel which had previously attended special courses of instruction instituted by the Transportation Administration. Each Decauville company was assigned to the construction and operation of a certain light railway system, under the technical control of the Transportation Administration and under the administrative control of the Administration of the lines of communication of the Army Commissariat.

A repair shop was assigned to each narrow gauge line for ordinary repairs to engines and rolling stock; these shops often constructed new material. Heavy engine repairs were made in the shops of the State (Government) Railways and they also supplied and repaired special parts whenever the smaller establishments, on account of their limited equipment, were unable to do so.

SUPPLY OF MATERIAL.

Serious difficulties were encountered in obtaining stationary and rolling material for the construction of light railway lines. One of the main difficulties at the beginning of the campaign was the scarcity of available tenders (scorte), owing to extensive use in Libia. Moreover, the available material belonging to the industrial concerns in the interior of the country was also very limited. Later, these difficulties were increased as a result of the retreat on the Piave, when nearly all of the working material and tenders which had been collected during the first period were lost.

The construction material required for the 75 cm. gauge lines was procured from the national industries. The initial rolling stock (engines, tenders, cars and trucks) had been obtained through the requisition of material belonging to private companies operating

75 cm. gauge lines, while awaiting the delivery of 15 engines which had been ordered in America and of 15 engines, 40 cars and 250 ordinary baggage cars which had been ordered in Italy.

The 60 cm. gauge lines were equipped, at first, by the requisition of both stationary and rolling material; later, the stationary material was supplied by the national and private industries. 25 new engines and several hundred cars were obtained, and 50 additional engines ordered, from America. Owing to the great development of the 60 cm. gauge lines during the second period of the war and the impossibility of obtaining sufficient quantities of materiel from the national industries, as the latter were already heavily engaged in production, it became necessary to order 150 more engines from America and 300 kilometers of rails from England through the Military Board of Allied Supply. These supplies were delivered the latter part of November, 1918.

At first, engines were of various types, as it was necessary to use whatever material could be requisitioned in the country. Later, 80 HP. engines were ordered for the 75 cm. gauge lines and 40 HP. engines for the 60 cm. lines.

Numerous types of cars were also employed, on account of the diversity of materials to be carried, the necessity of employing whatever rolling stock was readily obtainable, and the advisability of using a type already in construction.

A total of about 300 engines and more than 10,000 cars of all kinds were used. This does not include numerous small trucks employed by the various units in the zone of operations and in the rear zone, for the removal of dirt.

AERIAL TRANSPORTING CABLES (TELEFERICHE).

(Chart 8, Chapter XVI, Vol. I.)

The Italian Army operated for the most part in steep mountainous regions. The scarcity of good roads in certain zones, the difficulty of constructing new ones due to the condition of the terrain and lack of time, the exposed position of many of the points of passage, as well as the impracticability of many roads and foot paths during the winter season on account of the heavy snows which obstructed the mountain passes, necessitated the adoption of a rapid mechanical means of transportation. Moreover, this means of transportation had to be safe, independent of road conditions and susceptible of rapid construction.

These means were offered by the use of aerial transporting cables which, by prolonging ordinary mechanical transport lines (narrow gauge railways, motor transport, etc.) and crossing the impervious

zones which formed the larger part of the Italian front, made it possible to send supplies from the lower valleys to the troops in the mountain districts.

For this purpose, powerful permanent cable systems were installed, and the use of temporary demountable cable systems, which had been carefully planned before the war, was greatly developed.

Benzine motors were generally used although, wherever possible, electric motors were installed. Provision was also made for the construction of hand operated aerial transporting cables. Under the circumstances, these offered great advantages over other means of transportation, especially in the saving of time.

ORGANIZATION OF THE SERVICE.

In order to coordinate this important technical service, an "Administration of the Aerial Transporting Cable Services" was created at the Supreme Command (General Command of the Engineers) in July 1916.

Experienced, permanent personnel was secured through the organization in the armies of "Autonomous Aerial Cable Platoons." These platoons varied in number and strength in the various armies and, at the end of 1916, they were organized into "Aerial Cable Companies" (one for each army). However, the aerial cable personnel assigned to large units which were not attached to the armies remained as "autonomous aerial cable platoons."

Urgent repairs to the material were undertaken by these companies in special repair shops. The company commander made the requests for the necessary supplies for the platoons and these were sent to the supply center and to the army Commissariat.

In the autumn of 1916, for the purpose of improving the aerial cable personnel and provide for its organization into detachments and proper assignment of same, a "Depot for Aerial Cable Personnel" was organized. This depot included a training detachment and a school for motormen. Moreover, a shop for the construction of aerial cable material was added thereto later. To control the supply of special technical materials produced by national industries, a "Supply Center for Aerial Cable Material" was established at Milan and this establishment tested and forwarded aerial cable material to the Armies.

TYPES OF AERIAL CABLES USED.

Numerous types of cables were used and these also varied greatly in length. The carrying capacity of the aerial cables employed on the Italian front was determined by the condition of the terrain and the exigencies of the particular positions which they were to serve.

The aerial cables were grouped into three different categories: (*a*) Hand worked emergency aerial cables (telefori); (*b*) dismountable aerial cables; (*c*) permanent aerial cables (teleferiche), generally of high capacity.

"Telefori" or hand worked aerial cables were sometimes assembled in the construction shop of the depot for aerial cable personnel and then set up in the positions where they were needed or assembled on the spot, and erected with whatever material was available locally.

According to the uses for which they were intended, the equipment was of varying types and consisted of one, two, or three cables. Their average length was 500 meters and their average carrying capacity was 50 tons a day.

The dismountable aerial cables were of two types: one, known as "C. T."[1] and the other "B. B. B.",[2] from the names of their manufacturers.

Planned to meet military exigencies, facilitate and accelerate transports, aerial cable lines consisted of three cables, two for carrying the load and one for traction purposes, and were composed of various metallic parts which could be readily assembled by means of bolts (bulloni).

The usual length of the "C. T." lines was 1,000 meters and 20,000 meters for the "B. B. B." type. Their carrying capacity averaged from 10 to 20 tons per hour.

The high capacity, permanent, aerial cables used in the Zone of the Armies were similar to those which had been installed before the war for the service of fortified places and those in general use for industrial purposes. They were constructed on the endless belt principle and carried small cars, provided with automatic coupling apparatus, which were connected with the traction (drawing) cable.

Their length varied, although they could attain up to 8,000 meters, and they had a carrying capacity averaging about 150 tons an hour.

EMPLOYMENT OF AERIAL CABLES OF VARIOUS TYPES.

The employment of a particular type of cable was determined by the distance to be covered, the configuration of the ground and the importance of the positions to be supplied.

"Telefori" (hand worked aerial cables) were used to carry the supplies to small posts and troops in the more advanced positions.

Dismountable aerial cables were used immediately behind the first lines and in positions far from roads, on account of the ease with which such lines could be transported and the rapidity with which they could be set up.

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[1] C. T.—Ceretti e Tanfani. [2] B. B. B.—Badoni, Belloni e Benazzoli.

Permanent aerial cables, of great capacity, were found more suitable when used at a certain distance to the rear of the first lines and rendered good service by reducing motor transportation, thus diminishing traffic on the roads and leaving them free for the movement of troops. Moreover, cable transportation was much speedier and more economical than motor transportation.

SEA LEVELS SURPASSED.

Some aerial cables, such as those used to cross rivers, ravines and valleys, only rose a few meters above sea level but, in the Alpine zones, the aerial cables attained heights of from 600 to 700 meters and certain cables reached an altitude of 1,500 meters above sea level.

The highest altitudes reached by the aerial cables were in the Cadore region and in the region of the Adamello where, normally the lines attained between 2,000 and 3,000, and even 3,500 meters above sea level.

IMPORTANCE OF THE SERVICES CARRIED OUT BY THE AERIAL CABLES ON THE ITALIAN FRONT.

Generally, the employment of aerial cables was found to be indispensable whenever it was necessary to establish a speedy means of supplying certain positions, particularly those which on account of the irregularities of the terrain would have required the tedious and difficult construction of ordinary roads and necessitated, perhaps, numerous bridges or other engineering works (opere d'arte); moreover, in a great many cases, the amount of transportation involved would not have compensated for the expenditure of money, time and effort which such construction might have incurred.

In Italy, the Aerial Cable Service assumed great importance and attained a considerable development, on account of the peculiar situation of the Italian front which was located, for the most part, in high and mountainous territory.

During the offensive on the Bainsizza in May 1917, numerous aerial cables were erected and, after the crossing of the Isonzo had been effected, these cables connected the river with the mountainous slopes which had been taken from the enemy and which were only served by very difficult foot paths. Twelve aerial cables were erected on these positions in about ten days and some began to operate in less than four days.

Similarly, after the retreat in the mountainous zone between the Piave and the Brenta in the early days of November 1917, it became necessary to speedily establish a system of aerial cables for the supply of the front line troops, as the existing cable lines on Monte

Grappa were insufficient and, by the middle of November, some of the new aerial cables in this zone were already in operation. These lines carried urgently needed supplies for the troops in that sector and played an important part in the Italian resistance.

It may be said that some of the important positions, which were inaccessible in any other way owing to the nature of the ground and on account of climatic conditions, were maintained solely because aerial cable transportation made it possible to bring up supplies from below to the troops which were tenaciously holding these positions, notwithstanding all the adverse conditions.

The aerial cables rendered valuable service in connection with the evacuation of the seriously wounded and provided a rapid and comfortable means of trasportation.

Another important service carried out by the aerial cables was the transportation of munitions for the artillery, mortars, etc.; they were also often used for the transportation of light guns (mountain artillery). The use of the aerial cables made liaison possible between batteries located in difficult positions and provided them with the necessary munitions. In conclusion, the aerial cables also rendered invaluable services in the transportation of food, supplies and materials.

CHAPTER XV.

SECTION V.

LIGHT RAILWAYS (AMERICAN).[1]

Light railways were the outgrowth of stabilized warfare. Light railway construction could not keep pace with the advance of the troops in open warfare. However, in a campaign of maneuver that is being fought over an area where the lines have previously stabilized for a long period and both sides have established systems of light railways, then the advancing army can use those of the enemy by merely connecting up the intervening space across "No Man's Land" provided, of course, they both happen to be of the same gauge. Until the advance progresses beyond the enemy's systems, it is comparatively easy to keep abreast of the troops, as was the case in both the St. Mihiel and Argonne-Meuse operations. During the four years of stabilized warfare extensive systems of 60 cm. railways were constructed and operated by both the French and Germans. In the St. Mihiel sector alone the Germans had several hundred kilometers of track.[2]

We are particularly concerned with the 60 cm. roads, a very different thing from the narrow gauge lines of the French. The latter were a meter in width and had been extensively used by the French before the war in the coal fields. Where these existed they had been adapted to military purposes.

To the American Army officers who had studied the problem, it seemed that the one meter road was not essentially a light railway but that it was merely a duplication, on a smaller scale, of the standard gauge railroad. It required almost as much time, labor and material for its construction and could not carry the loads of the standard gauge lines. On the other hand, the 60 cm. railway was essentially a light railroad which could be laid quickly, being made up in sections of ties and rail complete. It did not require elaborate grading, cost much less than the one meter railway and, if subjected to shell fire, could be quickly repaired. For these reasons it was decided to concentrate on the 60 cm. railway and, for the A. E. F., this became the agency that extended the standard gauge railway into the zone of combat where the latter could not operate.

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[1] Extract from the chapter on: Transportation, Report of G–4, G. H. Q. to the Commander in Chief.

[2] See Chart 9, Chapter XVI, Vol. I.

It is perhaps more scientific to look upon the 60 cm. railway as a supplement to the motor and animal drawn transportation, rather than as an extension of the standard gauge. It can be laid parallel to roads and relieve motor transport of burdens, doing the work at much less expense and saving a large amount of wear and tear on roads and matériel. In the advance on Paris in the spring of 1918, the Germans laid 60 cm. tracks alongside of practically every important highway and transported the bulk of their supplies over them. On all the fronts where the 60 cm. railways were laid, the service rendered was invaluable and their efficiency was not limited to defensive warfare but was of the greatest value in all offensive actions.

Among the first studies the Commander in Chief had made upon arrival in France, was that of the systems of light railways of the British and French. With the organization of the Transportation Department, a Manager of Light Railways was appointed as assistant to the Director General of Transportation (D. G. T.). He was charged with the responsibility for construction, operation, and maintenance of all light railways for the use of our forces. In February 1918, light railways were placed under the Chief of Utilities, where they remained until July 1918, when they were placed under the Engineer Corps and they remained under the latter until the end. (G. O. 37, H. A. E. F. 1917 and G. O. 114, G. H. Q., 1918)

Some time previous to the preparations for the St. Mihiel offensive our engineers had taken over from the French some 244 kilometers of track. After the successful advance this was connected up with existing German lines, increasing the trackage to a total of 394 kilometers. An idea of the work done is shown by the fact that, from September 8th to September 14th, 22,713 tons were carried by 1,123 trains. 2,250 officers and men were engaged in construction, 124 in maintenance and 531 in operation. Ammunition was the principal item carried but, at one time, the whole system was given over to transporting water for the advanced troops.

In the Argonne-Meuse area, the French had light railway lines connecting Souhesmes, Dombasle, Esnes and Fleury; Les Illettes, Aubreville, Barricade, and an extension system in and around Verdun. Inasmuch as the offensive on this front came as a comparative surprise to us, it was agreed that the French should continue to operate the lines, but that our personnel should care for the maintenance and the connection of the lines with those of the Germans, repairing and operating the lines taken over from the Germans.

Immediately after the "jump off," we started to work on the three lines:

1. Aubreville—Neuville—Varrennes.
2. Le Triangle—La Barricade—Cheppy.
3. Esnes—Bois de Malancourt—Montfaucon.

By October 10th, connection was made with the German system and completed, so that trains could be operated throughout. The delay in getting this finished earlier was the result of the continuous warfare of the four years preceding, rains, and the shell-swept condition of the terrain. Often the tracks would disappear under an ordinary burden. These seemingly insurmountable difficulties were overcome and by the 20th of the month we were operating 164 kilometers of light railway in advance of the lines in existence before September 26th, the day the offensive was launched. At the date of the Armistice 344 kilometers had been added. During the week ending November 1st, 11,257 tons in 1,149 trains were transported. The speed with which the German lines were put into operation is illustrated by the fact that, on the night of November 1st, artillery ammunition was delivered by light railway in Landres—St. George, 12 hours after the troops left their trenches to capture the town.

This is a brief summary of the efficiency of this type of communication as utilized by us and the other armies. The details of the organization and its operation can be found in the reports on the light railways and the Engineering Corps.

Light Railways.[3]

ORGANIZATION.

1. The Division of Light Railways and Roads was in charge of a Director, under whom was a Deputy Director, to whom the Manager of Light Railways reported.[4]

2. Under the Manager of Light Railways were four main divisions, in charge of: (*a*) General Superintendent of Transportation; (*b*) Chief Engineer; (*c*) General Superintendent of Motive Power; and (*d*) Supply Officer.

3. The Division of Light Railways and Roads was one of the four main departments under the Chief Engineer, A. E. F. Originally

[3] Prepared for the M. B. A. S. by the Chief Engineer, A. E. F.

[4] Note from "Organization of the S. O. S." by Col. Wright, Historical Branch, U. S. War Dept.: "The Department of Light Railways and Roads as noted above, originally from two departments under the D. G. T., was consolidated when the Service of Utilities was created. It operated entirely in the Zone of the Armies, being concerned with the construction of 60 cm. gauge railroads, the erection and repair of the rolling stock necessary for the same, and the repair of French roads within its sphere of activities. It had nothing to do with the maintenance of roads in the S. O. S., that duty being charged to the Department of Construction and Forestry. It had nothing to do with any standard gauge road."

light railway work had been a function of the Transportation Department, but when the Service of Utilities was created on February 16, 1918, the construction, maintenance and operation of light railways passed to the Chief of Utilities, (Major General W. C. Langfitt) who, on March 19, 1918, created the Utilities Department of Light Railways and Roads.

4. In light railway operations in areas under various tactical commands, the Department of Light Railways and Roads maintained technical supervision through officers detailed to the staffs of the Chief Engineers of these commands. After May 7, 1918, the Department of Light Railways and Roads became primarily an agency to estimate light railway and road requirements in trained personnel and in construction and operation of equipment, and to make provision for their delivery to the construction and operation forces. The organization consisted of the following main division heads: 1.—Manager of Roads; 2.—Supply Officer; 3.—Manager of Light Railways; 4.—Chief Engineer; 5.—General Superintendent of Transportation; 6.—General Superintendent of Motive Power; 7.—General Superintendent of Construction.

5. The Service of Utilities was abolished on July 11, 1918, and General Langfitt was appointed Chief Engineer, A. E. F. Without change in its form of organization until after the cessation of hostilities, the former Utilities Light Railway Department was continued as the Division of Light Railways and Roads, Office of the Chief Engineer, A. E. F. After the Armistice was signed the duties, lines, equipment and personnel pertaining to the light railway service were withdrawn from tactical command and the responsibility for all such work passed to the Chief Engineer, A. E. F. As a unit of the office of the Chief Engineer, A. E. F., the Division of Light Railways ceased to function after February 20, 1919. The Director and a large part of its personnel were relieved and the remainder transferred, partly to the Section Engineer, Advance Section, for the operation of certain light railway lines serving quarries and partly to the Engineer Purchasing Officer, for salvage purposes.

OPERATIONS.

6. In the zone close to the front lines, where it would have been impracticable to construct standard gauge railways or to operate large, heavy locomotives, there was developed an extensive system of light railways with track of 60 cm. gauge and equipment in the form of tractors and cars on correspondingly reduced scale. The service of light railways began at railheads to which munitions and supplies were transported by standard gauge lines and there transferred, either directly or after storage, to the 60 cm. lines. They increased steadily in scope and importance during the war and were

a vital part of the supply system for the armies. Indeed it is difficult to see how the armies could have functioned without them. Great quantities of munitions, supplies, and equipment were delivered with regularity and rapidity. Troops were transported to and from the trenches by light railway and wounded were brought back in special cars adapted for carrying munition on the out-bound trip and wounded on the in-bound trip. While the actual construction and operation of light railways was normally under army command, the broad plans for utilizing this means of transport, for establishing central shops for heavy repairs and for procuring the large quantities of supplies and equipment needed, were developed and put into execution by the Division of Light Railways and Roads under the Chief Engineer, A. E. F.

7. When hostilities ended there were in service for the American Armies 2,240 kilometers of 60 cm. lines, of which 300 kilometers had originally been constructed by the French but rehabilitated by the A. E. F., 200 kilometers had been constructed outright by the A. E. F. and 1,740 kilometers had been taken from the Germans, comprising 900 kilometers south of the battle line of 11th of November, 1918, and 840 kilometers just in front of it. (Chart 4, Chapter XVI, Vol. I.)

8. The principal troops regularly engaged on light railway construction and operation included the 12th, 14th, 21st and 22nd Engineers and the 528th, 540th, 544th and 546th Service Battalions; the first work done by the 12th and 14th Engineers being with the British Armies in France and Flanders.

9. From these organizations certain officers were selected to form a nucleus for a Department of Light Railways, which was later created and which eventually became the Division of Light Railways and Roads, of the Engineer Department. These officers made extensive investigations of light railway construction, operation and equipment, prepared the necessary organization plans for field and shop forces, and developed a centralized department for handling the light railway work in American sectors. Large orders were placed for shops, track material, equipment (including locomotives, cars and cranes) tools and operating supplies.

10. In addition to service performed for the British Armies, the work of the light railway regiments included construction and operation of lines in all of the principal sectors held by American troops. At the time of the Armistice, the system was divided into three main divisions, consisting of the Verdun District, the Toul District and the so-called Abainville-Sorcy line, which connected the central repair shops with the system at the front. This latter line was 28.5 kilometers long and was put into operation August 22, 1918. While short, it was a vital element in the system since it

afforded access to the Abainville shops, the primary supply provided for engines, cars and other equipment.

11. The site for these central repair shops at Abainville, was selected after about twenty-five other locations had been examined. Construction was begun April 26, 1918, and the shops and yards established covered about 125 acres. There were in all 10 buildings, into the construction of which entered about 450 tons of steel.

12. Track material and equipment had, early in the history of the A. E. F., been ordered on a general requisition. The rail ordered weighed 25 pounds per yard, about 25% heavier than the rail ordinarily used by the British and about 40% heavier than the customary French rail. Experience has shown that the heavier rail will much more than pay for itself in added volume and speed of traffic. About 85,000 ties were obtained from Portugal and the large additional quantity of ties needed were secured from the Forestry Section of the Division of Construction and Forestry. Steam and gasoline locomotives and cars of various types were secured in the United States.

13. Throughout the whole period from the middle of May, 1918 to the end of the war, the light railway organization carried on its activities in liaison, not only with the Fourth Section of the General Staff, G. H. Q., and with the Chief Engineers, but with the Armies, and the Fourth Section of the Army Staffs with whose work its operations were closely connected.

14. In addition to large amounts of construction carried out directly by the Department of Light Railways, special detachments of light railway troops, track laying gangs, bridge gangs and operating units—were formed and trained at Abainville and supplied to the armies thoroughly equipped with tools and materials. During the summer of 1918, construction and operations at the central shops and on the Abainville-Sorcy line were carried on under direct charge of the Manager of Light Railways. In the 1st and 2nd Army areas operations were under the Chief Engineers of the armies. The Manager of Light Railways, however, kept in close touch with the army organizations and assisted them with trained personnel, equipment, materials, and supplies.

15. The largest number of American light railway troops engaged at one time was between 15th September and 9 November, 1918, when the force amounted to 13,650. The net tonnage handled by light railways operated by American forces amounted to more than 8,100 tons per day in October, 1918. To handle this tonnage there were available in the various operating districts 104 steam locomotives, 61 gas locomotives and 1,695 cars, 20 feet long. The personnel engaged on this work numbered 55 officers and 2,585 men, operating 703 kilometers of main line and sidings. During one week in September,

10,600 tons of ammunition were handled. In one week of November, 10,700 tons of rations were transported. During various weeks it was not unusual for light railways to carry more than 3,100 tons of personnel and 1,800 tons of water.

16. A number of heavy troop movements were carried out by light railways. For example, during the relief of the 82nd Division by the 89th Division, on the nights of August 4th to 9th, inclusive, 23,155 men were shipped; in this relief, 6,175 men were moved by light railway on the night of August 8th alone. Light railways were called upon for much long haul traffic on account of delays on standard gauge lines.

17. American light railways, contrary to the British and French practice, lengthened the usual haul of freight in certain cases far beyond anything previously considered practicable for 60 cm. army lines. The average haul for the entire American light railway operations was 15.3 kilometers, which was probably 30% greater than either the British or the French average hauls. In the Toul sector, where the 21st Engineers operated, there were made regular movements from railhead to battery or company of 48 kilometers for ammunition, 55 kilometers for rations and water and 43 kilometers for personnel.

18. Deliveries from the light railway central shops at Abainville during the Meuse-Argonne offensive developed the most extraordinary of all light railway movements made on American lines, the longest on record being from Abainville to Grand Pré, a distance of 175 kilometers. This move was executed several times. In one day during the Meuse-Argonne offensive nine trains of material were sent from Abainville to Dombasle, a distance of 140 kilometers.

19. On November 10, 1918, the light railway organization for the American Armies was operating 623 kilometers of main line track with a personnel on operation of 57 officers and 3,557 men behind a front of 92 kilometers, equivalent to 5.8 men and officers per kilometer of main line track operated.

20. After the Armistice the light railways proved very useful not only for supply but also for salvage. In the statistics furnished by the Director of Light Railways, is shown all tonnage hauled to and including Feb. 1, 1919, and that it is difficult to arrive at the amount hauled since November 11, 1918. For this reason the total is given, so that some idea may be formed of the service performed by the light railways. These railways hauled, to the date given, a total of 860,000 tons of ammunition, forage, rations, water, construction materials and personnel with a ton mileage of 8,106,700, including the empty haulage. The tonnage alone represents over 280,000 loads for 3-ton motor truck, and this manner of stating it gives an idea of the value of the light railway service to the A. E. F.

ANNEX "A"—CHAPTER XV—SECTION V.

LIGHT RAILWAY ACTIVITIES OF THE ENGINEERING AND CONSTRUCTION GROUP, A. E. F.[1]

The construction of light railways and roads, under the immediate supervision of G–4, G. H. Q., was limited to the advance section, S. O. S. and to army areas. The Department of Light Railways and Roads was in fact a division of the office of the Chief Engineer, and was maintained at G. H. Q. until the signing of the Armistice. Details of a General Staff nature were discussed directly between the Director of Light Railways and Roads and the officers of G–4–C. The operation of light railways was, necessarily, an army function and detailed reports in connection therewith will be found in the reports of the commanding generals of the armies and with that of the Chief Engineer, A. E. F. Similarly, the construction of roads will be covered by the same reports. The following figures are, however, given as indicative of the magnitude of these operations, viz:

On the day the Armistice was signed, the A. E. F. was operating 2,240 kilometers of light railway, of which 1,740 kilometers had been taken from the Germans, and the balance had been newly constructed or rebuilt. Up to February 1, 1919, our light railways had handled a total of 860,652 tons of material, of which 166,202 tons was ammunition. In one week, 10,600 tons of ammunition were handled. In six nights, 23,138 soldiers were carried, and the light railways played a very important part in moving forward to the combat lines, and assisting in the evacuation of sick and wounded. The daily net tonnage handled in October 1918 was 8,100 tons. In one week 10,700 tons of rations were handled. On November 11th, 165 locomotives and 1,695 cars were available for use. In five hours, on one occasion, 135 men laid 14,200 feet of light railway track, or slightly under 3 miles. Ten shop buildings, 70,000 square feet total area, were erected at Abainville above Gondrecourt. The shop project occupied 125 acres and shop employees had created 2,300 cars and repaired 140 locomotives.

[1] Extract from letter of Chief of Group, G. H. Q., A. E. F., Group C (Engineering), Fourth Section, General Staff, 1 April, 1919—To: "A. C. of S., G–4, G. H. Q., A. E. F.," on Activities of G–4–C (Engineering and Construction Group of the 4th Section, General Staff, G. H. Q., A. E. F.)

In the S. O. S. alone, exclusive of the advance section, 300 miles of road had been maintained and repaired, and 90 miles of new road had been constructed. The mileage of road worked over in the advance section including army areas, has never been fully calculated but, subsequent to the Armistice, there had been engaged about 34,500 troops of all arms of the service other than Engineers, 34,000 civilians and 15,000 prisoners, in an attempt to restore these roads to approximately the same condition that they were in when the American Expeditionary Forces arrived in France.

These forces were exclusive of 43,000 Engineer troops engaged in construction, and 18,500 engaged on forestry projects, all under the Director of Construction and Forestry.

NOTES ON AMERICAN LIGHT RAILWAY OPERATIONS.[1]

1. In the zone forward of the light railway system, no organized rail system of transportation was operated in the American Expeditionary Forces.

Numerous short, independent, lines were constructed of light rails, with little or no ballast, and were utilized and operated by individual organizations. In the St. Mihiel sector, many artillery-gun positions, machine-gun locations, and strong points were thus served. The power utilized on these lines was either man or animal-drawn. The American Army had available for this purpose only a very limited number of four-wheeled trucks, which had been purchased from French commercial enterprises and were practically worn out through prior service during commercial life. After the preliminary stages of the St. Mihiel drive, many small German cars were captured and were utilized in this manner. This system of distribution was handicapped in its development, principally because the amount of material for distribution to troops or to an organization was extremely limited.

The greatest development in this auxiliary system was made in the Forêt de la Reine, which was located in the St. Mihiel sector. This forest was very heavily wooded, swampy, and almost devoid of roads. Herein were located a large number of these branch lines and they were greatly utilized in the manner stated above. There was also available for use a very limited amount of 40 centimeter track, which was used in a similar manner but with smaller and lighter equipment. This trackage was inherited entirely from the French, as none was purchased by the American Army. Naturally, our experiences with this class of transportation in the Meuse-Argonne were more limited, due to our front never being sufficiently stabilized to have permitted much of a development. There can be no doubt, however, of the advisability of transportation of this nature, and this is especially true when weather conditions and tactical conditions make the utilization of other transportation methods more than difficult and often requiring resort to pack transport.

[1] These notes were prepared for the M. B. A. S. by Col. E. D. Peck, Chief Engineer, 1st Army A. E. F.

The American Army also had a few mono-rail cars but their value was not determined upon, as the number available was very small and they were used only for a very inconsiderable period.

2. No experiment had been made as to the desirability of utilizing a 2′ 6″ gauge rather than the 60 cm. The experience of the American Army shows conclusively that the American motive power for the 60 cm. lines was too heavy and was designed with a too high center of gravity. This combination of weight and height of center of gravity necessitated a very large amount of maintenance. It is certain that a 2′ 6″ gauge would have materially increased the stability and lessened the amount of track maintenance, which was very high as compared with the operations of the French.

3. The American Army made no experiment with the 30-pound rail. It did, however, use the 25-pound rail in France to a very great extent, as all the rails purchased in America were of this weight. For the rear lines 25-pound rail was infinitely more satisfactory than the 16-pound French rail which was used almost exclusively in the forward areas, and especially when it came to construction of roads under fire and for rapid development. The 16 or 20-pound rail undoubtedly has the advantage for rapid construction, but for the main arteries of commerce, having the maximum travel thereon, it is believed that the heavier rail is preferable.

CHAPTER XVI.

SECTION I—PART I.

ORGANIZATION, ETC., OF THE MECHANICAL TRANSPORT IN THE BRITISH ARMY IN FRANCE AND FLANDERS.[1]

1. MOTOR TRANSPORT.

(*a*) *Organization of Mechanical Transport* (Chart 1, Chapter XVII, Vol. I).—The mechanical transport of the British Army was run by, and formed one of the branches of the Royal Army Service Corps (R. A. S. C.). There was no special mechanical transport corps. The transport worked under the Director of Transport who was one of the directors on the Quartermaster General's staff, and was not controlled by the Director General of Transportation.

The majority of the mechanical transport in an army was allotted to army corps, i. e., each army corps had a corps M. T. column which was subdivided into M. T. companies capable of meeting the maintenance requirements of the divisions and corps troops (exclusive of siege artillery) which formed the army corps.

In a similar manner, to each corps was allotted a corps heavy artillery M. T. column which controlled a number of M. T. companies for the maintenance services of the siege artillery brigades, one company being allotted for the service of each brigade.

Certain small units, such as signal units and medical units, were allotted a few vehicles for the carriage of their technical stores and equipment.

In addition to the above, there were certain pools of transport which remained in the hands of the Quartermaster General (Q. M. G.) for allocation to formations which might be temporarily unable to cope with the work required of them by means of the mechanical transport allotted to the various units in that formation. These pools of transport consisted of G. H. Q. reserve M. T. companies and the reasons which led to the formation of these units and the role they were intended to play are explained in Appendix I.

[1] Prepared for the M. B. A. S. by Director of Transport, British Forces in France and Flanders.

There also existed a "bus park" for the carriage of troops and this was kept under G. H. Q. control primarily for tactical purposes.

(*b*) The pooling of transport was as outlined above, viz: certain allotments were made to each army corps and certain allotments to each army as and when required, from the G. H. Q. reserve.

Each army corps reported daily to army H. Q. the extent to which mechanical transport vehicles could be made available for duty under army control to carry out extraneous services, or to assist other corps or armies which might be in need of help.

(*c*) Road traffic was controlled by the Provost branch of corps and army headquarters. In all forward areas traffic circuits were worked out so as to ensure that narrow roads did not become congested by having double streams of traffic on them and also by the posting of trained traffic posts at all important cross roads.

2. MOTOR TRANSPORT SUPPLIES.

(*a*) The mechanical transport vehicles of the British E. F. were all supplied from England where they were purchased by the Ministry of Munitions and handed over to the War Office for disposal to meet the requirements of the various expeditionary forces.

(*b*) *System of Storage* (Chart 2, Chapter XVII, Vol. I).—In order to make good the recurrent wastage of M. T. vehicles a reserve was held in France based on the number of vehicles in service. This reserve was calculated on the following scale:

Lorries, including busses	4%
Gun tractors	10%
Cars	7%
Ambulances	9%

When the reserve was depleted to less than the figure laid down above, arrangements were made to bring it up to strength from England, either by means of special demands or by arranging for monthly consignments to be sent overseas. The localities where the reserves were kept have varied from time to time to meet the military situation, but it may be stated that at the time of the Armistice, reserve vehicle parks were established at Rouen, Abbeville, Wissant (near Calais) and Valenciennes.

(*c*) All casualties of motor vehicles, other than motor cycles, were reported to the Director of Transport who issued instructions for replacements to be made to armies from the reserve vehicle depot most convenient to the locality where the replacement was required. Motor cycles were replaced on indent from the advanced M. T. depot.

All demands for spare parts were forwarded to the advanced M. T. depot, from which place detailed distribution was made to

the majority of units. In certain cases, however, the base M. T. depot actually made direct issues, acting as the agent of the advanced M. T. depot to certain units which might be more conveniently situated, as far as railway facilities were concerned, than the advanced M. T. depot.

8. SYSTEM OF MAINTENANCE.

(a) *Types of repair parks.*
(b) *Locations.*
(c) *General description of system.*

There were practically only two echelons of repair of M. T. vehicles in the British Armies in France and Flanders. The forward echelon consisted of mobile workshops with small machine tools, such as 5-inch lathes, electric drills, etc., which were allotted to all M. T. units. In these shops it was possible to carry out all classes of light running repairs, but field units were not encouraged to carry out heavy overhauls unless they happened to be in rest for a considerable period and were thereby enabled to devote more time to executing such work.

The second echelon of repair was provided by the heavy repair shops located on the lines of communication well in the rear of the armies, the exact sites being settled by military conditions prevailing at the time. The locations of these heavy repair shops were as follows:

No. 1---------- PARIS.
No. 2---------- ROUEN.
No. 3---------- HONFLEUR (evacuated from St. Omer owing to enemy action).
No. 5---------- ROUEN (evacuated from Bergues, near Dunkerque, owing to enemy action).

All the above dealt with the complete overhauls of vehicles. No. 3 was devoted to the repair of motor cars, ambulances, etc., while No. 2 dealt with motor cycles and sidecar combinations. This shop, however, together with No. 1 and No. 5 was mainly concerned with the overhaul of lorries. There was in addition a fourth heavy repair shop located at Rouen which was solely concerned with retrieving of unserviceable stores evacuated to the base from units at the front. It was also in a position to manufacture a certain number of spare parts of which there was a shortage in the supply from England. In the heavy repair shops the general practice was to strip a vehicle completely and re-assemble it. Of course, if a vehicle came in with, say, only an engine damaged, the whole vehicle was not necessarily stripped and the engine only was repaired or replaced. In practice, however, it found that 80% or 90% of the vehicles arriving in heavy repair shops required practically complete stripping.

SALVAGE OF MOTOR TRANSPORT.

Every M. T. unit was provided with one or more first-aid lorries, according to the number of vehicles on charge. These first-aid lorries were provided with a certain amount of lifting tackle, jacks, skids, etc., to enable them to go out and tow any lorries which had broken down or had run into ditches. Should the first-aid lorries not be capable of salving a casualty, special units, called "mobile repair units," were allotted on the scale of one to each army and were provided with specially fitted salvage lorries which could extricate a derelict from almost any position.

NOTES ON BRITISH M. T. SERVICES IN FRANCE.

EMPLOYMENT [2]

1. There are 24,000 lorries in the B. E. F. With certain exceptions noted below none of these lorries are definitely allocated for special work either for ammunition supply or any other service. In practice, lorries are pooled and used to the best transportation use according to the needs of the moment. Thus lorries may be on ammunition supply for artillery for a period and immediately afterwards be switched on to the carriage of R. E. stores.

The exception is that of ammunition lorries of siege artillery battery ammunition columns which are rarely used for other purposes. In the event of even these lorries being not required for ammunition supply, due to abnormal tranquillity of a front, they also become available for detail on general transport work. It is not practicable, therefore, to distinguish between lorries "for ammunition transport" and those "for other services."

Lorries definitely allotted to a division are those of the divisional M. T. company of 75 working lorries. They are controlled by the corps however, and are not necessarily always at the disposal of the division to which they are affiliated. In other words, divisional M. T. companies are "pooled" in a corps for the common good.

Corps have corps M. T. companies of 30 working lorries. These are not a reserve but are specifically for the supply of the numerous army troops attached to a corps who are situated at such a distance from railhead as to necessitate the use of M. T. for drawing supplies, mails, ordnance. stores, etc. These lorries are equally available with those of divisional M. T. companies for common corps pool when their primary duty for the day is finished.

Armies have each an army troops M. T. company of 60 working lorries. The same remarks apply to this unit as to a corps troops M. T. companies.

[2] Prepared by the British Section, M. B. A. S. (September 1918).

General Headquarters (G. H. Q.) has a G. H. Q. troops M. T. company of 48 working lorries to meet the supply, ordnance and general transport need of General Headquarters. G. H. Q. reserves of M. T. are dealt with under paragraph 5 of these notes.

2. The normal proportion of lorries for the services quoted varies according to the weight of the following factors: (*a*) Whether operations are in progress or whether the front is quiet. (*b*) Whether dumping is in progress on any particular front for a contemplated offensive or defensive action, or whether extensive defensive lines demanding large quantities of R. E. stores, or large hutting programs are being undertaken in any particular area. (*c*) The development of light railways in any area. The more highly developed these communications are, the less the number of lorries in use.

The only fixed, or nearly fixed, scale of lorries which can be given as a guide are those in use for rations. This may be taken as requiring one three-ton lorry for every 1,000 men's rations, or 200 horses' rations. Even in this case, numbers vary in different localities as, whenever possible, formations draw supplies by divisional train (and even first line transport occasionally) from railheads, thus releasing lorries for general transport duty.

From these considerations it is clear that no normal or standard proportion of lorries can be laid down, and one of the advantages which caused the adoption of the system of pooling lorries within the corps is that we obtain thereby an elastic system of transportation which will adapt itself to meet the changing conditions under which demands for M. T. are made.

3. Concerning allocation of mechanical transport, paragraph 1 answers this question. The divisional resources are not reinforced but "pooled" under the corps.

4. There are no reserves at the disposal of an army normally, but it has been found advisable to allot to armies temporarily certain of the G. H. Q. reserves. These and their work are dealt with in the next paragraph.

G. H. Q. disposes of 16 G. H. Q. reserve M. T companies each of 90 working lorries, and also one auxiliary bus park.

Of the 16 G. H. Q. reserve M. T. companies all but three have been allotted to armies. Their primary duty is to assist in the transport of ammunition for siege batteries, and the 3 at the disposal of the G. H. Q. are in hand to reinforce any army hard pressed for transport for this purpose when operations develop on any army front. When not required for ammunition work those allotted to armies are at the disposal of army commanders for general transport duties, the greater percentage of which consist in the

transport of stone for road maintenance. The balance are required for engineer stores in connection with rear defenses.

5. Certain companies are allotted to the cavalry corps to ensure maintenance during operations, and one to the auxiliary bus park for the conveyance of regimental equipment and baggage of troops carrying out tactical moves by bus. The auxiliary bus park is designed solely for the purpose of carrying out speedily tactical moves of troops. It is in no sense a "reserve" and is entirely controlled by the General Staff. It has a capacity of approximately 12,000 seats.

6. The only existing M. T. in armies other than that which has been dealt with above are motor ambulance convoys, which are specialized medical units, and "park sections" of army field artillery brigades. The latter are attached to the divisional M. T. companies affiliated to the divisions to which the brigades are attached for operations. They are pooled with the remaining lorries of the divisional M. T. companies.

7. Any re-inforcements of M. T. vehicles or personnel arriving in the next three months will be required to maintain the ordinary casualties in existing establishments. Therefore, as far as is known in France, there are no expectations of organic changes.

Chapter XVI—Section I—Part 2.

MOTOR TRANSPORT—THE BRITISH SYSTEM OF TRAFFIC CONTROL.[1]

As is shown in other sections of this chapter the traffic control units, under the French system, formed part of and functioned directly under the orders of the "Direction du Service Automobile", which was one of the services directly under G. H. Q. This service operated the automobile units and also administered the traffic control units.

Under the British system, motor transport was assigned to divisions, but was placed at the disposal of others under the corps. That is to say, the corps pooled the motor transport of the divisions constituting it. As a general rule, the army had no reserve of motor transportation, but called on the G. H. Q. reserve when it was necessary for movements to be made which could not be handled by the corps transportation. These vehicles were under the direction of the "Q" Branch of the staff.

On the other hand, the traffic control units operated under the "A" Branch of the staff. To secure cooperation in the movements of large bodies of troops, it was essential that the "A" and "Q" Branches work in unison. As has been indicated before, the "A" Branch was responsible for personnel, discipline, military regulations, and controlled the Provost Marshal's Branch from which the units were drawn for the various traffic control posts.

The advanced roads were controlled by the corps and army staffs, each being responsible in a definite area.

When it became necessary to move large bodies of troops or supplies across the areas of several armies or corps, the preliminary arrangements were made between the army or corps staffs. They were then made known to the traffic control officers of each corps or army through which the movement was to pass; these traffic control officers, usually accompanied by a staff officer from the headquarters of the unit concerned, made the necessary detailed arrangements; the staff officers indicating what roads were available for the movement and selecting routes for traffic. The conditions of the roads were necessarily considered and the main roads were selected for the use of the motor transport. Horse transport and other slow moving

[1] Prepared for the M. B. A. S. by Colonel Harry L. Hodges, General Staff, American Setcion, M. B. A. S.

transports were sent, if possible, by other and second class roads. When this transport, motor or otherwise, had to return, it was sent by another route if possible; the general rule being to have traffic, so far as circumstances permitted, move in only one direction on a road.

Since movements of troops or supplies by motor transport were quite frequent, and to avoid unnecessary road and terminal surveys in each case, a traffic map was ordinarily maintained at army or corps headquarters showing, by means of red and blue lines, roads which could be used by motor transport, roads which could be used by horse transport, etc.

When a movement was ordered, the organization commander supplied the "Q" Branch of the staff with whom he served with all details as to the number of men and tons of material to be moved. The "Q" Branch arranged for the supply of vehicles from their own transports, in the case of divisions, or by appeal through army headquarters for the use of the G. H. Q. "reserve" or the auto bus park.

The traffic control units were usually directly under the command of army headquarters as will be shown in the extracts from the regulations for the use of the Provost Marshal's Branch, British Armies in France "(Section 3.—Traffic Control, pages 16, 17 and 18)" which follow:

Recent operations, when several corps were operating on a narrow front, have emphasized the necessity for strict road control, if troops in action are not to suffer from delays in sending up reinforcements, ammunition and food.

In order to ensure satisfactory control during active operations it is essential that traffic control posts should be mounted at all cross roads and road junctions in the area in advance of railheads. In addition, during important movements, it will be necessary to block all side roads. Mounted men will also be necessary to continually patrol between the control posts. Whenever a formation arrives in a new area immediate steps will be taken to establish control posts at all important points.

Traffic control posts will consist of specially selected N. C. Os. and men drawn from Divisions. They should be placed at the absolute disposal of the A. P. Ms. They must be available at all times, and so organized that an A. P. M. can move them from point to point, and distribute them as circumstances require. In fact, whenever it can be satisfactorily arranged, the N. C. Os. and men on control duty should form part of an A. P. M.'s establishment, and administered by him.

Each post should consist of not less than one N. C. O. and four men; important points where two men are required to be on duty at a time should be proportionately strengthened. The N. C. Os. and men of each post should be billeted on the spot, and arrangements made for the distribution of rations.

Particular attention is to be paid to the Traffic Orders which have been issued.

It is most important to educate: (a) Those in charge of traffic which has to be controlled. (b) Those whose duty it is to control traffic.

A. P. Ms. should report to their staff all cases that come to their notice of these orders not being known to officers commanding trains, column parks, etc.

A. P. Ms. are responsible for the training of the M. M. P. and the traffic control personnel. They must see that they thoroughly understand their duties, that they act with discretion and foresight, and above all, that they not only check and bring to notice deliberate disobedience of orders, but also assist traffic in every possible way.

Officers commanding transport units, both horsed and mechanical, are responsible for the control of traffic past their units, by day and by night, when they are either halted or parked by the roadside.

A. P. Ms. should satisfy themselves that adequate arrangements are made by these units.

A. P. Ms. will invariably inform all other A. P. Ms. through whose area troops or transport belonging to their formation are about to move. The information must include times of movement, nature of columns and routes to be followed.

System for working traffic.—Traffic should be worked on one of the two following systems: (a) The Point System. (b) The Block System.

The point system is employed on roads where there is a constant movement of traffic, and during the movement of large bodies of troops, for which it is necessary to keep roads clear of all other traffic.

In this system, control posts are placed at all important cross roads, road junctions, supply and ammunition dumps, railheads, refilling points, and medical collecting stations, also when necessary, at points where side roads enter the route which is to be kept clear.

The block system should be employed when a small force only has to be dealt with, and there is not much traffic on the roads. The procedure is as follows:

A certain number of men, preferably cyclists or mounted men, are to be detailed to proceed in advance along the route to be followed by the troops. One, or two men, are posted at each cross road, or road junction for such a distance ahead of the column as will ensure the march being carried out without interference by other traffic. When the head of the column reaches the first post, the men mount and proceed to the road junction beyond the farthest post, clearing the road as they go. This procedure is carried out by successive posts, until the troops reach their destination.

INSTRUCTIONS FOR THE GUIDANCE OF TRAFFIC CONTROL POSTS.

In order to ensure the proper working of traffic arrangements under all circumstances, N. C. Os. and men employed on controls will be thoroughly instructed by the A. P. M. in their duties.

In pursuance of these general instructions the "Fourth Army Standing Orders, 'A' and 'Q' Branches" prescribe that:

TRAFFIC CONTROL.

344. *Responsibility.*—Corps will be responsible for the regulation of all traffic within their respective areas, and will establish the necessary controls to ensure that the traffic orders are enforced.

345. *Personnel.*—The following personnel will be provided by each Division: (*a*) At least one traffic officer, who will be placed absolutely at the disposal of the A. P. M. (*b*) An adequate number of especially selected N. C. Os. and men, trained in traffic duties, to supplement the military police whenever necessary. (*c*) Permanent traffic control personnel, consisting of at least—1 sergeant, 7 corporals or lance-corporals, 29 rank and file (Infantry); 3 cyclists drawn from Corps Cyclist Battalion.

The above men will be struck off the strength of their units and will be shown on the effective strength of the Divisional Employment Company on A. F. B. 213, under the heading, "By Arms Attached."

Each of these N. C. Os. and men must be chosen for his intelligence, activity and suitability for the important duties to be performed. Each should, in the event of big operations, be capable of taking command of a post formed of untrained men.

This personnel is to be placed permanently under the A. P. M. of the Division for training, duty and discipline. It is to be changed as seldom as possible, and is to be employed on traffic control only. Unsatisfactory men are to be replaced at once.

Unfit N. C. Os or men are not to be included in this Divisional establishment.

(*d*) In addition to the above-mentioned permanent establishment of N. C. Os. and men, such extra N. C. Os. and men as may be required for the control of traffic in towns of any size in the billeting area allotted to it.

346. Whenever circumstances demand it, the whole of the personnel referred to in (*a*), (*b*), (*c*) and (*d*) above will be pooled at the disposal of the A. P. M. of the Corps, for allotment to subareas, as required.

347. *Control Posts.*—It is essential, during important movements, that fixed control posts should be placed at all cross-roads and at all points where side roads debouch into main roads, and that roads used by troops and transport should be effectively patrolled by mounted traffic control personnel.

348. Each control post must be provided with a copy of the Army Motor Traffic Circuit Map, mounted on a board and varnished.

349. All columns or convoys of vehicles, and all single vehicles, are to comply with the instructions given by a control post or by traffic patrols.

350. Traffic control posts and traffic patrols are to be regarded as exercising authority under a Provost Marshal, and will be held responsible that their instructions are obeyed.

351. Passing a control post against the orders of the post will be regarded as "forcing a traffic control post" and will render the offender liable to trial by Court-Martial.

Every traffic control post will be provided with a card. Any officer who fails to comply immediately with the orders of a traffic control post will write on this card:—

(*a*) His name, rank, unit, and formation to which he is attached.

(*b*) His reason for disobeying the order.

352. The Army Commander, whether on foot, horse-back, or in a car, is never to be stopped by traffic controls, except on account of a special order as regards a particular road being unsafe.

353. *Responsibility of Control Posts.*—Control Posts will be armed and will be held responsible that they:

(*a*) Make all military and civilian traffic follow the routes laid down in Traffic Orders, as indicated on Traffic Signboards and Traffic Control Maps.

(*b*) Control and regulate passage of all motor and horse-drawn vehicles, and prevent the blocking of roads. At points where congestion is likely to occur vehicles must be kept on the move.

(*c*) Stop all mechanical transport and horse-drawn vehicles proceeding against traffic circuits. Take the number, name and unit of the driver, and, if feasible, turn back the vehicle and order the driver to proceed to his destination by the correct route.

(*d*) Do not accept any pass for a vehicle to proceed in a direction contrary to traffic direction circuits, unless the pass is signed by a Staff Officer of Army or Corps Headquarters, or by an A. P. M.

(*e*) Stop all motor lorries, motor-buses, ambulances, cars and motor cyclists travelling at an excessive speed, and obtain full particulars regarding the driver. (Speed limits are given in S. O. 374.)

(*f*) Take name, number and unit of all drivers trotting horses and mules in draught.

(*g*) Do not stop motor cars or motor cyclists for the purpose of examining card passes, either by day or by night, unless special orders are issued that this is to be done.

(*h*) Do not allow exercising of horses or mules on M. T. circuits.

(*i*) Take the numbers of all lorries unprovided with a "look-out man," and, whenever possible, stop the lorry and obtain full particulars of the driver.

(*j*) Stop and ascertain full particulars of all M. T. vehicles traveling at night with unshaded headlights.

(*k*) Log all important movements of troops and transport past their posts.

(*l*) Enforce obedience to all Traffic Control Orders, as and when issued. Any officer, who, owing to an emergency, disobeys their orders, will sign the card referred to in S. O. 351. They will act, if they are being forced, no matter by whom, in the manner prescribed for sentries on active service.

354. *Movement of Troops.*—Corps will invariably inform all other Corps through whose area troops or transport belonging to them are about to move. This information, which will include times of movement, nature of columns, and routes to be followed, will be communicated at once to the A. P. Ms. of the areas concerned. Traffic control must, however, be so organized that blocks cannot result from neglect to furnish such information.

355. When considerable columns of troops or vehicles are about to march, an officer should precede them and should warn all control posts along the route which is to be followed by such columns.

356. Officers in command of columns either of troops or vehicles are reminded that they are responsible at all times for the maintenance of march discipline within their commands, and that any slackness in this respect or violation of the rules regulating traffic may cause disaster to troops in action by delaying the flow of reinforcements, reserves, ammunition, or food.

357. The method of marching, and of moving in such a manner as to leave roads as clear as possible for other traffic, is to be practised at all times until it becomes a habit.

358. The following minimum distances will be maintained between units on the march in the Army Area:—

	Yards.
Between batteries of artillery	100
Between sections of D. A. C. or B. A. C.	100
Between artillery brigades	500
Between companies	100
Between unit and its transport	100
Between battalions	500
Between transport of units when brigaded	100

In addition, vehicles of all kinds, whether mechanical or horsed, must leave gaps of 25 yards between each section of six vehicles and 50 yards between columns, to enable traffic to pass.

359. When a column of troops or transport is halted by a block in the traffic, the officer in command of the column must communicate to the nearest control post the composition of his column and his destination.

360. Whenever columns of troops or vehicles halt, cross-roads and road junctions must be left clear. Heads of columns will therefore halt at least 50 yards short of cross-roads and road junctions.

361. It is particularly important that railheads and refilling points should not be blocked, and that roads should be kept as clear as possible during halts.

362. It is forbidden for troops to use the permanent way and lines under construction as roadways. Authorized crossing places only will be used.

363. Units will send out, immediately on arrival at their quarters for the night, guides to lead their baggage and supply vehicles from the train to their quarters. As the wagons of a unit may become separated by the end of the march, there should be one guide for every wagon.

364. *Vehicles—General.*—For purposes of traffic control, light tenders and box cars will be regarded as motor ambulances; and motor buses, steam tractors and water-tank vehicles will be regarded as lorries.

365. All drivers are to be informed of their destination before taking the road. If for any reason their destination cannot be definitely stated, they must be informed of the place where they will meet their guides.

366. Officers in command of Divisional trains, of supply and ammunition columns, and of motor ambulance convoys, will be held responsible that they ascertain, before they start, the circuits which should be followed by them.

367. Avoidable halts may not be made on a main traffic route. Vehicles must draw out clear or into a side road.

368. Whenever a vehicle breaks down or a column makes a regular halt, the officer or N. C. O. in charge will at once improvise a suitable control, pending the arrival of the responsible traffic personnel.

369. Whenever a block occurs on a road it is the duty of any officer or N. C. O. who may be present to take steps at once to clear it, and to provide a free passage for passing vehicles, unless the matter is being dealt with by a traffic control unit, to whom every assistance will at all times be given. Blocks are most frequently caused by a vehicle halting in the fairway and remaining halted for a long time when it could easily be halted in another spot close by without interfering with the traffic.

370. A car or other mechanical vehicle which is overtaking another vehicle, must give way to an approaching vehicle. Also motor vehicles moving on a main road have right of way over other debouching from a side road.

371. Drivers of motor vehicles when approaching a traffic control will signal the direction in which they wish to travel.

372. Fast moving traffic will slow up when passing troops, and will give them every consideration.

373. All motor traffic on roads along canal banks will stop and give the inside of the road to any mounted man who may ask for this to be done by raising a hand above his head.

374. *Speed Limits.*—The speed limits are as follows:

	Miles per hour.
Motor cycles	25
Cars	20
Motor ambulances	15
Light tenders	
Box cars	8
Lorries	
Motor buses	
Steam tractors	
Water tank vehicles	

375. The speed of cars will be reduced to 10 miles per hour or less when passing through villages and towns or over bad or paved roads. When carrying sick and wounded, the speed of motor vehicles will be so modified so to ensure the safety and comfort of patients.

376. Similarly, the speed of motor lorries and ambulances will be reduced to 6 miles per hour or less when passing through villages and towns, or over bad or paved roads, or when the traffic is congested. The speed limit for lorries on timber roads is 6 miles per hour.

377. *Lorries.*—Lorries will move independently of mounted and dismounted troops on the line of march.

Mechanical transport will not block the roads by waiting to form column before moving off. Convoys will be divided into sections, each of six vehicles, with an interval of 25 yards between sections. Every sixth vehicle will carry suspended from the left side of the tail-board a detachable red disc, 18 inches in diameter, fixed in such a manner as to be clearly visible from the rear, and not obscured by the tarpaulin, and will, in addition, carry a red disc, 9 inches in diameter, suspended from the radiator cap, or other suitable part on the front of the vehicle.

378. The last vehicle of each convoy will carry a double red disc suspended from the left hand side of the tail-board. Other vehicles will not approach within 25 yards of any vehicle carrying the red disc, except when about to pass the column.

379. Convoys of over 10 and under 30 vehicles will be accompanied by at least one officer; convoys of over 30 vehicles will be accompanied by two officers. These officers will accompany the column from start to destination, setting the pace, and superintending the march disci-

pline throughout the service on which they are employed. The fact that lorries are working singly does not relieve the road officers of their responsibility for supervising their lorries on the journey. Officers commanding units will arrange frequent patrols of officers and N. C. Os. along the roads on which their vehicles are working.

380. Loaded lorries are to be given the "right of way," and empty convoys will halt, if necessary, to allow them to pass. Motor cars, motor ambulances and horsed transport will always give way to motor lorries and will leave them the centre of the road.

381. Motor transport will be halted or parked along a road in such a manner as to allow the free passage of traffic in both directions. If this is not possible, an interval of 25 yards will be left between each 10 vehicles.

382. All motor lorries and motor buses will keep strictly to the traffic circuits shown in the Army Motor Traffic Circuit Map. Every lorry and bus will be fitted with a board, on which will be mounted a copy of this map. This board will be placed in a position where it can be readily consulted by the driver.

383. Arrangements must be made for a look-out to be kept at the rear of every lorry when moving or when temporarily halted on a road. Some device, operated by a string, or a ball, will be adopted, so that the look-out at the back can signal at once to the driver.

384. Lorry drivers are not to be ordered to take their vehicles up side roads or tracks, which are not included in the normal traffic circuits. The officer or N. C. O. in charge of a convoy, or the driver of a single lorry, is the judge as to whether the route is practicable. If the driver considers the route to be impracticable, he will demand a written order from a superior. The driver will then be relieved of all responsibility and the signer of the order will be held accountable for his action and for any damage that may result from it.

385. *Motor Cars and Motor Cycles.*—No restriction is placed upon the movements of despatch riders, or of motor cars carrying officers on duty. Cars carrying staff officers are not be to compelled to follow lorry routes. R. F. C. tenders, carrying offiicers on artillery duty, and labelled "On Artillery Duty," are to be treated as motor cars carrying officers on duty.

386. Behind the fighting area sentries will not challenge or stop motor cars or motor cycles at night, except at the recognized control posts of the forbidden zone, and at such special posts as are established from time to time under the orders of A. P. Ms. The sentries on these posts are to be provided with lanterns.

387. *Motor Ambulances.*—Motor ambulances will conform to the motor traffic circuits. Corps are, however, empowered, in case of emergency only, to authorize their movement against the circuits, in which case special control arrangements must be made.

Such movements will only be permitted when: (*a*) The circuits are free from supply vehicles, that is to say, usually from about 12 noon one day to 6 a. m. the following day. In this connection every endeavor will be made to ensure that supply columns refill and complete their movements by midday. (*b*) The circuits are not required for use by large bodies of troops.

388. Motor ambulances may also use roads not marked as motor traffic circuits, provided that: (*a*) Such roads are suitable for them. (*b*) They follow the arrows directly they debouch into a circuit.

389. *Horsed Vehicles.*—Horsed vehicles of all kinds must keep as near as possible to the right side of the road. The personnel not actually looking after the horses must not, when halted, stand about in the road.

390. Horses and mules in all transport vehicles are not to be trotted, except in cases of emergency.

391. The normal hourly halts will be observed throughout a march.

392. All ranks, whether mounted or dismounted, will march in the column and not on the near side of it.

393. Only an authorized load, the current day's forage, and rugs for the team may be carried on a vehicle.

394. Horses and mules will not be tied to vehicles, except in cases of emergency.

395. *Civilian Vehicles.*—Whenever civilian vehicles are likely to interfere with military movements, they must not be allowed to drive on to traffic circuits or on to any roads required for military movements. If they happen to be on such roads during such movements, they must either be moved to one side clear of the road and halted, or turned into a field. The *gendarmes* attached to formations should be utilized to enforce this order.

396. *Exercising Horses.*—Horses and mules are not to be exercised through towns or on roads marked in red or blue on the Army map "Motor Traffic Circuits." *Grandes Routes, i. e., Routes Nationales* and *Départementales* are not to be used by parties exercising animals.

They will be exercised under the supervision of an Officer, unless an Officer is not available, except when they number less than 20. N. C. Os. in charge of exercising parties will ride in rear and not in front.

397. Led horses being exercised or taken to water will invariably have bits. Care will be taken to ensure that the bits are removed when the animals are drinking.

398. *Double Banking.*—Two columns of troops or vehicles are not to "double bank," i. e., move abreast along a road in the same direction, unless ordered to do so by a General Officer.

399. Wheeled traffic, other than motor cars conveying officers and despatch riders, must not endeavor to pass other traffic moving in the

same direction when another stream of traffic is approaching from the opposite direction, unless the officer in command has ascertained that there is sufficient interval between the two approaching streams of traffic to prevent any chance of a block.

400. *Closing Roads.*—When roads have to be closed for repairs during certain hours, information will be forwarded without delay to A. H. Q., and to all Corps, in order that a notice may, if necessary, be published in Routine Orders.

401. *Railway Crossings.*—Road traffic must be so controlled that trains are not stopped at points where the railway crosses open roads. The delay to the road transport will be slight if the control posts are efficient.

The delay to trains held up by road transport is, however, serious, because engines cannot always re-start on a grade, and have to run back a long way before they can gather sufficient way to carry them over the grade.

Close attention to this important point will be repaid by greater punctuality of trains.

On the other hand, trains must not be shunted or stopped in such a way as to block level-crossings for a moment longer than is absolutely necessary.

402. Accidents to the gates at level crossings are continually being caused through want of care on the part of motor car drivers.

All level crossings must be approached with care, at a moderate speed, especially at night. No attempts must be made to rush gates when they are being lowered. If the crossing is closed, cars must pull up at least 2 yards from the gate.

403. Drivers are forbidden to commence passing over a level crossing until both gates have been opened.

404. Corps will arrange for the warning boards shown in S. O. 406 (*d*) and (*f*) to be placed in conspicuous positions, not less than 30 yards from all unguarded level crossings. Both boards will be fixed to one upright, 8 feet in height, which will be painted black and white alternately. The circular board will be fixed above the other. A red light will be suspended from the boards at night.

405. *Traffic Signs.*—Corps are responsible for the placing a sufficient number of traffic signs in their areas. The following are particularly necessary: (a) Direction arrows on traffic routes. (b) Signs at dangerous corners and level crossings. (c) Signs refusing roads and routes to certain classes of traffic. (d) Road direction signs.

406. The following signs, which have been standardized by G. H. Q., will be made of tin and affixed to light rods:

(*a*) HORSED TRAFFIC ONLY. (24-in. x 24-in. White letters on black ground. Square shaped sign.)

(*b*) NO LORRIES OR AMBULANCES. (24-in. x 24-in. White letters on black ground. Diamond shaped sign.)

(*c*) ROAD CLOSED. (24-in. x 12-in. White letters on black ground. Rectangular sign.)

(*d*) DANGER. (24-in. diameter. White letters on red ground. Disc.)

(*e*) BERLIN 33 k. (24-in. x 6-in. White letters on black ground. Arrow shaped sign.) To be fixed on upright and to point in direction of the place to which it refers.

(*f*) LEVEL CROSSING. (26-in. x 12-in. White letters on black ground. Rectangular sign notched on each end. See S. O. 404.)

407. *Lectures to Transport Units.*—Effective regulation of traffic depends not only on the efficiency of the personnel which regulates it, but also on the hearty cooperation of officers and N. C. Os. in charge of columns, and particularly on the road discipline of the troops.

A. P. Ms. of Corps should give lectures on this subject to junior officers at the Corps school, and to officers and N. C. Os. of all transport units in the Corps.

408. *Traffic Rules.*—Traffic rules have been printed for the drivers of: (*a*) Cars. (*b*) Lorries or buses. (*c*) Motor ambulances. (*d*) Box cars or light tenders. (*e*) Horsed transport vehicles.

Each of the above sets of rules is printed on a sheet 13 inches by 8 inches. Spaces are provided for the signatures of drivers.

409. The appropriate set of rules is to be pasted on every vehicle, with the exception of motor cars, in a position where it can be read by the driver. Motor car drivers will keep their copies with their passes.

Applications for additional copies will be made to D. D. S. and T., A. H. Q.

410. *References to A. H. Q.*—The Assistant Provost-Marshals of Corps will communicate with the Provost-Marshal, A. H. Q., on all questions regarding the control of traffic at points where responsibility is divided or uncertain.

411. *Disciplinary Action.*—The above traffic orders are to be made known to all concerned.

412. Proper traffic control can only be instilled into all concerned if effective disciplinary action is taken in every case of disobedience of the orders on the subject. Copies of the reports on cases of such disobedience sent by A. P. Ms. to units will be sent to Corps, Divisional, or other Headquarters concerned, and units will report to their respective Headquarters the punishment awarded by them in each case.

413. *Parking of Vehicles.*—Vehicles are not to be parked in such a way as to block the fairway or side turnings.

414. Narrow roads are not to be used for parking either mechanical or horsed transport.

415. When vehicles are parked on a road, they will invariably stand on the worse, and not on the better, side, so as to leave the best part of the road free for passing traffic. They will never be parked near cross roads or at a bend in the road, and standings must be found off the road as soon as possible. (See also S. O. 278.)

416. *Passes for Motor Cars—Army Area.*—The only recognized passes for British motor cars in the Army Area are: (*a*) Temporary (one day) passes, signed by the commanding officer of the unit to which the car belongs. (*b*) Serial car passes, issued by P. Ms. and A. P. Ms. One pass per vehicle suffices, and the senior officer present is responsible for the other occupants.

417. In the rare cases in which it may be necessary to send warrant officers, non-commissioned officers or men in cars without officers, the senior soldier present is to be provided with written authority from the responsible officer stating the names of the individuals to be transported, the date, destination and route, and the duty on which engaged.

418. Drivers of cars ordered to meet officers must be provided with a temporary pass showing the duty on which they are proceeding.

419. French pink "Permis de Circuler" and Belgian "Laissez Passer" are not accepted as passes for British personnel in the British Army Area.

420. *Passes for Motor Lorries and Ambulances.*—Vehicles travelling in convoys in charge of an officer do not require passes.

All single vehicles and convoys not in charge of an officer require a duty order made out on A. F. W., 3413, which will be signed by the officer commanding the unit to which the vehicles is attached.

The officer signing the pass will be responsible that the journey is necessary and on duty. He will also be responsible that the number of vehicles is not in excess of that required to perform the duty, and that the duty cannot be performed by horsed transport or by combining it with some other duty, so as to reduce the amount of motor traffic on the roads.

421. *Syllabus of Training for Traffic Control Personnel.*—Instruction will be given in the following:

(*a*) Army Motor Traffic Circuits Map.

(*b*) Army Traffic Orders. Every man should thoroughly understand these orders and the reasons for them.

(*c*) Corps and Divisional Orders for Horsed Transport Routes.

(*d*) Signals to be employed, namely:

(I) STOP.—Hand or red lamp held steadily above head, arm extended in the direction of the approaching traffic.

(II) COME ON.—Arm or white lamp extended and swung well forward. This signal must be made distinctly. The red lamp must not be used.

(III) KEEP TO THE RIGHT.—Circular movement of extended arm in the direction that vehicles are to incline.

(IV) SLOW DOWN.—Open hand raised and lowered alternately in line with the hip.

(*e*) Approximate length of various columns, e. g., infantry, battalions and brigades, batteries and brigades of artillery, etc., and the distances to be maintained between units on the march.

(*f*) Action to be taken in certain eventualities with a view to preventing a block, or disentangling traffic which has become disordered.

(*g*) Recognized methods of dealing with all ranks contravening orders, and in submitting short written reports.

(*h*) Identification marks on lorries.

(*i*) Thorough knowledge of the Divisional Area as regards:

(I) Points of the compass.

(II) Towns and villages, and roads leading to them.

(III) Nature of all roads, whether fit for single or double traffic, and all points on them where traffic may become congested, such as cross-roads, road junctions, dumps, railheads, field ambulances, casualty clearing stations, and entrances and exits of fields or yards where vehicles are parked.

(IV) Alternative routes from one point to another, in case traffic is interrupted on any one road.

(*j*) Practical training, in the exercising of authority, on every existing control post in the Divisional area, especially at railheads, and when considerable movements of troops are taking place, or when roads have to be cleared for special reasons.

(*k*) Practice in noting what columns pass their post, and in what direction, i. e., logging of all important movements.

(*l*) Reconnaissance of roads in neighboring areas.

(Foregoing from "Fourth Army Standing Orders", British Army, Adjutant General's and Quartermaster General's Branch, Part I).

Appendix I—Chapter XVI—Section I.

G. H. Q. RESERVE M. T. COMPANIES.

MECHANICAL TRANSPORT IN THE BATTLE OF PASSCHENDAELE, 1917.

After the battle of Passchendaele in 1917, in which mechanical transport had been put to the severest of all tests—the maintenance of a force in action against the heaviest concentration of hostile artillery up to that date, a concentration which was most intelligently directed against roads and light railways in rear of the fighting formations—the potentialities and limitations of mechanical transport were fairly well defined.

During the latter phases of this battle the mechanical transport had to be content also with bad roads and continued rainy weather. The roads upon which many of the more important formations depended were without foundation, a mere crust laid on a semi-liquid clay sub-soil, designed in peace time for farm traffic only. Such were the Hell Fire Corner-Westhoek-Zonnebeeke road, upon which over 100,000 men depended, and the Ypres-Wieltje road. An elaborate system of light railways was continuously in operation, but in spite of all efforts they proved so vulnerable that they were unable, even in a small degree, to cope with the immense volume of ammunition, engineering stores, supplies, etc., required by the troops, and the large bulk of maintenance work fell upon the roads and mechanical transport.

As a result of this severe test several factors emerged which had a considerable bearing upon the course of events during 1918. It was established beyond question that light railways were unreliable in battle against a modern artillery concentration. It was equally evident that reliance could be placed upon mechanical transport under similar circumstances to a degree which a few months earlier would have been considered impossible. It was proved that provided plentiful supplies of timber and stone were available, even the most elementary nature of road could be made temporarily fit for mechanical transport, and maintained so despite the most intelligent direction of enemy artillery fire against nodal points. Road transport is elastic, susceptible to control, and able to take full advantage of lulls in hostile fire. The vehicles can skirt shell holes, which in themselves can quickly be filled with rubbish dumped by a tipping lorry. Thus,

provided the driver has skill and courage, the mechanical transport vehicle gets through where the light railway train is immobilized with probably a break in the line before and behind it, and a target for well directed fire.

On the other hand, it was found that the strain on M. T. drivers was almost intolerable. Much of the driving had to be done at night without lights, and the gauntlet had to be run at every exposed point on the road with a vehicle all too conspicuous. Casualties to drivers were by no means negligible, and even where no direct hits were registered on vehicles, the strain on a tired man made him unskillful and many a vehicle, although not hit, ran off the narrow roads and became bogged in the soft cratered roadside, to be destroyed within a short time by enemy artillery. The system did not suffer much by such casualties, for in most cases the lorries bogged themselves off the road and so cleared the way for oncoming lorries behind them, but another disadvantage had to be taken into consideration. The mechanical strain on chassis began to tell seriously on the condition of vehicles. The battle in its worst conditions was protracted, and the strain on vehicles increased during its whole duration, so that the demand for spare parts became a serious item long before the final phases. At the same time a general shortage of spare parts, replacement vehicles, driver reinforcements, petrol and lubricants made itself felt seriously, and in October 1917, it became apparent that the end of the mechanical transport system of maintenance was not far off, if active operations on the major scale were to be continued for long. Fortunately, this crisis did not arise.

REORGANIZATION OF MECHANICAL TRANSPORT IN FRANCE.

The experience of 1917, demonstrated clearly the necessity for a complete reorganization of the mechanical transport system, in anticipation of the heavy demands which it was quite evident would be made upon it in the spring of 1918.

The first measure decided upon at G. H. Q. was to establish definitely the system that M. T. vehicles were for the common use, and except in a few isolated instances, such as electric light lorries, signal lorries, etc., were not to be specialized for use with any particular service. The system of pooling throughout was forced on all units and formations, not without some opposition. All the vehicles withdrawn thus from existing war establishments were organized in M. T. companies on a universal establishment of a headquarters and six sections of sixteen lorries each, fifteen to be working lorries and one a spare lorry to allow for periodic overhaul. These companies were allotted to corps in the proportion of one company to each division and one for corps troops. One company

was allotted to each army headquarters for army troops and one to G. H. Q. for G. H. Q. troops. In the allocation it was made quite clear that these companies were for communal use, and did not belong exclusively to the divisions or other formations to which they were temporarily attached.

This measure secured a large economy in actual vehicles in the field as well as in personnel, and was based on the theory that pooled vehicles used intelligently would produce a greater output of work per vehicle than would be the case were vehicles affiliated exclusively to units as heretofore. Later, the theory was proved sound in conception and in operation.

FORMATION OF G. H. Q. RESERVE M. T. COMPANIES.

The balance of vehicles obtained in this manner was put into a general reserve. Part of this reserve was placed on one side to be used after overhauling to provide replacement vehicles for M. T. companies. The number reserved for this purpose was calculated upon the experience gained in 1917, of the probable number of vehicles to become total casualties in 1918, after allowing for provision from home.

The residue were put into order and formed into G. H. Q. reserve M. T. companies, and it was found that there were sufficient to form at first eight and, later, twelve of these companies on the universal establishment of a headquarters and six sections.

RESULT OF THE GERMAN OFFENSIVE, MARCH 1918.

By March 1918, when the German offensive opened, the new organization was in being throughout the field armies, and was nearly completed in the L. of C. area. Six G. H. Q. reserve M. T. companies had already been formed, and were in excellent condition both as regards the morale of the personnel and the mechanical condition of the vehicles. Other companies were nearly ready for use, and speaking generally mechanical transport had recovered from the strain of 1917, and was in fit condition to face all probable demands. Eventually it proved equal to extraordinary demands, arising as a direct result of the initial success of the enemy and becoming accentuated later as a result of the success of the Allies. The fact was clearly shown that whether in retirement or in victorious advance the strain on mechanical transport never slackens.

After the partial failure of light railways in 1917, estimates of their value as a means of transportation had to be recast. The balance of opinion was against their extended use, but this decision was

influenced by the difficulties of the provision of material. Whatever the cause, the effect was twofold. Firstly, the more recently developed British army area—that of the Fifth Army, where the enemy attack was heaviest—was practically devoid of light railways. Secondly, greater dependence was placed upon broad-gauge railways. Railheads were very far forward, and armies had come to regard broad-gauge delivery almost to units as a normal procedure.

When the German attack developed, broad-gauge railheads with their accumulation of material of all kinds were soon lost. New railheads opening in the rear could not operate immediately with absolute success, and the rapidly changing situation created circumstances of difficulty in railway operating which in a few days resulted in preliminary disorganization. As the enemy advanced matters became worse. The forward engine depots were lost, and it became extremely difficult to arrange haulage. With the progressive loss of communicating lines between main routes, such as the Amiens-Achiet-Arras line, return routes for empty material became difficult to arrange. Main routes became congested, and increasing delays were experienced in the movements of troops and reinforcements and in the delivery of ammunition and supplies. The demands for engineer material to construct rear lines of defence became insistent, and in addition to these difficulties were those caused by the anxiety of army commanders to save as much material as possible from falling into the hands of the enemy, and to ensure the evacuation of hospitals and French civilian personnel and material.

The railways, though directed with the greatest thought and skill, were unable to cope with such a demand for transportation. Disorganization became more and more pronounced and culminated when, with what proved to be the limit of the German advance, the great lateral line St. Just-Amiens-St. Pol-Hazebrouck came under enemy shell fire and had to be abandoned as a railway route. At that stage, there was only one lateral route open, that through Eu-Abbeville-Etaples. Under the tactical necessities of the moment most of the British base work was transferred to Havre, and consequently nearly the whole of the railway traffic for the northern armies from the base had to pass along this one line, which was seriously threatened by air attack on the Canche bridge at Etaples. Taking everything into consideration, it is probably correct to say that at this critical period the whole railway system for many miles behind the front lines was in a state of thorough disorganization, and the maintenance of the armies as an effective fighting machine was in serious peril.

At this stage, mechanical transport saved the situation. The railheads had been moved far back, and the necessities of the armies had to be provided by long distance road work, which was carried out entirely by mechanical transport. Throughout the retirement, armies had appealed insistently for the allocation of G. H. Q. reserve M. T. companies to assist them, but the policy at G. H. Q., in view of the ultimate disorganization of the railways, had been to keep these companies in reserve until the last possible moment, and no reserve company was allocated to an army during this period unless the need was clearly imperative, and even then the company was withdrawn as soon as the Quartermaster General considered that the situation permitted. The fullest and most economical use was thus made of all divisional, corps and army companies, and no mechanical transport energy was wasted for lack of careful thought and arrangement in subordinate commands.

Meanwhile the formation of new G. H. Q. reserve M. T. companies was continued, auxiliary units of all descriptions being broken up temporarily to provide the necessary lorries and drivers, and by the time the railway disorganization had reached its worst stage, ten of these companies were at the disposal of the G. H. Q. They were then utilized at full pressure to ensure the maintenance of the force, and proved capable of the task.

The reorganization of the mechanical transport carried out during the winter of 1917–1918 provided not only the element of centralized control which ensured the best use being made of transport in the field, but also that reserve which made possible a special effort, just when it was vitally necessary. There can be no doubt that mechanical transport saved the armies from the time that the Amiens-Arras railway line was rendered useless until it was regained as a result of the operations of July 1918,—a period of about two months.

MECHANICAL TRANPORT WORK DURING THE ALLIED ADVANCE.

During the victorious advance the British armies were again very largely dependent upon mechanical transport, as the reconditioning of the railways was a slow process owing to the skilled use of delayed mines placed in nodal points by the enemy during retirement. Matters became worse immediately after the Armistice when the rapid advance of the Allied troops into Belgium took place. The enemy left all railways in the territory evacuated by them in a highly disorganized state, congested with abandoned rolling stock, and with signalling equipment very much damaged. Delayed mines continued for a considerable period to disorganize the basic system, in spite of every effort made by searching parties, even with the assistance of German records.

It soon became evident that again the armies would be dependent upon mechanical transport for supplies, and this time over very long hauls. To meet the situation the decision was taken to delay the advance of main bodies while the railways were being put into order, and to send forward only a light screen of troops, subsisted on a double echelon of mechanical transport, to carry out the spirit of the convention of Armistice.

Mechanical transport once again rose to the occasion. Centralized control made it possible to withdraw M. T. companies from formations remaining behind within horse transport distance of a railhead, and utilizing them to provide the double echelon of mechanical transport required for formations advancing far ahead of railheads. Thus the organization proved sound, its elasticity making it possible to adapt quickly the available resources to widely differing circumstances.

It is only just to add that without the grit and resource of the lorry drivers the results achieved by the reorganization of the mechanical transport in the winter of 1917–1918 could not have been obtained. The personnel, both officers and other ranks, showed an endurance and resolution not one whit behind that shown by the infantry soldier in action. Had the war continued longer it is doubtful whether either personnel or material could have stood the strain, and it is equally questionable whether the opportunity could have been found in the winter of 1918–1919 to rest and re-condition men and vehicles as in 1917–1918. It should be fully appreciated that the armies in general owe a large debt to the R. A. S. C. motor transport drivers.

(sgd.) M. G. TAYLOR,
Brig. Gen.
Deputy Director of Movements.

6th July, 1920.

COMMANDANT DOUMENC

French Army. Contributor "French Motor Transportation"

CHAPTER XVI.

SECTION II.

GENERAL ORGANIZATION OF THE MOTOR TRANSPORT SERVICE IN THE FRENCH ARMY.

(Chart 6, Chapter XVII, Vol. I.)

SUMMARY.

PART I.

THE MOTOR TRANSPORT SERVICE BEFORE THE WAR.

SECTION 1—THE PREPARATION.

The General Staff of the Army had already taken steps to provide the mobilized army with motor transportation.

The Army, itself, possessed but an insignificant number of motor vehicles (exactly 170 in 1914); the majority of these were of an antiquated type or were assigned to some particular use (ambulances, T. S. F. vehicles).

It was therefore necessary to depend upon vehicles belonging to civilians and to provide for their listing and requisition in the same manner as for horses and ordinary vehicles.

The "instruction (law) of March 21, 1914, providing for the requisitioning of motor vehicles for the needs of the Army in case of mobilization" prescribed, in a very precise and explicit manner, the rules which were to be carried out by the requisition commissions.

As a matter of fact it was necessary to organize the new units very carefully, as they were composed of officers who were assigned to a service of which they were almost ignorant and, at the same time, to a service which was to carry out operations which had never been undertaken before.

In addition to the establishment of the "Requisition Plan," the General Staff of the Army had taken steps to procure, during peace time, "heavy weight" units suitable for special uses. This was accomplished by means of a number of special measures and the first of these measures was an agreement with the "Compagnie Générale des Omnibus," whereby all of this company's automobile rolling matériel was to be placed, upon mobilization, at the disposal of the Army. Moreover, the military authorities also maintained a sort of option on the matériel which might be manufactured during the war.

The second measure endeavored to encourage the manufacture and purchase of "heavy weight" vehicles by a system of bonuses. This bonus system operated as follows: Each year the Ministry of War organized contests, which consisted of strictly regulated and controlled endurance tests. The trucks which fulfilled all requirements of the tests were awarded a decision and classed as "primé." The purchaser of a "primé" vehicle received a fixed cash allocation from the State, which was known as a "purchase bonus" (prime d'achât) and in addition, to encourage him in maintaining his vehicle constantly in good condition, he also received a yearly bonus known as an "upkeep bonus" (prime d'entretien), on condition that he keep his truck equipped with accessories and spare parts.

Moreover, the personnel of the Motor Transport Service was to be obtained as follows:

Motor transport troops, however recruited, and without considering the terms under which they were obliged to serve (active service or auxiliary service), were to be drawn from reservists or "Territoriaux" who were professional drivers of either passenger cars or "heavy weight" trucks, and from workmen employed in the automobile industry or from similar industries. Furthermore, "amateur drivers" (automobilists conventionnels) were also admitted.

The last named, by agreement made with the Minister of War during peace time, assured the State the use of their vehicles and their personal services as drivers at the time of mobilization.

The officers were to be chosen from among the reserve officers, belonging to all branches of the service, who were specially equipped, through professional and general knowledge, to handle motor transport units. These officers were assigned to the "Military Train Columns" (Escadrons du Train des Equipages Militaires) and, after undergoing a course at a motor transport training center were assigned, during peace time, to work which included such duties as would devolve upon them at the time of mobilization (convoys, classification, endurance tests).

As a result of these regulations and agreements, the Motor Transport Service was provided with about 200 officers and 8,000 troops.

Finally, the General Staff of the Army prepared rules for the future use of vehicles. The first of these regulations governing motor transport policies was published in the "Provisional instructions of April 17, 1913, for the use of motor vehicles in time of war."

The experiences of war made it necessary to modify this document very extensively. However, the fact remains that, such as it was, it formed the solid basis for subsequent improvements in the Motor Transport Service.

SECTION 2.—THE MOBILIZATION.

On August 2, 1914, the mobilization of the personnel and the requisitioning of matériel was begun, along the lines indicated in the "instructions" of April 17, 1913, and of March 21, 1914.

By the use of requisitioned vehicles and of their ordinary driving personnel, or with emergency personnel, the local commissions organized detachments of from fifteen to twenty vehicles and sent them to the *Assembling Center* (Centre de Groupement) of the region. The commissions systematically exercised their right to immediately assign men, who were liable to military service and who had been assigned to other services, as drivers for the Motor Transport Service.

At the regional assembling center, after a rapid examination, and in case of need a quick overhauling of the matériel in the "*Provisional Repair Shops*" (Ateliers de Réparations Provisoires), "*convoy elements*" (éléments de convoi), consisting of about forty vehicles each, were formed and sent to one of the four "*Motor Transport Organization Centers*" (Centres d'Organisation Automobiles), which were located at Reims (transferred later to Versailles), Versailles, Lyon and Dijon, respectively. These centers completed the organization of the units and distributed them among the armies, in accordance with the "first allotment schedule" prepared by the "Commandant of the motor transport units" (Commandant des Unités Automobiles).

The personnel of the provisional repair shops was used in the formation of various repair organizations.

Finally, the personnel and the matériel of the "C. G. O." (Compagnie Générale des Omnibus) was mobilized on the spot, organized into units, and sent direct to the armies in accordance with previous plans.

As early as August 3rd, a group of unconverted motor-busses arrived in the Ardennes and was soon followed by two other groups. These aided in the movement of the "covering" troops and in preparations for the concentration.

As a whole, the mobilization of the Motor Transport Service was carried out rapidly and in good order. On the 31st of August, 9,000 vehicles of all kinds, including 6,000 trucks, had reached the armies and each army was provided with its own "*Motor Transport Reserve Park*" (Parc Automobile de Réserve).

PART II.

GENERAL ORGANIZATION OF THE MOTOR TRANSPORT SERVICE.

SECTION 1.—THE DIRECTION (DIRECTING AGENCY).

The Motor Transport Service was attached to the General Headquarters of the "Armies of the North and the Northeast" (Direction of the Rear)[1]. The duties of chief of the service were exercised by a General Staff officer (Officier Supérieur Breveté).

The duties of the "Director of the Motor Transport Service" (Directeur du Service Automobile) or "D. S. A.", as he was generally known, were prescribed in an order issued by the Commander in Chief under date of June 6, 1916, and he was given technical control over the motor transport services of the armies. Under this authority, he supervised and controlled the technical use of all motor vehicles in the armies, with the exception of those belonging to the artillery.

He was in command of all units or organizations which were not assigned to an army and had the authority of a corps commander over these units.

He could be called upon by the Commander in Chief to take over the command, in an army or in an army group, of the motor transport units which had been placed at the disposal of that army for use in contemplated operations.

It is obvious that the D. S. A. kept in close touch with the 3rd Section (3e Bureau) of the General Staff, and that he was consulted whenever operations were contemplated in which the Motor Transport Service was to participate.

Moreover, as the D. S. A. was called upon to give his advice on all questions concerning the manufacture of new types of vehicles, or the improvement of existing types, he had to remain in touch with the various agencies in the interior which were charged with supplying the armies with motor transport matériel.

The D. S. A. was assisted by an Assistant Director, who ranked as a field officer. It is obvious that the D. S. A. could not accomplish the numerous and varied tasks which devolved upon him unless he had a strong administrative organization working under his direct orders, one composed of selected personnel and provided with the necessary facilities: automobiles, telephones, typewriters, etc. After a few experiments, the interior organization of the D. S. A. was finally decided upon and the work was distributed among the "Sections." In the office organization of the D. S. A., "Section A" really filled the part of a staff "3rd Section" (Operations) while another section,

[1] B. O. Vol. 100—"Organization of the Service of the Rear in the Armies."

known as "Section B," was charged solely with questions of upkeep and distribution of matériel.

Finally, the supervision of all motor vehicles in the armies necessitated the establishment (at the Motor Transport Direction) of a statistical service, which operated by means of a system of "cards" (fiches) which made it possible to immediately identify any vehicle and check up its assignment.

Despite the physical and mental activity exerted by the D. S. A. and by his assistants, as well as despite the material means placed at their disposal, the operation of such a huge organization as the Motor Transport Service would have been impossible had the commands of its subordinate echelons not been judiciously organized.

At the beginning, each army had a *Chief of the Army Motor Transport Service*, (Chef du Service Automobile) whose authority extended over all of the army motor transport units. The creation, first, of army groups and then of transportation reserves and "groupings", brought about the organization of "*D. S. A. Delegations*" (Délégations de la D. S. A.) on the staffs of the army group commanders and, later, the formation of "*Motor Transport Regulating Commissions*" (Commissions Régulatrices Automobiles—C. R. A.). The functions of these various organizations will be studied later.

The organization of such a service, of a service whose primary qualification is that it should be able to go into action immediately, requires a rapid, dependable, system of communications, and this obliged the D. S. A. to establish a liaison service of his own, by means of motor vehicles.

Within twenty-four hours, at a maximum, the most distant of the Motor Transport Service units could be reached. In addition to this courier service, the M. T. Direction supervised the execution of its orders and kept in touch with the needs of its organizations by means of missions, composed of officers, and through personal inspections by the Director of the Motor Transport Service. As a matter of information, the D. S. A. never covered less than 6,500 kilometers monthly, and the Assistant Director also covered a similar distance.

The total distances covered by motor transport officers travelling on missions attained 25,000 kilometers monthly.

SECTION 2.—EXECUTIVE AGENCIES.

1. THE ORGANIZATIONS AND THEIR CORRELATION.

The elementary formations (organizations) of the Motor Transport Service were:

The sections for the transportation of matériel.

The sections for the transportation of personnel.

The sections for the transportation of road material (Transport routier).
The medical sections.
The sections for the transportation of fresh meat supplies.
The sections for the transportation of telegraph personnel.
The regional motor transport sections (Automobiles de place).

Sections for the transportation of matériel (by abbreviation T. M.).—These were composed of trucks of the same make and type. They could transport 35 net tons (charge utile), or the personnel of an infantry company.

The T. M. sections consisted of from eighteen to twenty trucks each, according to the type of trucks which composed them, plus a two-wheeled field kitchen trailer and a passenger-car for the lieutenant in command of the section.

Theoretically, each truck was to have two drivers. However, it was often necessary to limit this to three drivers for two trucks, and sometimes to even less.

A T. M. section was an administrative unit, under the orders of a first or second lieutenant, and was organically assigned five non-commissioned officers, one of whom was a "quartermaster" (fourrier).

Four T. M. sections constituted a "group," under the orders of a captain or first lieutenant. Six "groups" were sometimes united into a "transportation grouping" (groupement de transport), commanded by a captain, or by a squadron or battalion chief.

All of these formations were composed of vehicles of the same make and, in so far as possible, of the same type.

The carrying capacity of a group was 140 tons, which corresponded to the weight of the daily supplies of two divisions, the supplies for the "unassigned" army corps troops (E. N. E. d'un Corps d'Armée) or for the transport of the personnel of an infantry battalion.

A "transportation grouping" could readily move the infantry of a division (Infanterie Divisionnaire).

It will be seen later that special "groupings" for the transportation of horses were organized in 1918, in order to provide for the transport of divisional artillery.

There were 101 T. M. sections in service with the armies in August 1914; 362 in July 1915; 459 in January 1916, and 715 in November 1918.

Sections for the transportation of personnel (by abbreviation T. P.).—This type of formation had been organized at the beginning of the war, with cars and "busses" which had been requisitioned from large hotels and, particularly, with matériel obtained from the "Compagnie Générale des Omnibus." Within a short time, the hotel cars and "busses" were relegated to the special services and only "C. G. O." motor-busses were retained in the T. P. sections.

The "C. G. O." furnished new matériel at the rate of one "section" per week, which made it possible to keep this transportation in working order.

The disadvantages of the T. P. sections resulted from their specialization. They could only transport troops, while T. M. sections, whose trucks were equipped with collapsible benches, could carry either personnel or matériel. On the other hand, the T. P. sections required a lesser number of vehicles for a similar carrying capacity; forty motor-busses could carry a battalion, while this required eighty trucks.

The T. P. sections consisted of from nine to eleven motor busses each, according to the type used. A "group" consisted of four T. P. sections. In addition, each group included two "C. G. O." trucks of 3,500 kgs. net carrying capacity (charge utile), two light trucks, and two two-wheeled kitchen trailers. As in the case of the T. M. groups, T. P. groups were sometimes assembled into "groupings."

In practice, for the reasons given above, the number of T. P. sections was not increased during the war. There were twenty-three of these sections in August 1914, and twenty-two in November 1918. The gradual transformation of the T. P. matériel into trucks for the transportation of artillery horses (three to five per vehicle) was undertaken during the latter part of 1917.

Sections for the transportation of road material (by abbreviation T. M. R.).—In November 1914, the Command recognized the urgent need of providing for the transportation of the necessary materials for the repair and upkeep of the roads by means of motor transport.

The Motor Transport Service, which was chiefly interested in maintaining the roads in good order, organized the first T. M. R. sections with uncovered trucks of old or odd types. Later, it was enabled to organize complete T. M. R. sections, with trucks of an homogeneous type and specially equipped for the transportation of road material, i. e., metal-lined trucks with unloading appliances.

The T. M. R. sections of each army were assembled under the orders of a captain, who was known as "Commander of the group of Motor Transport Road Sections" (Commandant du Groupe des Sections automobile routières).

There were thirty-nine T. M. R. sections in service in October 1916, and eighty-nine in August 1918.

Medical (*Sanitary*) *sections* (by abbreviation S. S.)—At the beginning of the campaign it had only been possible to organize twenty-five S. S. sections and, even then, the matériel consisted for the most part of delivery wagons which had been requisitioned from large stores and provided with emergency equipment.

During November 1914, the situation was improved. The D. S. A. ordered the requisition, from Panhard and from other manufacturers, of passenger-car chassis equipped with a metallic frame-work covered by waterproof canvas, and provided with hooks for stretchers. This equipment was invented and designed by Dr. Lemaitre. Eight "Panhard-Lemaitre" sections were rapidly equipped. Little by little, the matériel of the S. S. sections was increased and improved. Light trucks permitted the transportation of either sitting or lying wounded. Heating arrangements, by means of exhaust-gas, were installed. In January, 1915, fifty-two S. S. sections worked with the armies and, in July of the same year, eighty-eight of these sections were in operation. From thence on, each infantry division was provided with one M. T. medical section and, later, it became possible to provide a S. S. reserve for each army. This reserve was placed at the disposal of either the Commander in Chief or the army commander.

The reserve sections were used either to relieve worn out S. S. sections or to provide large units, which were being moved long distances by rail, with a S. S. upon their arrival, thus avoiding costly movements by road. Finally, this system enabled the High Command to quickly reinforce the means of transportation for the medical evacuations of an army engaged in important operations.

The M. T. medical sections were composed of twenty motor ambulances, which could transport from 80 to 120 lying and from 120 to 140 sitting wounded; plus a passenger-car for the commanding officer of the section. The composition of the troop and non-commissioned personnel of the S. S. was analogous to that of the T. M. sections.

It would be unjust not to mention the valuable assistance given the French Army by the foreign medical motor transport sections.

These units were organized by means of matériel and with volunteer personnel assembled by various Allied or pro-Allied committees, British, American and Russian, and were granted a special status. A special agency attached to the "Central Motor Transport Depot" (Magasin Central Automobile), known as the "*Office of the Allied Sections*" (Office des Sections Alliées—O. S. A.), centralized all questions pertaining to these sections and constituted, so to speak, the "section" of the Motor Transport Direction in charge of these formations. Seventy sections were in service at the time of the entrance of the United States into the war.

The American Army took over all the units which had been organized by various private American committees and created a special service which was at the disposal of the French armies. This service consisted of seventy-one sections, nine repair echelons, and two base camps. It was placed under the orders of Colonel Kean and, subsequently, under Colonel Percy B. Jones.

In addition to the American Red Cross (five sections) and the units of the American Field Service (thirty-eight sections), the following organizations furnished medical motor transport sections to the French Army:

	Sections.
British Red Cross Committee	4
British Ambulance Committee	6
British Red Cross Society and St. John's Order	3
British Ambulance Unit	3
French Relief Fund	2
Comité des Ambulances Russes	5
First-Aid Nursing Yeomanry	2
Hackett-Lowther Unit	2

The two last named committees were organized by English ladies and their personnel was entirely feminine.

Those who have seen these sections at work render deep homage to the courage and spirit of these "lady drivers" (conductrices) while under fire. Miss Fraser, of the S. S. "Y.2," was awarded the Cross of the Legion of Honor and a number of other "conductrices" received the "Croix de Guerre."

There should also be mentioned a few of the persons who unstintingly devoted their time, money, and efforts toward the organization and upkeep of these formations. It is impossible, unfortunately, to name them all: Madame de la Panouse, Sir Arthur Lowley, Sir Arthur Stanley, Mr. Bradly Payman, Lord Dounoughmore, Lt. Col. Barry, Captain Maxwell, Mr. Léon Joly, Captain Totham, Lt. Col. A. Piatt-Andrew, Major Gallatti, Major Harjes, Mrs. Vanderbilt, Major Osborne, Messrs. de Golubeff and de Wienawski, Mrs. Henderson, Misses Hackett and Lowther.

The foreign medical motor transport sections were always organized as were the French S. S. They were administered by an officer of the Motor Transport Service, assisted by a chief and assistant-chief who were foreigners. These sections were composed of twenty-one vehicles. The American S. S. cars (S. S. U.) consisted of "Ford" chassis, equipped with a body of an American type known as "field service," and could transport three lying wounded or four sitting. This improvised matériel made up for its feeble carrying capacity by its remarkable strength and ease of operation.

Sections for the transportation of fresh meat supplies (by abbreviation R. V. F.)—These formations were destined to carry meat from the slaughtering centers or from the rail-heads (gares de ravitaillement) to the distribution centers, and were at first composed solely of improved "C. G. O." matériel. At the time of the Armistice, this matériel was being replaced by 40-HP. Berliet chassis with special bodies, in order to obtain better carrying capacity (charge utile) in proportion to the total weight of the vehicle.

At the mobilization, three types of R. V. F. sections were organized: A, B and C:

Type A, of four vehicles, for the cavalry divisions (D. C.).
Type B, of nine vehicles, for the infantry divisions (D. I.).
Type C, of twenty vehicles, for the army corps (C. A.).

The C-type R. V. F. sections were gradually withdrawn and finally disappeared from the R. V. F. detachments which had been created to supply unassigned troops (E. N. E.); they were composed of eight motor busses each. Only B-type R. V. F. sections and a few sections of the A-type remained in service; the B-type section had, however, been reduced to seven vehicles. Each division was provided with an "R. V. F.-B" section. The R. V. F. sections were administrative units, commanded by a first or second lieutenant, who also assumed the duties of chief of the motor transport service (C. S. A.) of the infantry division to which his R. V. F. section was attached.

In August 1914, there were sixty-three R. V. F. sections in service in the armies, and 147 in November 1918.

Sections for the transportation of telegraph (signal) personnel (by abbreviation T. P. T.).—During the war the necessity was felt of providing the Telegraph Service with motor transportation. Twenty-one T. P. T. sections were successively created and attached to the "permanent inspections" of the Motor Transport Service. These sections were composed of seven passenger-cars, ten trucks (or light trucks, at the rate of three heavy trucks for four light trucks), and one trailer for transporting poles. The personnel consisted of one first or second lieutenant, in command, five non-commissioned officers and about twenty men. From the telegraphic point of view, a detachment of Telegraph Service personnel operated in conjunction with these sections.

Regional motor transport sections (Sections Automobiles de place) (by abbreviation S. A. P.). These sections were created in November 1914, for the supervision, upkeep and repair of all motor vehicles assigned to the "regions" included in the Zone of the Armies. They consisted mostly of passenger-cars and light trucks. Their composition varied greatly, according to the service to which they were assigned, and they were commanded by a captain or lieutenant, under the orders of one of the "permanent inspectors." There were finally nine of these sections.

2. MOTOR TRANSPORT SERVICES OF THE ARMIES.

At the beginning of the campaign, there was a "Chief of the Motor Transport Service" (Chef du Service Automobile—C. S. A.) on the staff of each army. This C. S. A. was either a captain or a major

(commandant) and he was assisted by a captain, or by a first or second lieutenant, who acted as assistant chief. The increase in the number of motor transport units soon showed the insufficiency of personnel in this organization. In January 1915, a presidential decree fixed the authority of the C. S. A. and he was given the authority of a corps commander over all army motor transport units and formations. Accordingly, he had at his disposal:

1. The motor transport units belonging to the army, proper, and to the army headquarters, the motor transport groups and sections for the transportation of matériel, the T. P. T. sections, army M. T. medical (S. S.) sections, motor transport parks, etc.

2. The motor transport formations organically attached to the large units under the army.

The C. S. A. soon had to be provided with means for fulfilling these duties. In September 1914, a second officer was assigned to assist him, and then a third, in November of the same year. Finally, in December 1914, an administrative officer was assigned to the motor transport services of each army. This administrative officer was charged with paying for the direct purchases made by the M. T. services and, in addition, was supervisor of an "annex" on behalf of the supervising administrative officer of the "Army Main Artillery Park" (Grand Parc d'Artillerie de l'Armée). It also became necessary to proportionately increase the administrative troop personnel as, according to the tables of organization in effect at the mobilization, the war strength of this personnel consisted of only two secretaries.

It is out of the question to endeavor to follow the expansion of the motor transport services of each army day by day; it is only possible to briefly indicate here their main lines of development and the principles which governed their operation.

In 1914, one of the first tasks of the C. S. As, and perhaps not the least difficult, was the preparation of a list of the vehicles which were in service in their respective armies. This work, owing to the more or less irregular conditions under which certain requisitions and assignments had been made, was only completed about the end of the year.

At the beginning of 1915, the motor transport services (Services Automobiles—S. A.) of the various headquarters were reduced to their regulation quotas, and the S. S. and R. V. F. sections were gradually brought to their normal strength. The inspection duties of the assistants to the C. S. A. then began. The difficulty of following the motor transport services of large units during the movements of such units, brought about the creation of the post of "Commander of the army corps headquarters motor transport services," in February 1915.

In October 1915, it became necessary to increase the authority of this officer, who thereupon took the title of "Chief of the army corps motor transport services." This officer held the rank of captain or first lieutenant, and was the representative of the C. S. A., for the supervision and upkeep of the S. S. and R. V. F. sections; he was also technical advisor to the "Intendance" (Supply) and Medical Services for the employment of the R. V. F. and of the S. A. units. He had at his disposal: the motor vehicles of the headquarters, the R. V. F. detachment of the "E. N. E." (unassigned units), the motor transport matériel of the army corps telegraph section and of the corps litter-bearers (G. B. C.), and, finally, the motor transport matériel belonging to the divisions composing the army corps.

It also became necessary to create a chief of the divisional motor transport services. In October 1916, the commanders of the divisional R. V. F. sections took the title of "Chiefs of the divisional motor transport services," and they had the same authority, within the divisions, as the chiefs of the army corps motor transport services in their relations with the army corps commanders.

The results of this organization were that all of the army motor transport services were subordinate to the chief of the army motor transport services. Particularly, all communications between the units and the army park were obliged to pass through his hands.

Concerning the employment of motor transportation which had been placed at the disposal of the army, the C. S. A. acted as chief transportation executive of the 4th Section (4e Bureau) at the army headquarters and, as such, he received, centralized and classified, in the order of their importance, the transportation requests of the various army units and services. It was the daily duty of the C. S. A. to prepare the army's "transportation plan" (plan de transport) for the following day, following the indications of the 4th Section and in accordance with available means of transportation. He then assured the execution of this plan by the motor transport groups under his orders.

The two great principles upon which it was constantly necessary to rely, and which are the basis of an economical and rational transportation service, are: "non specialization of vehicles" and "work at full capacity". These words are self-explanatory, but the chiefs of the army motor transport services and the 4th Sections of the army staffs were sometimes obliged to put up a strong fight against the claims of certain services, which aimed at nothing less than the constitution of separate motor transport services for their own use. It was only by maintaining these two principles that the High Command was able to prevent wastage of its motor

transportation and maintain strong reserves of transportation at hand, ready to function in time of need.

Finally, it should be noted that during the numerous movements of armies which took place after 1916, the Motor Transport Direction adopted the policy of maintaining the motor transport services where they were, regardless of the movements of armies.

3. UNITS AND ORGANIZATIONS AT THE DIRECT DISPOSAL OF THE D. S. A.—RESERVES AND TRANSPORTATION GROUPINGS (GROUPMENTS).

The necessity of being able to rapidly and surely convoy, to any point of the front, large units which were being held in reserve and at the disposal of the Commander in Chief, required that steps be taken for the creation of large motor transport units which would be independent of the army motor transport services and under the direct orders of the Commander in Chief.

The nucleus of these units was created, experimentally, during the latter part of 1914, when a number of "groups", composed of four T. M. sections each, were placed under a single head and assembled into a provisional "grouping". This trial having given excellent results the experiment was carried out further.

Several independent groupings (Groupements indépendents) were organized and, in April 1915, these were united under the orders of a single officer and placed under the direct orders of the Motor Transport Direction. The "*Transportation Reserves*" (Réserves de Transport) were thus created. These reserves and groupings were designated, following the custom existing in the Motor Transport Direction, by the name of the officer in command.

The composition of a motor transport reserve underwent modifications. According to the "instructions" of April 27, 1915, it was commanded by an officer, generally of the rank of captain, with three assistants (one guide, one road commissioner, and one general file-closer),[2] and was composed of four "groupings" of three "groups" each, plus one "trouble" section (section de dépannage); the latter under the orders of the general file-closer. Each group consisted of four sections and was commanded by a "Chief of Group" (Chef de Groupe). In addition to these twenty-four sections, each motor transport group had a twenty-fifth section, which was known as the "headquarters section," (Section dite d'Etat-Major), composed of a mobile repair-shop and of reserve and supply vehicles. A fourth assistant, in charge of supplies, was added to the "headquarters section" of each motor transport grouping.

[2] 1 orienteur, 1 commissaire de route, 1 serre-file général.

On March 18, 1916, the composition of the staff of the motor transport groupings and reserves was definitely fixed as follows:

Staff of Motor Transport Reserve.—One captain or field officer; one captain, as assistant; nine men.

Staff of Motor Transport Grouping.—One captain, commanding; four assistants; one chief surgeon and 154 men.

Under the provisions of the above-mentioned instructions, each motor transport group was to be provided with a "grouping shop" (atelier de groupement) and a unit for repair and upkeep.

During the month of August 1918, new, special motor transport groupings were organized for the transportation of divisional artillery (Groupements A. D.).

These grouping were of two types, depending upon whether they consisted of 5-ton Pierce-Arrow matériel or of "C. G. O." matériel.

(a) *Pierce-Arrow matériel—Staff of Motor Transport Grouping.*—Three groups, composed of two sections for the transportation of horses, 3 T. C. trucks, and two or three sections for the transportation of matériel, personnel, and baggage; a total of 89 T. C. trucks, 100 T. M. trucks and 36 trailers, or, 99 T. C. trucks and 130 T. M. trucks without trailers.

(b) "*C. G. O.*" *matériel—Staff of Motor Transport Grouping.*—Three groups, composed of three sections of twenty vehicles, for the transportation of horses; two groups, composed of three T. M. sections, or a total of 180 T. C. trucks and 108 T. M. trucks.

As the result of this composition, and in the same manner that the transportation capacity of a motor transport grouping corresponded to the strength of the divisional infantry, the "A. D." grouping provided for the movement of the divisional artillery.

As finally organized, a motor transport reserve could transport indiscriminately, either personnel or matériel (T. M. groupings), personnel only (T. P. groupings), or, personnel, horses, and artillery matériel (A. D. groupings).

Following the requirements of operations as it did, the organic composition of the motor transport reserve could not be integrally preserved. At the date of the Armistice, the High Command had: Nineteen motor transport groupings, assembled into nine motor transport reserves, and three independent motor transport groupings, at its disposal. Of these twenty-two groupings, two were of the "A. D." type.

The plans for the employment of the large motor transport units were naturally based on the plan of operations of the High Command. Their assembly and distribution in the field corresponded to the Commander in Chief's plans for the contemplated use of the army corps and infantry divisions which were at his disposal, and

these plans were made in accordance with the various hypotheses foreseen. The exact, and it may be said daily, adaptation of means of motor transport to operation requirements and to the general situation of the armies was thus maintained. The High Command thus had at its disposal a system of transportation which could be put to instant use, and one which could also adapt itself without delay to the various requirements which might arise unexpectedly. This is one of the great advantages of motor transport over rail transport in a system of transportation such as that which had been conceived and organized in the French Army.

It should be noted here that all of these motor transport groupings were not composed exclusively of French personnel. Kabyles and Malgaches (colonial personnel) were tried, but they proved unsatisfactory and any idea of employing them had to be abandoned. On the other hand, Indo-Chinese laborers, despite their muscular weakness and sensitiveness to bad weather, were entirely satisfactory and were assigned to certain types of motor vehicles. They were trained in a special training center located at Congy (later, at La Villeneuve-aux-Chênes), and became excellent drivers. They were patient, disciplined, docile, and took particularly good care of their cars. At the date of the Armistice, three complete motor transport groupings were operated by Indo-Chinese drivers.

Before the entry of the United States into the war, the American Field Service had proposed to the "Office of the Allied Sections" (O. S. A.) that the surplus volunteer drivers, who could not find a place in the S. S. sections, be assigned to other motor transport units. This proposition, after study by the Motor Transport Direction, was adopted by the Commander in Chief and a complete motor transport grouping was thus constituted. After America's entrance into the war this personnel was militarized and completed as fast as it arrived. It was then formed into a motor transport reserve of two complete groupings, i. e., the "Mallet Reserve": Grouping No. 8 (Captain Pavillon) and Grouping No. 9 (Captain Langlois).

Finally, toward the end of the campaign, Siam sent a body of officers and men to France and these were used in the formation of motor transport Grouping No. 25. At the time of the Armistice, the qualities shown by these soldiers made it possible to look forward to an extension of their employment.

It would be impossible to describe here, even briefly, the rôle of the various motor transport reserves and groupings during the course of operations. However, it can be truthfully stated that they were prime factors, in the hands of the French High Command, in the conduct of the campaign and that they were always equal to their task.

Motor Transport Regulating Commissions (Commissions Régulatrices Automobiles—C. R. A.).—The experiences gained during 1914 and 1915 had shown the great difficulty of maintaining the flow of traffic on roads in the battle zone during periods of operations, as well as the dangers which could result on account of delays, or of the absolute impossibility of bringing reinforcements and supplies to the armies in due time.

The necessity of carefully organizing traffic in the battle zone, and of providing for its strict regulation and control, had not escaped the Motor Transport Direction. The latter began its work by establishing precise rules for the loading and unloading of troops and matériel, and then saw to it that these rules were enforced. At the same time, the Motor Transport Direction required all of its own units to conform strictly to traffic regulations (règles d'une bonne discipline de marche).

However, experience had demonstrated that convoys met with all kinds of unforeseen obstacles, i. e., other convoys occupying the roads, traffic jams on bridges and at crossroads, mixing of animal-drawn and motor-transport convoys, double flow of traffic on too narrow roads, etc.

The matter therefore had to be treated as a whole, and the Motor Transport Direction studied plans for the organization of an agency which would have complete authority over all operations which could possibly be carried out over a road. The German offensive on Verdun was launched at that time and, within a few hours, the Motor Transport Direction transferred into the domain of reality and execution that which, until then, had only been thought of. On February 22, 1916, the first "Motor Transport Regulating Commission" was created and established at Bar-Le-Duc.

The problem consisted in taking over the only existing supply route, i. e., the road from Bar-Le-Duc to Verdun, and reserving this road for the exclusive use of motor transport units and motor transportation. This solution was all the more necessary owing to the fact that in certain places the road was barely seven meters wide.

All means of action were placed in the hands of a single authority, the "Motor Transport Regulating Commissioner" (Commissaire Régulateur Automobile), who established traffic regulations, prepared transportation plans in conjunction with the Command, determined the loading and unloading points, and made assignments for operation and maintenance purposes.

The road itself was subdivided into sections or "cantons," each about fifteen kilometers in length, at the head of which was a "Chief of canton" (Chef de Canton). Each "canton" unit was

assigned to a road which was equipped with the "block system," "Chiefs of cantons" were also charged with marking the roads, overcoming traffic interruptions, and supervising the repair or removal of damaged cars on the roads (dépannage). A complete telephone system connected the Regulating Commissioner with the various "cantons" and the latter among themselves.

At noon, February 22nd, it was decided to put these measures into effect; four hours later the road had been cleared and, on the 23rd, a whole division had been moved to its positions.

At the end of February, 3,000 motor trucks were circulating over the "Sacred Way" (Voie Sacrée), not including passenger, medical, and R. V. F. cars. This figure increased to 8,000 vehicles and was maintained during seven months. The experience at Verdun was conclusive. In his "General Orders" (Ordre du jour), the Commander in Chief recognized the endurance and bravery of the motor transport troops who had largely contributed to the "salvation" of Verdun. The principles which developed from the experience thus acquired were embodied in the "instructions for the organization of an L. of C. road (route d'Etapes) for intensive traffic," dated December 16, 1916.

The Somme offensive, in 1916, gave further proof of the prime importance of the C. R. A. The commission at Longeau was established on the 1st of July, 1916. The new principles were extended and the commission was no longer assigned a single road, but was given a system of roads. It had to provide for animal-drawn traffic alongside the roads reserved for motor transport traffic, it determined the direction of the traffic flow, organized circuits, and caused the establishment of numerous loading and unloading points. The results attained here substantiated those which had been obtained at Verdun, particularly in the transportation of munitions, and these were delivered with remarkable regularity throughout the battle of the Somme. At times, 6,000 vehicles passed over the single Bray-Cappy road every twenty-four hours. This, at certain hours, represented one vehicle every four seconds.

Later, these principles were extended still further and the C. R. As. were no longer organized solely in case of emergency; instead, C. R. As. were established along the entire front and a system of roads known as a "zone of action" (Zône d'action), whose limits were well determined, was assigned to each.

Furthermore, through the creation of "main circuits" (grands itinéraires), which were indicated on 600,000-scale maps and which were numbered and reserved in advance for certain types of convoys (motor trucks, tractors, animal-drawn, etc.), the High Command thus reserved itself, to a certain extent, a special system of roads for important movements of its strategic reserves by motor transport.

All movements by motor transport were obliged to go from one C. R. A. to another, over previously designated itineraries. The transmission of orders for the supervision of movements was thus very much simplified.

A final improvement was effected by the distinction which was established between "operating C. R. As." (C. R. A. d'exploitation) and "traffic control C. R. As." (C. R. A. de circulation). The first followed the advance of the troops, step by step, with their mobile "cantons," and were finally provided with means of transportation (motor transport reserves and groupings), which were placed at their disposal by the Motor Transport Direction. The second simply supervised traffic in the rear zones and served as training schools for the personnel.

The above regulations, progressively added to, resulted in the: "*Inter-Allied Regulations for the Motor Transport Services*," of October, 1918, and the various Allied Armies which were fighting in France thus adopted the regulations which had been formulated by the Motor Transport Service of the French Army, the excellency of which had just been demonstrated.

Delegates of the D. S. A.—As long as motor transport units were exclusively assigned to armies, and as long as the number of motor transport reserves and groupings which were at the disposal of the Commander in Chief was small, the Motor Transport Direction could readily control the employment of its large units. The necessity for decentralization became apparent, however, with the creation of "groups of armies," and of numerous motor transport groupings and reserves which were distributed along the entire front. The Motor Transport Direction could no longer directly supervise the organization of important motor transport movements, and the execution of such transports had to be regulated on the spot, by accredited representatives of the Motor Transport Direction with the military authorities concerned.

A superior officer of the Motor Transport Service (S. A.) was detached to each commander of a group of armies and placed under his orders, except in technical matters, for which he remained under the Motor Transport Direction. This officer was attached to the 4th Section (4e Bureau) of army group headquarters and was known as the "Representative of the Motor Transport Direction" (Délégué de la D. S. A.).

This organization, which had been tentatively provided for on January 4, 1917, was definitely established on January 21, by order of the Commander in Chief.

The representative of the D. S. A. was responsible for the execution of such transports as were requested by the group of armies, or by the armies belonging thereto, by means of the G. H. Q. motor

assigned to a road which was equipped with the "block system," "Chiefs of cantons" were also charged with marking the roads, overcoming traffic interruptions, and supervising the repair or removal of damaged cars on the roads (dépannage). A complete telephone system connected the Regulating Commissioner with the various "cantons" and the latter among themselves.

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transport reserves and groupings which were temporarily at the disposal of the group of armies. In accordance with the orders of the commander of the group of armies, he assigned these motor transport units and provided for their supplies; he also supervised the organization of their commands and liaisons. He was the technical advisor of the commander of the group of armies in the organization of motor transport traffic (circulation) and for the employment of T. M. and T. P. sections. Furthermore, in accordance with the orders of the Commander in Chief and of the commander of the group of armies, he established C. R. As. and constantly supervised their operations. At the same time, the representatives of the D. S. A. supervised the motor vehicles assigned to the "Directions" (Directions d'Etapes) of the L. of C. of the groups of armies, and provided for the movements of personnel and matériel required by these L. of C. directions.

It will thus be seen that through the creation of "representatives of the D. S. A.", C. R. As., and motor transport reserves and groupings, a system was organized which enabled the Motor Transport Direction to immediately satisfy the motor transportation requirements of the Command, whether for tactical or strategic movements.

PART III.

SUPPLY AND UPKEEP.

SECTION I.—SUPPLY OF MATÉRIEL.

1. THE "CENTRAL MOTOR TRANSPORT STOREHOUSE" (MAGASIN CENTRAL AUTOMOBILE).

Provisional "instructions," dated August 17, 1913 (?), provided for the establishment of a "*Main Motor Transport Reserve Park*" (Grand Automobile de Réserve—G. P. A. R.) at the time of mobilization, for the purpose of maintaining the supplies of tools, spare parts, and matériel in the army motor transport parks, and to make important repairs which could not be undertaken by the latter.

This main park was to be organized in one of the peace time motor transport centers and was to comprise three services: supply, repair, and transportation. No provision had been made for the assembling, during peace time, of stocks of reserve supplies.

It should be noted, however, that the constitution of such a stock of reserve matériel was almost impossible, on account of the multiplicity of types of motor vehicles which were to be obtained, through requisitioning, at the time of mobilization. The G. P. A. R. was therefore to acquire its supplies from the manufacturers according to needs, and was to meet the demands of the army motor transport

parks by the shipment of complete carloads of supplies to the "railheads" (Gares de ravitaillement).

On August 2, 1914, the G. P. A. R. was established in the cartridge factory of Vincennes. A field officer of the regular (active) Army was placed at its head and he was assisted by a number of reserve officers (officiers de complément).

From the very beginning, this organization presented serious drawbacks. The cars generally did not reach their destinations; moreover, the situation was further aggravated by the withdrawal of the G. P. A. R. to Montluçon, and the shipment to this town of all spare parts manufactured in the factories located in the region of Paris. As a matter of fact, in September 1914, the motor transport services of the armies completely lacked spare parts.

The Motor Transport Direction, in conjunction with the commanding officer of the G. P. A. R. (who had remained at Vincennes with the last elements), organized a provisional system of supply, from the factories direct to the armies, and provided for the delivery of these supplies by means of motor convoys from the "*Army Motor Transport Organization Park*" (P. A. O.) at Versailles. The situation was considerably improved thereby, but this was only a temporary organization, with limited means, and as the P. A. O. at Versailles was already busily engaged with the organization and forwarding of motor transport units to the armies, a new special agency had to be created.

On November 4, 1914, the Commander in Chief decided upon the creation of the "*Central Motor Transport Storehouse*" (Magasin Central Automobile—M. C. A.) and entrusted its direction to an officer of the Motor Transport Service (S. A.).

The M. C. A. was established in one of the depots of the "C. G. O.", located in the Rue Lebrun, and in some of the buildings of the "National School of Arts and Trades" (Ecole Nationale des Arts et Métiers).

Two "instructions" from the Commander in Chief, dated November 10th and 25th, respectively, prescribed the method of operation for the new establishment. These were based on the following principles:

1) The M. C. A. was to operate solely as a "wholesale" agency and was only to have a small number of accredited "customers": Motor transport parks, inspections, and groupings.

2) A daily liaison system, in both directions, was to be established between the M. C. A. and the receiving parties.

3) Direct relations (correspondance directe), under the same conditions.

4) The supplies which the M. C. A. was to furnish were to be classified in three categories: *Stock supplies*, or parts and materials in

common use, which could be ordered in advance and stored in large quantities. *Special parts*, ordered only in accordance with actual needs, which were never to be stored and which were to be delivered as soon as received. Finally, "lots" of *replacement supplies*, (lots de rechanges), which included mechanical assemblies and parts commonly employed in the construction of vehicles of the types in general use in the armies. These supplies were to be ordered in advance, according to estimated requirements based upon past experience.

5) "Stock index cards" (fiches comptables) were to be established concerning prescribed motor transport stores, so that it would be possible to know at all times: what requests had been received; cost price; quantities of supplies which had been ordered from the manufacturers, as well as quantities delivered, or to be delivered, by the latter; stores on hand, and the normal total amount of stock to be maintained.

6) The automatic filling of requisitions, in the order in which these requests were received.

7) The establishment of a system of consecutively numbered duplicate vouchers which were to accompany deliveries until their receipt by the destinee; the duplicate to be duly receipted and returned to the M. C. A.

On the whole, the above principles were always followed by the M. C. A., despite the expansion of this agency and minor modifications in its interior organization.

On the other hand, the methods by which the M. C. A. supplied itself underwent some changes. At the beginning, the M. C. A. contracted for supplies and assured their reception and technical verification, while the bills were approved (avalisées) by one of the establishments of the interior, (first, by the "G. P. A. R.", then by the "Supply Center" (Centre d' approvisionnement) at Vincennes, and later by the "M. G. A.") which verified and settled the accounts. Subsequently, an establishment was created, under the orders of the Minister, for the purpose of replenishing the stocks of the M. C. A., in accordance with the estimates of the latter. This establishment was called the "*General Motor Transport Depot*" (Magasin Général Automobile—M. G. A.).

Finally, the "lots" of spare parts were ordered direct from the manufacturers by the establishments which gave orders for new vehicles, namely: the "Supply centers for motor transport matériel," located at Vincennes and at Lyon. (The last named was a former G. P. A. R., which had been decreased and transformed.) These two establishments received the orders of the M. C. A. for supplies of spare parts.

The M. C. A. was to undertake certain inspections and repairs, as well as the manufacture of various delicate parts which could not

be obtained elsewhere. For this purpose, it maintained a remarkably well equipped "*Motor Transport Park Section*" (Section de Parc) and, in 1917, a large shop for the repair of magnetos was added thereto.

At the beginning of April, 1917, a ministerial "decree" combined the central motor transport storehouse (Magasin Central Automobile) and the general motor transport depot (Magasin Général Automobile) under the authority of the M. C. A. The new establishment was known as the "*Central Supply Depot of the Motor Transport Service*" (Magasin Central d'approvisionnement du service automobile: M. C. A.–S. A.), and it was placed under the orders of the Minister. About the same date, another establishment was created and placed under the orders of the Commander in Chief. It was attached to the M. C. A., and was known as the "*Transition Motor Transport Depot*" (Magasin Automobile de Transition—M. A. T.). It became the motor transport distribution agency for the armies, while the M. C. A.–S. A. remained solely the supply agency. This organization did not last long and in September 1918, the M. A. T. was absorbed by the M. C. A.–S. A. While it is impossible to enter here into the interior organization of the M. C. A., it can be stated that, despite the complexity of the various services which it had to maintain, the simplicity of its interior organization and the efficiency with which it operated made it compare favorably with the largest and best organized commercial establishments.

Finally, the "*Motor Transport Postal Service*," the "Office of the Allied Sections" and the "Statistical Service" (for the personnel of the Motor Transport Service), although under the direct orders of the Motor Transport Direction, were administered by the M. C. A.

The M. C. A. received a thousand orders a day from its accredited organizations and, during major operations, it shipped 1,500 spare parts daily. When spare parts were in stock, barely forty-eight hours elapsed between the time of receiving the order and the time of its delivery to the unit concerned.

In letters under date of March 19, 1916 and December 4, 1918, the Commander in Chief commended the director and the personnel of the M. C. A. for the results attained, thanks to their persevering efforts, during the battles of Verdun and of the Somme.

2. MOTOR TRANSPORT ORGANIZATION AND TRANSITION PARKS.

The necessary operations in the organization of motor transport units devolved upon the "*Motor Transport Organization Parks.*" These parks received personnel and matériel from the interior,

classified, sorted, distributed and grouped them, and then forwarded the completely organized units to the armies.

At the beginning of the mobilization there were two motor transport organization parks, namely, at Reims and at Dijon. During August and September 1914, the park at Reims was successively transferred to Melun, then to Vierzon and, finally, in October 1914, to Versailles. These two agencies supplied the armies with organized motor transport units and with single motor vehicles throughout the war.

On March 1, 1917, the motor transport organization parks were subdivided into two distinct organizations: the "*Motor Transport Organization Park*" (P. A. O.), proper, under the Minister of War, and the "*Transition Motor Transport Park*" (P. A. T.), under the Commander in Chief. The P. A. O. received the personnel and the matériel from the interior, organized them into units and then forwarded them to the P. A. T. The latter remained the executive and accounting agency of the motor transport services of the armies.

As an executive agency the P. A. T. assigned and forwarded organized motor transport units, or casual personnel and matériel, to their destinations in accordance with the instructions of the Motor Transport Direction. It also received motor transport personnel coming from the armies, and which was destined for the interior, as well as motor transport units which were being reorganized and which had to be re-equipped with new matériel.

As an accounting agency for motor transport matériel, the P. A. T. was charged with listing motor vehicles, according to series of numbers provided by the Motor Transport Direction. The records of the motor vehicles were centralized at the Motor Transport Direction. These records began at the motor transport organization and transition park and ended at the evacuation center.

In September 1918, the P. A. T. were completely amalgamated with the P. A. O. and passed under the orders of the Minister. However, in order to facilitate matters, it was understood that the Motor Transport Direction could give direct orders to the commanding officers of these parks, although the latter were considered as under the Minister.

In addition, the motor transport park at Dijon was charged with the repair of bicycles and motor-cycles. Moreover, a number of auxiliary services belonging to the Motor Transport Service, i. e.: Sales commissary, printing plant, laundry, service for the repair of damaged clothing, service for cleaning greasy rags, as well as various schools for drivers, accountants, medical attendants, and cooks, were attached to this park.

3. SERVICE FOR THE INSPECTION AND IMPROVEMENT OF MOTOR TRANSPORT MATÉRIEL.

(Service du contrôle et d'amélioration du Matériel Automobile—S. C. A. M. A.)

During the first year of the campaign, in order to meet the numerous requirements of the Motor Transport Service, the Minister of War was obliged to contract with certain French and foreign manufacturers for the acquisition of motor vehicles. Among the cars thus obtained, it was found that some had been faultily designed, while others were not adapted to the military use for which they were intended.

On the other hand, owing to the shortage of trained labor and raw materials, certain manufacturers were obliged to deliver chassis which could not stand the strain.

On July 15, 1915, it was decided to create a special service under the orders of the Motor Transport Direction for the inspection and improvement of motor transport matériel; this was the "S. C. A. M. A." This organization was charged with examining defective motor transport matériel which had been delivered to the Government, and studying what modifications were to be made, either in the methods of construction or maintenance.

For this purpose all damaged parts, which seemed to result from defects in construction, were submitted to the S. C. A. M. A. This was done only after such parts had been returned to the motor transport parks and there classified in one of the three following categories: normal wear, abnormal wear resulting from bad usage or upkeep, wear seemingly the result of poor construction.

In July, 1916, the functions of the S. C. A. M. A. were extended, and it supplied the manufacturers concerned with technical specifications for the purpose of facilitating complete or partial replacement of defective parts; these replacements were charged up to the manufacturers.

The S. C. A. M. A. was also charged with the detailed inspection of all new types of motor vehicles manufactured "in series" (fabricated), which were held in the motor transport organization parks, and with studying possible improvements in motor transport matériel; finally, it also carried out all necessary physical and chemical tests, as well as the analysis of materials, metals, lubricants and fuels.

A laboratory was established in the "School of Physics and Chemistry," (Ecole de Physique et de Chimie) and placed at the disposal of the S. C. A. M. A.; moreover, certain analyses could also be made in the "National Conservatory of Arts and Trades" (Conservatoire National des Arts et Métiers).

In nine months, the S. C. A. M. A. made 378 analyses and examined 14,606 "lots" of defective parts, involving free replacement to the value of 560,698 francs. At the date of the Armistice, the total value of the savings effected by this service for the benefit of the State attained two million francs.

SECTION 2.—"SUPPLY" (REPLACEMENT) OF PERSONNEL.

1. MOTOR TRANSPORT ORGANIZATION AND TRANSITION PARKS.

In the preceding paragraphs the functions of the motor transport organization parks in the organization of motor transport units, as well as their distribution among the armies, has already been explained. These parks were, so to speak, the "regulating stations" of the armies for the supply of motor transport units. Therefore they received both the personnel coming from the interior, and the personnel coming from the armies. The personnel from the armies was either to be returned to the armies (units being reorganized), else it was to be sent into the interior.

In the first case, the park not only had to clothe, equip, and arm the personnel, but it also had to sort and classify it according to individual qualifications (mechanics, drivers, laborers, clerks, orderlies, etc.) and, finally, it had to send this personnel to the armies, either as detachments or as organized units, in accordance with the orders of the Motor Transport Direction. It can thus be seen that the role of the P. A. O. was complicated and that it required order, method, and discipline on the part of its commanding officer. Moreover, at certain times it was necessary to act quickly and to organize and forward new units within a few days, sometimes even within a few hours, without mentioning reinforcements. However, they never rendered themselves liable to reproach, even during periods of intensive work.

2. MOTOR TRANSPORT TRAINING CENTERS (CENTRES D'INSTRUCTION AUTOMOBILES).

The mobilization gave the Motor Transport Service about 200 reserve officers (Officiers de complément) and about twenty officers of the regular establishment. The selection of these reserve officers was generally most satisfactory, the majority of them were good motor transport technicians and practical automobile men, but, with the gradual expansion of the service, it soon became necessary to secure additional officers.

It is impossible to "improvise" an officer, either in the Motor Transport Service or in any other branch or service. Motor transport officers, in addition to a general knowledge of command, ad-

ministration, and organization, must also possess technical theoretical knowledge and be capable of applying same practically; finally, they must know the regulations governing the employment of motor transport units. It was decided to create a training center which would be attended, on the one hand by soldiers from the Motor Transport Service and, on the other, by officers from other branches who were unfit for duty with their original branch of the service. The first course was organized at the P. A. O. at Versailles toward the end of 1914, but the place was unsuited for this purpose and particularly for field service training. The school was therefore transferred to the motor transport park at Beauvais in February, 1915, when it became the "*Motor Transport Training Center*" (Centre d'Instruction Automobile) and operated under the orders of the commander of the park. The program, which had been elaborated under the supervision of the Motor Transport Direction, comprised a technical part, a theoretical part, and a practical part; work in the shops; drills in field service, including transportation of personnel; administrative courses and very advanced military instruction. Upon completion of the course of instruction, which lasted six weeks, the students underwent an examination and were then classified; those who passed with the highest marks were commissioned as "temporary" second lieutenants (à titre temporaire).

At the end of 1916, the motor transport training center was separated from the park at Beauvais, to which it had been attached simply for administrative purposes and for the upkeep of the motor vehicles. On the 20th of December, the "technical inspection" of the motor transport parks was given control over all courses of instruction of the "E. O. R."

January 4, 1917, the motor transport training center was transferred to Meaux. It was established in public buildings and the students were distributed among the various cantonments. On the 6th of March 1917, it was decided to establish a regular camp, on grounds which had been leased near the gates of Meaux. Forty-five days later, the camp was completely built and received the "16th session" of the E. O. R.; shortly thereafter, the first American students joined their French comrades. These American students had been designated by the Motor Transport Direction, upon the recommendation of the O. S. A., and after agreement with the organizing committees. They came from the various motor transport formations which had been placed at the disposal of the French Army by American welfare organizations. A special program, consisting essentially of practical work, was inaugurated for their benefit and special instructors were assigned to them. A special classification commission was also organized, composed of instruc-

tors from the O. S. A., and of representatives from the various foreign committees.

In July, the "*Technical Inspection of the Motor Transport Parks*" having been dissolved, the squadron chief who had been "Inspector of operations" (Inspecteur de l'Exloitation), was named as director of the training center. About the same time, the Motor Transport Direction abolished the system of admitting candidates directly, "upon recommendation," and an endeavor was made to eliminate unsuitable candidates through a probationary trial, by means of "Training Platoons" (Pelotons d'Instruction), which functioned in certain armies under the direction of the various chiefs of army motor transport services. The programs prescribed by the Motor Transport Direction comprised general theoretical training, a course in motor transport technique, practical instruction in the shops, and practical military instruction. Upon completion of the courses, candidates were examined and classified by a board, and the best qualified students were authorized to follow the courses of the motor transport training center, while the others were either definitely or temporarily relieved.

The motor transport training center was temporarily transferred to Montereau after the events of March, 1918, and it then became a "mixed" establishment, i. e.: it operated under the Minister of War, while its personnel belonged to the armies. In October, 1918, the training center was reestablished at Meaux.

Incidentally, the motor transport training center also included a school for motor truck drivers and for drivers of steam rollers.

The above organization furnished more than 2,000 officers to the Motor Transport Service. It held twenty-five successive sessions, without interruption, and each of these sessions took care of from 120 to 150 students. Upon leaving the school, and before assigning them to the command of independent units (S. S., R. V. F. sections), students were generally detailed to organized motor transport units, where their knowledge could be tested. Students who were found to be particularly qualified for repair work were naturally assigned to repair organizations.

The Motor Transport Direction thus completely formed its own officer personnel.

The practical value of the course of training given at the motor transport training center was at various times submitted to the severe test of real war conditions, as for instance when the training center received orders to actually function as a C. R. A., viz: in November 1917 (during the British attack on Cambrai); in March 1918 (during the German attack on Amiens); and, finally,

in May–June 1918 (during the German attack on Château-Thierry and Villers-Cotterêts). The results obtained were excellent.

3. THE OFFICE OF THE ALLIED SECTIONS (OFFICE DES SECTIONS ALLIÉS—O. S. A.).

From the first days of the war, a large number of French and foreign welfare organizations placed medical motor transport formations at the disposal of the French Commander in Chief. In October 1914, the Motor Transport Direction decided to create an organization for the maintenance of relations with these various committees and to regulate, in conjunction with the latter, the numerous questions which came up daily concerning placing these volunteer motor transport units into service. On October 14th, a special office was therefore established, under the name of "*Office for the Foreign Motor Transport Medical Sections*" (Office des Sections Sanitaires Etrangères—O. S. S. E.). This was changed later to "*Office of the Foreign Sections*" (Office des Sections Etrangères) and, finally, to "*Office of the Allied Sections*" (Office des Sections Alliées—O. S. A.). The officer (captain) in charge of the motor transport postal service at the M. C. A., was also given charge of this new organization.

The first task of the O. S. A., in conjunction with the foreign committees, was to determine the status of the various sections and to determine on one hand, the rights and duties of these committees and of their members and, on the other, those of the Motor Transport Direction. After numerous and complicated discussions, it was finally decided that the Motor Transport Direction would control the employment of the personnel and matériel. Each section was to be commanded and administered by a French officer, while his assistant would be a foreigner and the latter would also represent the committee concerned. The volunteer personnel had to agree to serve (enlist) either for the duration of the war, or for a period of six months, and these engagements (enlistments) were renewable, through tacit understanding, for periods of three months. The matériel was listed in the same manner as the French matériel and maintained under the same condition as the latter. Traffic regulations were elaborated and explicit rules concerning the movement of the personnel and vehicles were established.

This status was adopted and the "O. S. A." was responsible for its strict application. It thus operated as a sort of "organization park" for the foreign motor transport units and as a consulting agency; it was also charged with coordinating the rather disconnected efforts of the various committees. In particular, the "O. S. A."

was to recruit and group the personnel and matériel of the units, cause their organization into "administrative units" by the motor transport park at Versailles, supervise the movements of personnel and matériel and maintain the reports of these organizations up to date.

In 1916, the O. S. A. was advised of the difficulties experienced at times by the motor transport parks in supplying spare parts for the cars belonging to the foreign units, especially as these were generally composed of American and British machines (often of little-known makes), and arrangements were made whereby the committees agreed to undertake the repairs of this matériel themselves. The committees therefore organized motor repair shops proportionate to the needs of their particular sections, and at their own expense. Five of these motor transport parks were established in the region of Paris and they operated under the control of the O. S. A. A few mechanics from the French Motor Transport Service were detailed to assist them.

When the O. S. A. was created, eleven foreign medical motor transport sections were operating with the French armies. At the date of the entry of the United States into the war these had increased to seventy-one sections, not including special medical units (American Red Cross hospital detachments), nor the vehicles belonging to certain other welfare organizations (French and other Red Cross units), all under the control of the O. S. A. (Altogether 2,508 vehicles and 3,622 drivers.)

As already shown, even before the entry of the United States into the war, the O. S. A. played an important part in the organization of "transportation groupings" (Groupements de Transport) composed of volunteer American personnel. It also played an important part in the recruiting of the feminine labor (main d'oeuvre) employed as drivers and for work of all kinds. Five medical motor transport sections were composed solely of feminine personnel and gave entire satisfaction to the Command.

In September 1918, the O. S. A. was attached to the Interior.

SECTION 3.—REPAIRS.

1.—SHOPS FOR MOTOR TRANSPORT GROUPS AND GROUPINGS.

The "repair shops" for motor transport groups and groupings will simply be mentioned because, as a matter of fact, they were rather "trouble stations" (ateliers de dépannage) than repair shops.

2.—ARMY MOTOR TRANSPORT PARKS (PARCS D'ARMÉE).

The "*Army Motor Transport Reserve Parks*" (Parcs de Réserve d'Armée) had been provided for in the plans for the mobilization of

the Motor Transport Service, and were to be assigned at the rate of one per army. The Command had designated them for a double rôle at that time: (1) Repair the motor vehicles in service in their particular army. (2) Maintain a reserve of motor vehicles in good running order to replace those mentioned under (1) above.

After a few experiments, the army motor transport parks were all organized on the same plan: One "*Sorting T. M.*" (T. M. de triage); two or three motor repair sections, called "*Park Sections*" (Sections de Parcs); finally, a "store" or depot (magasin), containing the reserve motor vehicles and spare parts. The rudimentary facilities with which they were equipped at the beginning of the war, were progressively improved and modified to enable them to make repairs of medium importance; at the same time, they remained mobile enough to be able to move with all changes in the location of the park. As a matter of fact, throughout the war, one of the main problems of the Motor Transport Direction was the maintenance of army motor transport parks which would be able to follow all the movements of the army to which they were assigned.

With this object in view, the army motor transport parks were not to undertake repairs which would entail more than a certain number of hours' work, nor could they stock up with vehicles awaiting repairs, repaired vehicles, or spare parts. These conditions could only be attained through the establishment of a perfect system of supply for the exchange of spare parts between the army motor transport parks and the main supply agency. How this problem was solved has already been told in the section dealing with the M. C. A.

Finally, the army motor transport parks were to maintain an advanced echelon which would be ready at all times to follow the army in its forward movement. Theoretically, this echelon consisted of a park section (Section de Parc), with reduced equipment and functioned as a large "trouble" station (atelier de dépannage). All the army motor transport units received their spare parts and their mail through the army motor transport park.

The army motor transport parks were only to undertake limited repairs and were to send the vehicles which they could not repair, either to the "evacuation center" (Centre d'Evacuation), when repairs seemed impossible, or, to one of the motor transport repair parks under the Motor Transport Direction which were located in the rear zone and equipped to make heavy repairs. Each motor transport park was therefore under a *Connecting Park* (Parc de Rattachement). In November, 1918, the Motor Transport Direction ordered that, for the purpose of maintaining the mobility of the army parks, the latter should no longer send orders direct to the M. C. A., but only through their Connecting Park.

The Army motor transport parks accomplished a great deal of work. Altogether, these parks repaired an average of 1,500 vehicles every ten days, or about 5,000 vehicles per month.

The army motor transport parks, alone, sent out 1,928 vehicles during the last days of the war.

8. THE MOTOR TRANSPORT REPAIR PARKS (PARCS DE RÉPARATIONS AUTOMOBILES).

The mobilization plans only provided for the creation of the army motor transport reserve parks and of the G. P. A. R. It has already been shown why the Command suppressed the G. P. A. R. and created an organization for the supply of spare parts. The army motor transport parks, however, had only been established for specific purposes and under particular conditions, i. e.: the upkeep of the motor transport matériel of the army to which they were assigned, and for repair work which did not entail more than a certain number of hours' work.

The necessity was felt of having more permanent repair organizations behind the army motor transport parks, more completely equipped and capable of undertaking the work which could not be done by the army parks. This was the function of the "*Motor Transport Overhaul Parks*" (Parcs de Révision) and the first of these was created in February 1915. At the beginning, these overhaul parks had a triple purpose:

1) Undertake repairs which required a long time and which could not be done by the motor transport repair parks (Parcs de réparations).

2) Overhaul either single vehicles, or complete units, of a prescribed make and type.

3) Act as a motor transport "connecting park" (Parc de Rattachement) for the motor transport reserves and groupings which were directly under the Motor Transport Direction.

These two terms require defining: "overhaul" (révision), in opposition to "repairs" (in which the shop limits itself to changing the damaged part), consists in taking the vehicle completely apart, examining all component parts, one by one and changing those which are damaged or which have attained a degree of wear below tolerated standards; finally, reassembling the vehicle, so that the car comes out of the "overhaul" practically as good as new. A park functioned as the "connecting park" of a motor transport unit in the sense that, all parts, all mail, and all official communications, either to or from this unit, always passed through these parks.

The composition of the motor transport overhaul parks (Parcs de Révision) was similar to that of the motor transport repair parks

(Parcs de Réparation). The park was under the command of a captain, who was the "park commander," and three assistants; one of whom was in charge of the technical services, the second of the administrative services, and the third of movements (transportation). The park itself was composed of a "sorting T. M." (T. M. de triage) and a number of park sections (Sections de Parc).

The Motor Transport Direction always maintained the principle that while they were much more permanent and far heavier than the army motor transport parks, overhaul parks, were, none the less, mobile units and should always be in readiness to relieve the army parks as soon as these moved forward.

Important regulations were issued on this subject during the middle of March 1917, and prescribed the functions of the army parks and of their connecting parks.

These regulations were extended in October 1918, and during the same month the overhaul parks, which had in the meantine been designated as "*Motor Transport Repair Parks*" (Parcs de réparations automobiles), were subdivided into two categories. Four of these parks were designated as "*Advance Zone Connecting Parks*" (Parcs de réparation de Rattachement de l'Avant) and functioned as connecting parks for the army motor transport parks. These advanced parks were authorized to request assistance from the four "*Motor Transport Repair Parks of the Rear*" (Parcs de réparation de l'Arrière).

The efficient operation of the repair parks was always the object of constant study on the part of the Motor Transport Direction. A series of successive measures increased their output considerably, viz:

Intensification of production by night work, organized through rotation of crews.

Perfecting of working methods, by determining the number of hours' work required for a specified repair and by giving a bonus for output.

Stimulating and maintaining competition between the parks, by comparison of the results obtained.

Improving new labor by establishing apprenticeship courses and courses for "foremen" (Chefs d'Equipes).

Specializing "makes" of vehicles among the different repair parks, and the organization in these parks of the manufacture in "series" (fabrication), of spare parts for these particular makes of vehicles.

The Motor Transport Direction maintained three parks in 1915, five in 1916, and nine at the date of the Armistice; with a total of 7,000 workmen, of whom 2,000 were prisoners of war.

The output of these parks, thanks to the above-mentioned measures, continued to improve:

Date	Total number of vehicles repaired, etc.	Cars completely overhauled	Total
October 1917	1,623	538	2,161
February 1918	2,330	312	2,642
June 1918	3,455	417	3,872
October 1918	2,831	1,052	3,883

It should be noted that these results were obtained despite the fact that several of these parks had to change their locations as a result of military events during the "Battle of 1918."

Finally, in addition to their motor transport activities, proper, the repair parks were charged with a great deal of other work which they were equipped to handle. Of this work, perhaps the most important was the testing and construction of demountable hangars with metallic frames; these hangars were very useful to the Motor Transport Service.

It has been deemed advisable to stress the functions of the army motor transport parks and of the motor transport repair parks, because it is firmly believed that a transportation system such as the Motor Transport Direction is only as good as its repair and upkeep organizations.

SECTION 4.—EVACUATION (SALVAGE) AND REPAIR.

EVACUATION AND SORTING CENTER OF THE MOTOR TRANSPORT SERVICE.

(Centre d'Evacuation et de Triage du Service Automobile—C. E. T. S. A.).

December 31, 1916, a "*Center for the evacuation and sorting of the motor vehicles*" (C. E. T. V. A.) was established at Vincennes. This establishment, which later became the "Evacuation and Sorting Center of the Motor Transport Service" (C. E. T. S. A.), always remained under the Minister. It is therefore mentioned merely as a matter of information, and to complete the "cycle" followed by the motor vehicles from the time of their reception by the armies through the P. A. O., until their "death" at the C. E. T. S. A. The purpose of the C. E. T. S. A. was to receive the vehicles which had been evacuated by the armies, examine them, and determine whether they were to be "scrapped" or whether they could be used by certain services in the interior, finally, to salvage all parts which were worth it.

The armies evacuated on an average of 400 vehicles per month. At the time when these evacuations were heaviest, that is, during August and September 1918, this figure increased to 700. This was a small percentage of the total number of vehicles in service and is one of the best proofs of the output of the parks.

PART IV.

SERVICES ATTACHED AND SPECIAL AUTOMOBILE SERVICES.

SECTION 1.—SUPERVISION AND CONTROL SERVICES.

1. PERMANENT INSPECTION OF MOTOR TRANSPORT OPERATION AND TRAFFIC.

(Inspection Permanente de l'Exploitation et de la Circulation.)

During the early part of the war the need for correcting certain errors and abuses in the employment of motor vehicles, as well as for the supervision of all motor traffic in the Zone of the Armies, led the Command, upon the recommendation of the Motor Transport Direction, to establish a special organization.

On November 27, 1916, the "*Permanent Inspection of motor transport operation and traffic*" (Inspection permanente de l'exploitation et de la circulation) was created and a field officer of the Motor Transport Service was placed at its head.

The functions of the "Permanent Inspector" were of two kinds: (1) Supervision, properly speaking, of motor transport operations of the army units. (2) Supervision of traffic.

Without entering into the details as to the means employed by the permanent inspector in the execution of these duties, it can be affirmed that the results obtained were very tangible. These were: more efficient employment of motor vehicles by the suppression of unnecessary transports, and a three to one decrease in the number of passenger cars operating in the Zone of the Armies; briefly, in effecting an incontrovertible saving for the Government.

2. SERVICE FOR THE SUPPLY AND CONTROL OF GASOLINE.

(Service du ravitaillement et du contrôle de l'essence.)

From the date of the declaration of war until July 1917, the supplies of gasoline and various ingredients (oils, greases, etc.) were furnished by the "Intendance" (Q. M.) Service.

The regulating stations forwarded supplies or gasoline which had been requested by the units, through the daily supply trains (R. Q.). The system was simple, but the "Intendance" had no means of estimating the actual requirements of the units and it was therefore unable to exercise control over the requests. As reports were not centralized, it was impossible to know the quantity of gasoline consumed by each army or by each army service, consequently, the gasoline supply suffered severe "setbacks" (à coups) whenever large motor transport units moved.

Finally, the return of empty containers was not being carried out and this was a most serious matter, because it could result in completely stopping shipments from the interior.

On July 10, 1917, the Commander in Chief charged the Motor Transport Service with the supply of gasoline and ingredients for all motor vehicles (excepting those of the Aviation), and for all units employing gasoline. On July 14th, regulations concerning the establishment of gasoline consumption reports were published and, on November 1st, the final organization of the new service had been established.

This service comprised two distinct parts: Supply and control of consumption.

The basic organization of the supply system was the establishment of "*Main Depots*" (Dépôts Principaux) for each army and for each "Direction" of the lines of communication (Direction d'Etapes), to which "*Secondary Depots*" (Dépôts secondaires) were attached. Only the last named supplied the units. The secondary depots were filled by the main depots and the main depots were replenished by the commanders of the regulating stations.

Finally, to meet emergency requirements arising from the execution of important strategic movements (grands transports stratégiques), "*Precautionary stocks*" (Stocks de Précaution) were formed in November 1917, and these reserve stocks were distributed at the rate of from 12,000 to 30,000 hectoliters among main depots previously designated by the Motor Transport Direction.

To reduce the duration of the rotation of containers, six filling stations (ateliers d'embiddonage) were also established. These stations received the gasoline in tanks and emptied it into easily handled containers.

The control of gasoline consumption was a matter for deep and constant study on the part of the Motor Transport Direction. It was vitally important that there be no wastage of gasoline, especially as this fuel had to be obtained from abroad and because, while requirements increased, available supplies were decreasing.

In 1915, it was prescribed that the motor transport units should regulate their engines carefully and keep a record of daily trips made by the vehicles, as well as of their fuel consumption. Single motor vehicles were provided with "supply record books" (carnets de ravitaillement) for this purpose. At the beginning of 1917, a special supervision was established over the gasoline consumption of the motor transport of the various headquarters. October 7, 1917, a "*Central Service for the Control of Gasoline and Ingredients*" (Service Centrale du Contrôle de l'Essence et des Ingrédients) was created under the orders of the Motor Transport Direction to follow up all matters concerning gasoline supply, centralize the records of the depots, and make such recommendations as would tend to reduce consumption.

With this object in view, two important measures were ordered by the Motor Transport Direction. These were: the establishment of "*allotments*" (contingentement) and the creation of "*coupons*" (bons).

By the "contingentement," each unit received a monthly allotment which could not be exceeded. The "bons" were a kind of "sight-draft" (Chèques-à-vue) which enabled the units to draw their allotment from the secondary depots as needed, and which served as issue vouchers for the issuing depots.

The reports of the units and depots could be verified by the gasoline control service by comparing the stubs of the voucher-books returned by the units, with the "coupons" (bons) which had been returned by the depots. Finally, in order to avoid exaggerated consumption reports and maintain the savings which had been effected during certain periods, current voucher-books were declared void and a new series was issued.

These measures served to assure a regular supply of gasoline, even during the critical moments of the submarine warfare period, as well as judicious and economical use of the precious fuel.

8. THE PERMANENT MOTOR TRANSPORT INSPECTIONS.

(I. P. S. A. R. E. and I. P. S. A. R. O.)

At the beginning of the campaign, it was found necessary to check up on the manner in which certain territorial staffs and civil authorities had carried out the requisitioning of vehicles, or had accepted vehicles which had been placed at their disposal by private individuals. It was also necessary to control the upkeep and repair as well as the supplies for these vehicles. October 22nd, the Motor Transport Direction charged the chiefs of the army motor transport services and the P. A. Os., at Dijon and at Versailles, with the technical control of motor vehicles operating in the Zone of the Armies. Moreover, the P. A. Os. were charged with putting into regular form requisitions which had not been properly accomplished (irregulières). In November 1914, two "*Permanent Motor Transport Inspections*" were created to supervise the motor vehicles operating in that part of the Zone of the Armies which was not included in the areas under the direct orders of the various commanding generals of armies. In the latter, the chiefs of the army motor transport services were responsible for this supervision.

The Zone of the Armies was sub-divided into two parts: the 6th, 7th, 8th, 20th and 21st Regions were assigned to the "*Permanent Inspection of the Regions-East*" (Inspection Permanente des Régions Est—I. P. S. A. R. E.) and the 1st, 2nd, 3rd, 4th and 5th

Regions to the "*Permanent Inspection of the Regions-West*" (Inspection Permanente des Régions Ouest: I. P. S. A. R. O.). An officer of the Motor Transport Service was placed at the head of each of these services.

After making a census of the motor vehicles thus placed under their orders, and after standardizing (régularisé) the motor transport equipment of the various services, the permanent inspectors organized the "*Regional Motor Transport Sections*" (Sections automobiles de place) and successively took over the vehicles belonging to the "railway telegraph technical sections" (Sections techniques de Télégraphie des chemins de fer), the T. P. T. sections, the motor transport sections of the railroad engineer companies, of the hospital centers, of the regional hospitals, of the postal administrative services, of the railroad commissions, of the regulating stations and of various civil authorities or services (Prefectures, administrations for the reconstruction of the liberated regions, etc.).

The motor transport equipment of these sections was to be formed by means of "vehicles of old models" and the personnel was chosen from among the older militia classes, auxiliaries, etc.

In 1916, to enable these inspections to efficiently carry out their duties, it became necessary to decentralize their commands. The territory of each inspection was therefore sub-divided into five "groups," each under the orders of a captain. The group controlled all means of motor transportation existing within the territorial zone assigned to it. Finally, each group was provided with a repair shop which was attached to the regional motor transport sections (Sections de Place). In addition to the above, a shop corresponding in importance to a motor transport park section (S. P.) was also assigned to each inspection.

SECTION 2.—GENERAL SERVICES ATTACHED.

1. THE MOTOR TRANSPORT POSTAL SERVICE.

On account of their mobility and dispersion, particularly at the beginning of the war, the troops of the Motor Transport Service suffered from irregularity in the delivery of their mail. The Motor Transport Direction took up the matter immediately and, on August 24, 1914, it received authorization from the Minister of War for the establishment of a special postal service for the motor transport units, to be organized and administered by the Motor Transport Service itself. The motor transport postal system was originally organized as follows: All mail for motor transport personnel, which had at first been sent to the "*Connecting squadrons*" (Escadrons

de Rattachement) of the T. E. M. sections, was centralized in one of the two P. A. Os., according to its origin. The P. A. Os. then forwarded the mail, after sorting it, to the army motor transport parks to which the units were assigned.

The creation of the M. C. A. and the establishment of daily liaison between the M. C. A. and the army motor transport parks for the delivery of spare parts, naturally suggested the feasibility of operating the "*Postal service of the motor convoys*" (Service Postal des Convois Automobiles) in connection with this establishment. On November 28, 1914, the postal service was therefore transferred to Paris and attached to the M. C. A.

The post office of the P. A. O., at Lyon, was temporarily maintained as an "annex" and functioned for the motor transport units which were operating in Lorraine and in the Vosges. This office was closed at the end of 1916 and the postal service was finally centralized in Paris.

At the end of June regulations for the functioning of the postal service were issued, and these underwent only minor modifications thereafter. Without entering into details, these regulations can be summarized as follows: addresses were permanent; the envelopes simply mentioned the motor transport unit to which the addressee belonged; centralization of "motor transport convoys" at the M. C. A. and sorting upon departure; daily forwarding to the connecting motor transport parks (Parcs de Rattachement) through the daily liasons of the M. C. A.

Daily delivery of mail to the receiving units through the rotation of the supply in spare parts which was maintained by the motor transport parks.

At first, the postal service served only units which were under the Motor Transport Direction but, later, the A. L. G. P. and the A. S. were also served by it.

The development of the postal service brought about the installation at the main office of an "index system" (fichier) in which all of the motor transport personnel of the Army was listed alphabetically, for the purpose of re-addressing mail which had been misdirected. This "index" was kept up to date by means of personnel reports which were forwarded every ten days by the units. It formed the basis of the statistical service at the M. C. A., for the personnel of the Motor Transport Service. All that was necessary to complete the index, was the addition of a few details (class, date of enlistment, etc.), which were obtained from the units. This information was of great value to the Motor Transport Direction, as it facilitated the investigation of individual cases and furnished general information on various subjects, such as the number of men belonging to a particular "class," etc.

Finally, the postal service distributed gifts (tobacco, clothes, moving-picture films, etc.) which had been donated by private individuals to the units, and carried various urgently needed supplies to the A. L. G. P. or the A. S.

Initially, the postal service consisted of one directing officer, two non-commissioned officers, and twelve drivers. At the date of the Armistice, it had a personnel of two officers, twenty-four men, and ninety women. These figures are not excessive when it is considered that the mail handled by this service (which at the time of its creation amounted to 20,000 pieces per day) had attained 160,000 pieces per day by the end of October 1918.

Although only a minor service, the postal service nevertheless contributed a great deal, through the regularity of mail deliveries and through its general efficiency, towards maintaining the morale of the motor transport troops, particularly during critical moments.

2. PRINTING ESTABLISHMENT, CLOTHING DEPOT, LAUNDRY, SALVAGE OF CLOTHES.

All of these auxiliary services were grouped at the organization park (later transition park), at Dijon, and placed under the orders of the commanding officer of that establishment.

A) *Printing establishment.*—The operation and administration of the motor transport and repair units necessitated a considerable amount of "writing." Matériel, spare parts, and raw materials had to be carefully checked up whenever they were moved, transferred, or used, if things were to be run in an orderly manner. The work accomplished by the units had to be controlled and the numerous transfers of personnel noted. All this required that provisions be made for supplying large quantities of blank forms, registers, booklets, etc. In order to effect maximum savings on commercial cost of publication and obtain standardization in the printed forms used by the various motor transport units, the Motor Transport Direction decided to organize a printing establishment of its own; the latter would furnish duly accredited M. T. units with such forms as were officially authorized. Towards the end of 1916 (?), a printing shop was established at the park at Dijon. This establishment developed rapidly and in October 1916, when it was in full operation, the printing establishment employed thirty-one men and eighty-nine women. Its monthly output attained two million copies of printed matter, which was distributed to the various units through the motor transport postal service. It functioned under the control of the Motor Transport Direction until the Armistice; shortly thereafter it was amalgamated with the printing establishment which had been organized at the M. C. A.

B) *Clothing depot* (*Magasin d'habillement*).—The motor transport units or organizations which were under the direct orders of the Commander in Chief (groupings, repairs parks), generally experienced great difficulty in supplying themselves with clothing and equipment, either on account of their mobility or due to the fact that they were not attached to an army. Especially was this the case with reference to special clothing equipment (gloves, goggles, heavy clothing, etc.), which was scattered in the numerous "Intendance" depots. Therefore at the beginning of 1916, the Motor Transport Direction decided to assemble supplies of special clothing for motor transport troops and a clothing depot was established in the park at Dijon. This depot was charged with the distribution of special clothing to all motor transport units and with the supply of ordinary clothing of all kinds for the use of units under the Motor Transport Direction. Other units received their clothing from their own army.

Thanks to this organization, clothing could be supplied regularly to all motor transport units. Strict accounting at the depot and in the units made it possible to control all orders and shipments and prevent wastage. The clothing depot made shipments by complete carloads, or by means of motor vehicles leaving the park at Dijon and which were destined to the armies, or, through the postal service. The clothing of the various motor transport units was inspected frequently by two officers designated by the Motor Transport Direction.

The clothing depot functioned under the control of the Motor Transport Direction until the Armistice.

C) *Laundry*.—In 1916, a laundry was established in the park at Dijon to clean, dry, and store clothes; these were to be returned to the units. It also cleansed waste rags, which were used in large quantities by the Motor Transport Service. On an average, the laundry cleaned 1,000 pieces of clothing and 3,000 kilograms of rags monthly (kilog: 2.2 lbs.).

D) *Salvage of Clothing*.—The motor transport organizations possessed but limited means for the repair and upkeep of the clothing for their personnel and this resulted in an excessive usage of clothes. In 1916, the Motor Transport Direction decided to centralize the services for important repairs to clothing and shoes in the park at Dijon, and it also charged them with the renovation (during the summer season) of the fur-lined garments which were used during the cold season. A tailor shop and a cobbler shop operated in connection therewith. These shops employed about 150 workmen and received 700 coats, 1,800 jerseys, 2,700 pants, 4,700 boots (field shoes). 800 goat hides, 1,500 mackinaws and 500 leather jerkins from the armies each month. The percentage of salvage for each of these articles

amounted to: 95% for the coats; 65% for the jerseys; 40% for the pants; 75% for the boots; 95% for the goat hides and mackinaws, and 40% for the leather jerkins.

Unserviceable clothing was extensively used in the manufacture of "accessories": insignias, brassards, pennants, etc.

3. THE SALES COMMISSARIES OF THE MOTOR TRANSPORT SERVICE.

The great services rendered to the troops in the field by the "*Commissaries*" (Coopératives) are well known. These establishments enabled the soldiers to obtain provisions of excellent quality at a low cost, and to improve their "messes" (ordinaires) without having to fear the "shameful extortion practiced by profiteers (*mercantis*) operating near the front." In 1916, long before the general organization of the "*Central Sales Commissaries of the Armies*" (Coopératives centrales de l'Armée), the Motor Transport Direction authorized the officer in charge of the postal service to create a main sales commissary (coopérative mére), for the dual purpose of assisting the development of the motor transport sales commissaries at the front by furnishing them with supplies on credit, and coordinating purchases so as to obtain better quotations from the furnishers.

Founded with an initial capital of 65,000 francs, furnished entirely by generous French and foreign contributors, the main commissary soon did a monthly business averaging about 40,000 francs. This remained almost constant until 1917, when the "*Central Army Stores*" (Magasins Centraux d'Armée) were established, and this led to the amalgamation of the main commissary with one of the central stores, and the establishment of a chain of Motor Transport Service sales commissaries. The latter were of two types: The "*Park Sales Commissary*" and the "*Grouping Sales Commissary.*" The total figures for the business of the main commissary increased considerably and in May, 1918, amounted to 200,000 francs per month, while in September sales exceeded one million francs. At the date of the Armistice, merchandise to the value of 1,300,000 francs had been shipped to the front, and the net profits amounted to 170,000 francs.

At the beginning of 1918, in connection with the main sales commissary, a "*Sales Commissary for clothing for officers*" was established on the model of those which existed in each army. This establishment was subsidized by the Commander in Chief and functioned until the Armistice. It was then liquidated, after having furnished 400 complete tailored uniforms, sold various merchandise to the value of 750,000 francs and realized (from an initial capital of 5,000 francs) a net profit of 14,000 francs.

SECTION 3.—THE SPECIAL MOTOR TRANSPORT SERVICES.

1. THE MOTOR TRANSPORT SERVICE OF THE FRENCH G. H. Q. (G. Q. G.).

The motor transport service of the General Headquarters was organized on the day of the mobilization at the motor transport center of the "Fortress of Paris" (Champ de Mars). Its constituent elements, which had scattered after the first day of the mobilization, were reassembled for the first time at Vitry-le-François, about the 7th of August.

The composition prescribed by the tables of war organization was: three officers, fourteen mechanics, ninety-two drivers and non-commissioned officers; ten passenger-cars, fifteen motor-trucks and ten motor-busses. The number of vehicles had to be immediately increased by drawing upon the "ministerial motor transport reserve," and the equipment was progressively added to with the subsequent expansion of G. H. Q. In October 1916, this service had 384 drivers, forty-eight mechanics, fifty-seven vehicles of the first category (trucks, trailers, light trucks) and 168 vehicles of the second category. The second category attained 200 cars the following year.

It became necessary to proportionately increase the means for the upkeep of this service. The repair unit of the G. H. Q. motor transport service was considered as an independent M. T. park and was regularly accredited to the M. C. A. The G. H. Q. motor repair shop was designed to meet all requirements of the G. H. Q. motor transport service and generally had about thirty vehicles under repair.

Altogether, during 1916, the G. H. Q. passenger-cars covered 120,000 kilometers per month, or 1,420 kilometers per vehicle; these figures changed to 300,000 kilometers per month, and 1,240 kilometers per vehicle, in 1918. Similarly, thanks to a series of measures tending to economize fuel, the consumption of gasoline, which had attained 61,415 liters in December 1916, was reduced to 47,073 liters in July 1917. The cost, therefore, amounted to 0.0106 francs per H. P.-kilometer and this is a very low figure in comparison to the power of the motor vehicles which composed the park.

2. FRENCH MILITARY MISSION WITH THE BRITISH ARMY.

At the end of August 1914, it became necessary to group the motor vehicles which had been placed at the disposal of the French officers detailed with the British Army, i. e.: a total of thirty vehicles. On September 15th, the motor transport service of this mission functioned as a "*Headquarters motor transport service*" (Service automobile de Q. G.), and was attached to the motor transport service of the Sixth French Army and, successively, to whatever French army was in contact with the British armies.

The development of this motor transport service naturally followed the expansion of the British armies and as the number of vehicles increased, it became necessary to provide for their repair and upkeep. Four motor repair shops were organized at first, or one for each British army. These were soon replaced by a "*Central Motor Transport Park*" and by four separate motor repair shops. In 1917, the service was further increased by three motor transport "Road Sections" (Sections routières). This service was abolished in 1919, when the G. H. Q. of the British Armies in France was dissolved.

3. MILITARY MISSION WITH THE AMERICAN ARMY.

This motor transport service was created on September 6, 1917, and it was organized as an independent service on October 11, 1917, under the same conditions as the motor transport service of the French Mission with the British Army.

The motor transport equipment of the headquarters of the mission consisted of twenty-five vehicles. In addition thereto, French liaison officers with large American units were also furnished vehicles. At the date of the Armistice, the total number of vehicles in this service amounted to 120 motor cars and ten motor cycles.

4. GENERAL ARTILLERY RESERVE (RÉSERVE GÉNÉRALE D'ARTILLERIE—R. G. A.).

The A. L. G. P. units[8] were equipped with motor vehicles and, upon their creation, it became necessary to provide them with a separate motor transport service. The motor transport service of the A. L. G. P. included a "*Central Service*," under the direction of a captain who was chief of the service, and two assistants. It also maintained a park section which was located at Mailly. The central service was attached to the staff of the A. L. G. P. and it was called upon to collaborate in studies on a number of important questions, among which: regulations for the road maneuver of 240-mm. matériel mounted on trucks; instructions for drivers of "Knox" tractor carriers; transformation of carrier-carts; construction of two-wheeled trailers for 16-in. naval matériel; packing (for transport) of heavy caliber shells and the design of a type of "entrenching plow" (charrue fouilleuse).

"Park Section No. 17" (S. P. 17) had to be progressively increased to meet the requirements of the central service, and a training center for drivers of tractors, trucks and motor-cycles was assigned to it.

[8] Heavy long range artillery (Artillerie Lourde à grande puissance: A. L. G. P.).

In February 1917, the A. L. G. P. was absorbed by the "General Artillery Reserve" and its motor transport service became the motor transport service of the "R. G. A."

At that time, the central service consisted of a captain, who was chief of service (C. S.), assisted by one captain and three lieutenants. To the armies were detached: one captain, inspector and technical advisor of the 240-mm. groups; one captain, inspector and technical advisor of the 1st division (A. L. G. P.); one captain, inspector and technical advisor of the 3rd division (tractor A. L.), and one lieutenant, commanding the T. M. section, who also administered the personnel of the naval gunnery section.

The two organization centers of the R. G. A. units were each assigned one lieutenant, while a captain supervised both centers.

Finally, four lieutenants operated the service at the park of Mailly.

Among the tasks undertaken by the motor transport service of the R. G. A. may be mentioned: a study on trailers for 120-L. guns for use with "Knox" tractors; a study on a 40-ton truck for the transport, by road, of locomotives and railway cars, and a study on similar matériel for the transport of tug boat hulls.

"Park Section No. 17" (S. P. 17) was able to repair 120 vehicles per month.

In February 1918, the R. G. A. was amalgamated with the "General Inspection of the Artillery" (Inspection Générale de l'Artillerie) and it received a new expansion which was also participated in by its motor transport service. The latter organized a statistical service for its motor vehicles. Finally, the training center at Mailly was enlarged and a "trouble crew" (équipe de dépannage) was also organized there to act as an advanced echelon of the "S. P. 17"; a group of tractor drivers was transformed into T. M. sections to provide for important movements, and the functions of the inspectors were greatly increased.

5. TANKS (ARTILLERY D' ASSAUT—A. S.)

From the day when the Tank Service was first organized, there was close collaboration between the Motor Transport and the Tank Services. After October 1916, when the first tanks left the factories, the Commander in Chief decided to entrust the upkeep of this class of motor transport matériel to the Motor Transport Service.

The "*Service for the upkeep of the motor transport matériel of the Tank Service*" (Service de l'entretien du matériel automobile de l'Artillerie d'Assaut) was organized in December 1916, and placed under the orders of an officer (captain) of the Motor Transport Service who had previously commanded a group of motor "cater-

pillars." Shortly afterwards this officer was replaced by a first lieutenant, assisted by two second lieutenants.

The new service was responsible for: Repair services of the Tank Service; supply of spare parts; technical services for the tanks; liaisons with the Motor Transport Service.

All of the repair services of the Tank Service (A. S.) which were grouped in the camp of the A. S., as well as a park section (S. P. 54) of the Motor Transport Service, were placed under the direction of the upkeep service (Service d'entretien) of the A. S. In October 1917, the entire service consisted of about a thousand men. Numerous improvements were made in the tank matériel by a "mixed commission" which met weekly at the M. C. A. and which studied the recommendations of the upkeep service of the A. S. Among the studies made by this commission and put into effect were the classification of tanks used for training and combat purposes, and the methodical overhaul of combat tanks after a specified number of hours operation; the latter made it possible to maintain 75% of the matériel in good running order.

In December 1917, the A. S. decided to undertake the maintenance of matériel mounted on caterpillar treads, and the Motor Transport Service was only responsible for the supervision and upkeep of matériel mounted on wheels.

6. THE D. T. M. A. AND THE D. G. C. R. A.

Until February 1917, the motor vehicles used by the various formations of the "Direction of Military Transportation of the Armies" (Direction des Transports Militaires aux Armées—D. T. M. A.) were accounted for, either by the armies or by the permanent inspections.

The motor transport service of the D. T. M. A. was established in February 1917, for the better supervision and upkeep of its motor vehicles.

It operated as an independent service, under the direct authority of the Motor Transport Direction, and it was placed under the orders of a lieutenant, who was assigned two assistants.

It did not possess a repair organization of its own. Repairs were made in the motor transport parks and in the shops of the permanent motor transport inspections.

The service had a "pool" of vehicles at its disposal, which was supplied by monthly assignments from the Motor Transport Direction.

When the D. T. M. A. was abolished, the various services which composed it were distributed between the "General Direction of Military Transportation" (Direction Générale des Transports Mili-

taires—D. G. T. M.), which was under the Minister of Public Works, and, the "General Direction of Transportation and Supplies" (Direction Générale des Communications et des Ravataillements aux Armées—D. G. C. R. A.), which was under Marshal Foch.

In addition to its other functions, the D. G. C. R. A. served a large number of inter-allied organizations: Permanent Armistice Commission, Commission of Field Railways, base ports, etc.

It therefore became necessary to organize its motor transport into a regular service, based on the same lines as that of the D. T. M. A., and this motor transport service was placed under the orders of a captain, to whom two assistants were assigned.

This motor transport service consisted of about 200 vehicles, mostly passenger cars.

PART V.

ORGANIZATION OF THE MOTOR TRANSPORT SERVICES IN THE ZONE OF THE INTERIOR.

1. GENERAL ORGANIZATION.

The creation of new organizations, whose war time history and development have been set forth above, necessitated sending numerous personnel and large quantities of matériel to the armies, to meet the requirements of the Motor Transport Service.

The organizations of the interior, which functioned under the orders of the Minister of War, were charged with supplying this personnel and matériel. With regards to personnel, the Minister of War had the necessary means at his immediate disposal. For matériel, however, he called upon the Minister of the Armament. The latter was responsible for the procurement of matériel, either from France or abroad, and he saw to it that the orders of the Minister of War were complied with.

The directing agency of the Ministry of War was the "*Sub-Direction of the Motor Transport Service*" (Sous-Direction du Service Automobile), which was attached to the "Direction of the Artillery" (Direction de l'Artillerie). The principal agency of the Ministry of Armament dealing with motor transport matériel, was the "*Inspection of Motor Transport Service Production*" (Inspection des fabrications du Service Automobile).

Throughout the war, close and constant relations were maintained between these two agencies. At one time they were even grouped under one single "*Direction of the Motor Transport Service*," at first, under the Minister of War and, later, under the Minister of the Armament. However, at the beginning of 1918, these two agencies were separate, as stated above.

The various establishments, operating under the Ministry of War and the Ministry of Armament, whose function it was to supply the motor transport services of the armies with personnel and matériel will be enumerated below.

2. TRAINING CENTERS (CENTRES D'INSTRUCTIONS).

The purposes of these centers were: (*a*) to provide elementary training for men coming from all sources, (such as recruiting stations etc.), particularly, for those who were unfit for service in the infantry, or for wounded who had been cured; (*b*) to transform these men into drivers.

Five centers were successively created and developed, viz: the centers of Boulogne-sur-Seine, Orléans, Dourdan, Lyon, and Lunel. Four of these were afterwards specialized: Boulogne for drivers of artillery tractors; Orléans for drivers of passenger-cars; Dourdan for motor-truck drivers, and Lunel for drivers recruited from among the colonial troops.

These centers sent reinforcements (replacements) to the organization parks as needed. The function of these parks has already been described in Part III, Section 2, above.

3. REGIONAL GROUPINGS.

Independently from that assigned to the field armies, it was necessary to maintain a certain amount of motor transportation in the interior. This transportation served the military establishments located therein and facilitated the supply of the armies; for example, forestry operations could not have been carried on without the aid of military motor transportation.

In each region, all military motor vehicles were assigned to the motor transport grouping of that region. Each grouping maintained one or more repair shops, and an "*Inspection of Regional Motor Transport Groupings*" enabled the central administration to know their needs and supervise their management.

To each regional motor transport grouping was attached a "*replacement section*" (Section cadre), which functioned as a depot for the motor transport personnel of the region. The men who had been evacuated from the Zone of the Armies, as well as men discharged from the hospitals or returning from convalescence, etc., were forwarded to these depots. The "section cadre" of the regional motor transport groupings sent available personnel, either to the training centers or to the motor transport organization parks.

4. SUPPLY CENTERS FOR MOTOR TRANSPORT MATÉRIEL.

There were two of these centers: at Vincennes and at Lyon, and these were responsible for the supply of motor transport matériel.

They contracted with manufacturers, controlled the execution of contracts, received the matériel and forwarded it to the motor transport organization parks, as needed. In addition, these establishments received the motor transport matériel which had been evacuated by the armies and disposed of it to the best advantage.

5. VARIOUS SERVICES.

The following may also be mentioned as "attached services." (The importance of these services varied.)

a) The "*Inspection of inventions, studies, and technical tests*," whose activities were particularly devoted to the study of inventions which interested the Motor Transport Service and their application to tanks and traction for the heavy artillery.

b) The "*Service for the control of gasoline consumption*," which functioned for the regional motor transport groupings in the same manner as did similar army services, which have already been described.

c) The "*General Motor Transport Reserve*," which was a special "pool" of passenger-cars for the service of the various ministries and missions.

REPORT OF THE USE OF MOTOR TRANSPORTATION DURING THE OPERATIONS ABOUT VERDUN IN FEBRUARY AND MARCH 1915.

The interruption, at the beginning of operations, of the traffic upon the railroads between Ste. Menehoulde and Verdun, together with the insufficiency of the Meuse railroads, brought about the organization of special motor transport services. The object of this organization was to assure the supply of food, munitions, and various materials to the fortified region of Verdun, as well as the transport of troops to and from this region.

The problem presented was the following: (1) Provide for the transport to the region of Verdun, of an average of 2,000 tons of munitions per day. (2) Transport necessary food supplies and various materials to the units, at the rate of approximately 100 tons per division. (3) Assure the transport of troops entering or leaving the region. (4) Evacuate important matériel of all kinds stored in the "citadel" or fortress of Verdun.

Moreover, the problem was further complicated by the fact that convoys had to be moved over a single artery: the road from Bar-le-Duc to Verdun.

The motor transport units belonging to the fortified region of Verdun and to the French Third Army, were insufficient to carry out the transportation mentioned above. As a matter of fact, these units consisted of nine motor transport groups, with a total carrying capacity of about 1,250 tons. On February 20th, the "Direction of the Rear" (Direction de l'Arrière) established an organization at Bar-le-Duc, known as a "Motor Transport Regulating Commission" (Commission Régulatrice Automobile), and assigned the necessary means of transportation to it. The function of this commission was to regulate and centralize the motor transport operations which were required by the Command.

MEANS PLACED AT THE DISPOSAL OF THE MOTOR TRANSPORT REGULATING COMMISSION.

These means consisted of the following motor transport units:

1) By the 20th of February: the motor transport reserve "Rigaudias", composed of three motor transport groupings of six groups each (two groupings of two-ton "White" trucks, and one grouping of three-ton "White" trucks), parked in the region Saint-Dizier, Vitry-le-François, Châlons-sur-Marne.

2) On the 20th of February: the motor transport grouping "Ballut" (seven motor transport groups, consisting of all motor transport units originally assigned to the old Second Army), stationed in the region of Vitry-le-François.

3) On February 24th: the motor transport reserve "Collet", which was stationed in the region of Beauvais, (and part of which had been engaged in forestry operations), arrived in the region of Bar-le-Duc, after having accomplshed the movement of the infantry of the First Corps "en route". This motor transport reserve was composed for the most part of motor-buss units and was able to transport two brigades.

4) On February 25th: the motor transport grouping "Périsse", composed of five groups, which had been withdrawn from the motor transport units assigned to the First, Fifth and Seventh Armies and to the "Lorraine Army Detachment" (Détachement de l'Armée de Lorraine—D. A. L.)

COMPOSITION OF THE ABOVE MENTIONED MOTOR TRANSPORT UNITS.

The above mentioned motor transport units consisted of 175 motor transport sections, and their actual composition represented a total personnel strength of 300 officers and 8,500 men, with over 3,000 motor vehicles. The weekly fuel consumption of an equal number of motor vehicles for a 70-kilometer trip was estimated at, approximately, from 1,800 to 2,000 hectoliters of gasoline, 200 hectoliters of oil, and 200 kilograms of lubricants.

These 3,000 motor vehicles do not include those which were assigned to the motor transport services of the Third Army, which remained unchanged, nor the vehicles belonging to the motor transport services of the "fortified region" of Verdun and which had been assigned to the Second Army.

ORGANIZATION OF THE SERVICE.

The principle was adopted of employing the Meuse railroads as much as possible for the transport of food supplies. On the other hand, the motor transport services were to undertake the transport of troops, munitions, and engineer material, as well as that of the reserve stocks of food and forage required for the establishment of supply depots in the advanced zone.

In order to accomplish the above results, the "Motor Transport Regulating Commission" prescribed that:

a) The road leading to Verdun would be reserved for the exclusive use of motor traffic.

b) Motor transport convoys were not to transfer their loads to animal-drawn vehicles, so that no time would be lost in effecting such

transfers, and that motor transport convoys were to unload only at food and munitions depots, to be established at certain points.

c) A despatching system should be established for the purpose of regulating the movement of motor transport convoys upon the road.

d) It seemed advisable to organize a service for the maintenance and upkeep of the roads.

The Motor Transport Service organized the traffic control as follows: The road leaving the railway station of Baudonvilliers (the extreme rear point for the loading of munitions), passing through Bar-le-Duc and Verdun, and which ended at a terminus point located on the circuit of the forts (where the munitions and engineer material which had been transported by the motor convoys of the Regulating Commission were unloaded), was subdivided into "sections" or "cantons", and the service was organized in a manner similar to that employed in the organization of the railroad services.

Each of these "cantons" was placed under the command of an officer whose duty it was to enforce traffic regulations, control the movement of convoys, supervise the bussing and debussing of personnel, as well as the loading and unloading of material, which occurred in his "canton". This officer also co-operated in the maintenance and repair of the roads, by means of a special service known as the "Service for the maintenance of the Road System" (Service d'entretien du Réseau Routier).

In order to assure liaison, a representative of the "Service for the maintenance of the roads" was made a member of the "Motor Transport Regulating Commission". The services of the "cantons" (which were to operate continuously, night and day), employed 19 officers, 30 non-commissioned officers, and 225 men on a road circuit of about 75 kilometers.

Liaison between the "Motor Transport Regulating Commission" and the "cantons" was assured by means of direct telephone lines and through liaison agents.

ORGANIZATION OF THE MOTOR TRANSPORT REGULATING COMMISSIONS AND OF THE MOTOR TRANSPORT UNITS.

The composition of the "Motor Transport Regulating Commission" was fixed as follows:

a) A representative of the "Direction" of the Motor Transport Service at General Headquarters (the Director of the Motor Transport Service or his assistant).

b) Commandant (Major) Ballut and Captain Rigaudias. (These two officers were at the same time responsible for the command of the motor transport units which had been placed under their orders.)

c) Captain Laroche, representing the "Commission for the maintenance of the road system."

d) Finally, civilian personnel or clerks, and liason agents.

Transports were organized as follows:

The motor transport groupings composed of three-ton trucks (groupings "Ballut" and "Bouchet", which formed part of the motor transport reserve "Rigaudias") were specially assigned to the transport of munitions and engineer material from the railway stations of Baudonvilliers and Bar-le-Duc; the motor transport groupings composed of two-ton trucks or of motor-busses, (a total of four motor transport groupings), were assigned to the transport of troops, and were capable of transporting four brigades at a time.

The motor transport grouping "Périsse" was not specially assigned. Its units were used to re-inforce the above mentioned groupings, whenever these were insufficient, and to transport the food supplies which the Meuse railroads were unable to handle.

DATA ON THE RESULTS OBTAINED.

The regulations for intensive traffic organization were put into effect at midnight of February 22. Thanks to measures which had been taken in advance, the units responsible for the control of traffic were able to operate immediately and, within less than four hours, the main road (artery) Baudonvilliers—Bar-le-Duc—Verdun was entirely and exclusively reserved to motor transportation. (It never ceased to function thereafter).

a) *Transport of munitions from the 22nd of February until the 7th of March—a period of about fifteen days.*—The motor transport "T. M." groupings transported approximately 22,500 tons of munitions, or an average of 1,500 tons per day. These munitions were unloaded at various places (Verdun arsenal, forts of Dugny and Laindrecourt; Hill 252, Dombasle, Heipes and Lemmes). The total kilometric tonnage attained about 3,000,000 kilometric tons, or an average of 200,000 kilometric tons per day. The average number of motor trucks in use was 600 per day. The average length of the daily trips amounted to 135 kilometers.

The total distance covered by the motor trucks was about 1,200,000 kilometers, or thirty times around the circumference of the earth. The cost of this transportation can be estimated at approximately 1,200,000 francs. According to calculations, the transport of a ton of munitions is estimated to have cost 50 francs more by motor transport than by rail.

b) *Movement of troops.*—During the period between the 23rd of February and the 7th of March, or approximately fifteen days, the motor transport "T. P." groupings transported about 250 battalions, which corresponds to a total personnel strength of nearly 190,000 men; in other words, to 17 battalions, or 13,000 men per day. This transportation required the use of 190 motor trans-

port groups. The distances covered by empty motor trucks amounted to 900,000 kilometers, while the distances covered by loaded motor trucks reached 800,000 kilometers.

Thirteen motor transport groups were employed daily. Finally, the cost of this transportation amounted to about 1,700,000 francs; approximately 9 francs for each man transported, or 12 centimes per man and per kilometer (which was more than the first-class fare on the railroads).

c) *Miscellaneous transports.*—Motor transport groups also transported numerous and varied kinds of materials, etc., such as foodstuffs, medical supplies, engineer material, equipment for the work-shops of the Meuse railroads and for the engineer park at Verdun; transport of furloughed men (permissionnaires), evacuation of slightly wounded and of civilians, etc.

REMARKS.

The impression should not be gained that the means of transportation which had been placed at the disposal of the "Motor Transport Regulating Commission" sufficed, by themselves, to meet the requirements of the Armies which were operating around Verdun. As already stated, these means consisted of approximately 300 officers, 8,500 men, and 3,000 motor vehicles of all kinds.

In addition thereto, the army operating at Verdun controlled another transportation service (the "Motor Transport Service"), of about equal strength. This service was charged with effecting all transports which were not carried out by the "Regulating Commission," that is to say, transports extending beyond the main road (artery) Saint Dizier—Verdun.

It may be of interest to call attention to the considerable means which must be provided to take care of the upkeep and repair of such a large amount of motor transport matériel. The various units mentioned below were used for this purpose:

1) The motor transport park at Bar-le-Duc, with a personnel of 14 officers and 1,430 mechanics and drivers.

2) The park at Aulnay-l'Aitre, with a personnel of 10 officers and 571 mechanics or drivers.

3) Finally the motor transport overhaul park at Troyes, where only a part of the personnel was utilized, the remainder being employed in the two preceding parks.

CONCLUSION.

The experience gained during more than twenty days of practical use, established the fact that it is possible to assure the supply of munitions of a large army by means of motor transportation, as well

as the intensive movement of troops during very active military operations, even though the zone of action is at a considerable distance from the center of supply and from the rest areas.

The transports effected during this fifteen day period reporesented a daily movement of fifteen trains in each direction. The motor traffic upon the reserved road attained an average of 1,700 motor trucks per day in each direction or, approximately, one truck every 25 seconds. At certain times, and on certain points on the road circuit, the density of the traffic was doubled.

Despite the intensity of the traffic and adverse weather conditions, the regularity in the flow of traffic remained undiminished and it was possible, at the same time, to assure the maintenance and repair of the road and carry out special works, such as road sidings, resurfacing, etc.

It is only just to mention that the entire personnel, officers and men, displayed great zeal and activity in accomplishing the difficult tasks required of them, moreover, they understood that regularity in the transportation of munitions and food supplies was an important factor in the successful resistance.

Statistical Data on Transportation Effected from the 8th to the 13th of March 1916.

1. TRANSPORT OF MUNITIONS.

	Tons.	Kilometric tons.
From the 8th to the 13th of March	7,500	900,000
Report from the 1st of February to the 7th of March	22,500	3,000,000
Totals	30,000	3,900,000
Tons per day	1,375	177,000

2. TROOP MOVEMENTS.

	Kilometers covered by the motor trucks—		
		Empty	Loaded
From the 9th to the 13th of March	43,000	210,000	165,000
Report from the 22nd of February to the 8th of Mar	190,000	900,000	800,000
Totals	233,000	1,110,000	965,000
		2,075,000	
Tons per day	10,000	96,000	

3. DRIVERS OF THE TRANSPORTATION SERVICE—ENGINEERS (GÉNIE).

From the 8th to the 13th of March	3,000
Report from the 21st of February to the 7th of March	2,500
Total	5,500

Tons per day, 250.

Number of motor trucks (camions) on the road each day.—For the transport of material ("T. M." sections), 600 motor trucks. For the transport of personnel ("T. P." sections), 900 motor trucks.

CHAPTER XVI.

SECTION III.

MOTOR TRANSPORT SERVICE (BELGIAN).[1]

STATEMENT OF THE DEVELOPMENT OF THE MOTOR TRANSPORT SERVICE.

At the beginning of hostilities, the "Motor Transport Reserve Park" (Parc Automobile de Réserve) functioned at Antwerp. The motor transport reserve consisted of a number of trucks and motor ambulances which the Army possessed in peace time. In this park were also assembled all the motor vehicles which had been acquired by requisition at the beginning of the war. The function of this park was to supply the Army's motor transport requirements by replacing unserviceable machines and making necessary repairs.

This motor transport reserve park was the nucleus of the large motor transport construction and repair establishments which existed at the time of the Armistice. The park was removed to Calais at the time that the other base establishments were evacuated from Antwerp to that city.

At first the motor transport reserve park performed the same functions at Calais that it had performed at Antwerp, but it was soon apparent that this organization was insufficient. A new organization, known as the "Shop for the repair of motor transportation" (Atelier de réparation du charroi automobile), was therefore created in January 1915, but it did not possess the necessary equipment for the upkeep and maintenance of motor vehicles. It was originally used to receive and assemble motor transport matériel purchased in England and America. However, it could not even undertake minor repairs and most of the unserviceable cars had to be sent to repair shops at Paris and at London. In addition, the shop for the repair of motor transportation was responsible for the inspection of motorcycles and bicycles, and was charged with the organization of a reserve supply of spare parts and accessories.

It soon became evident that the existing organization for the repair of motor transport material could not be maintained much longer.

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[1] Prepared for the M. B. A. S., from documents furnished by the Belgian Ministry of War, "Direction des voies et communications," by Lt. Col. Ellery Farmer, American Section.

It was vitally important that the Motor Transport Service should not be dependent upon private industry and, during the early part of 1916, a plant for the manufacture of M. T. material for all the Army's requirements was established at Ste. Adresse, near Le Havre. This factory was known as the "Shop for the construction of motor transportation" (Atelier de Construction du charroi automobile—A. C. A.).

SHOP FOR THE CONSTRUCTION OF MOTOR TRANSPORTATION (A. C. A.).

The main object of this establishment was to receive unserviceable matériel, overhaul it, and put it in perfect running order. The A. C. A. did not make minor repairs. These were effected in the shops in the vicinity of the front or in the repair shops which functioned at the Calais base.

As all vehicles received by the A. C. A. were seriously damaged, they were entirely dismantled and completely rebuilt either with new parts, or from serviceable parts from salvaged cars which had been repaired.

The A. C. A. was organized as follows: (*a*) Administrative section and direction. (*b*) Technical section service. (*c*) Supply section. (*d*) Depot.

The Technical Section consisted of nine shops in which different classes of work were performed.

The Supply Section was supplied through the Belgian purchasing commissions in Paris, London and New York. The storehouses of the supply section furnished supplies, not only to the shops of the A. C. A., but also to the motor repair shops which functioned near the front and at the base of Calais. It procured supplies for the various makes of motor cars, motor cycles, and bicycles used by the Belgian Army, and prepared the necessary estimates for motor transport matériel to be purchased by the Belgian purchasing commissions.

The M. T. Depot consisted of sheds (hangars) for storing reserve vehicles, parks for storing damaged machines which were to be repaired, and a store of used parts where serviceable parts obtained from salvaged cars were assembled.

The technical section shops utilized the stores of used parts as much as possible and new parts from the Supply Section were only used in case of absolute necessity.

ORGANIZATION OF THE MOTOR TRANSPORT SERVICE.

1. *The motor transport services of the field army* maintained a large shop at Calais, designated as the "Shops for the repair of automobile matériel" (Atelier de réparation du matériel automo-

bile—A. R. M. A.). To this repair establishment was attached a large reserve park which was located at Marck, near Calais.

2. *The motor transport services of the rear* were composed of four motor transport units, established at La Panne, Soex, Calais and Le Havre.

The A. R. M. A. and the two M. T. units of the rear, at Le Havre and at Socx, were supplied direct by the A. C. A.

The A. R. M. A., in turn, furnished motor transport supplies to the motor transport services at La Panne and at Calais, and to the various divisions of the field army.

The motor transport unit at Le Havre was responsible for the motor transportation of the rear, i. e.: for the depots, convalescent hospitals, training centers and bases at Le Havre, Paris, Rouen, and other cities in France.

The motor transport unit at Socx was responsible for all the motor vehicles used by the Ministry of War.

The motor transport units at La Panne and Calais were responsible for the motor transportation of the hospitals and base establishments in the vicinity of these two towns. (Chart 3, Chapter XVII, Vol. I.)

Each of these four motor transport units operated a repair shop in which urgent repairs could be made. In addition, a divisional shop for the repair of motor transportation (Atelier divisionnaire de réparation du charroi automobile—A. R. C. A.) was attached to each of the army divisions.

Motor vehicles from the army divisions (Division d'Armée) and from the motor transport units at La Panne and at Calais, which required extensive, lengthy, repairs were sent to the A. R. M. A. at Calais.

ORGANIZATION OF THE MOTOR TRANSPORT SERVICE IN THE BELGIAN FIELD ARMY.[2]

The Motor Transport Service of the Belgian field army was under the direction of General Headquarters. It was represented by an officer, who was Chief of the Motor Transport Service and who had a technical staff at his disposal consisting of two technical officers and one non-commissioned officer.

This staff inspected the various motor transport units and the shops for the repair of motor transportation. It reported to the Chief of the Motor Transport Service on the general condition of the matériel, as well as on the work performed in the various repair establishments.

[2] Prepared by Major de Villiers, A. E. M., Belgian General Headquarters (3rd Section).

In addition, there existed a motor transport corps for each army division (Division d'Armée). This motor transport corps was divided into three parts: one for each infantry division (there were two infantry divisions in an army division) and one for the troops of the army division.

The Motor Transport Corps of the Infantry Divisions consisted of:

One M. T. platoon for the transport of artillery ammunition (about 20 four-ton motor trucks).

The Motor Transport Corps of an Army Division (Division d'Armée) consisted of:

One M. T. platoon for infantry ammunition (P. A. M. I.), 18 trucks (1½ tons).

One M. T. platoon for artillery ammunition (P. A. M. A.), 25 trucks (4 tons).

One M. T. ambulance and stretcher platoon (P. A. A. B.), 46 trucks.

One M. T. platoon for rations (P. A. V. X.), 80 trucks (1½ or 2 tons).

One M. T. reserve park (P. A. R.), 6 passenger cars and 12 light trucks (½ ton).

One M. T. platoon for supplies (P. A. R. A.), 12 trucks (1½ tons).

One M. T. postal service, 4 special cars.

One M. T. parcel post service, 3 trucks (¾ ton).

The Motor Transport Corps for a Cavalry Division consisted of:

One M. T. ammunition platoon (P. A. M.), 20 trucks.

One M. T. ambulance platoon (P. A. B.), 22 trucks.

One M. T. rations platoon (P. A. V.), 45 trucks.

One M. T. baggage platoon (P. B.), 54 trucks.

One M. T. reserve platoon (P. A. R.), 9 trucks.

One M. T. supply platoon (P. A. R. a.), 8 trucks.

One M. T. postal and parcel post platoon (P. A. R. b.), 5 trucks.

The Motor Transport Corps of a Heavy Artillery Brigade (Brigade d'Artillerie Lourde) consisted of:

One M. T. rations platoon (P. A. V.), 19 trucks.

One M. T. "Service of the Rear" and postal service platoon (S. A.), 18 trucks.

The Motor Transport Corps for the "Administrative Grouping of Army troops" (Groupement administratif des troupes d'Armée—G. A. T. A.) consisted of:

One M. T. rations platoon (P. A. V.), 23 trucks.

One M. T "Service of the Rear" platoon (S. A.), 19 trucks.

The Motor Transport Corps for the "Corps of Auxiliary Engineer Troops" (Corps des troupes auxiliares du Génie—C. T. A. G.) consisted of:

One M. T. rations platoon (P. A. V.), 27 trucks.

One M. T. "Service of the Rear" platoon (S. A.), 55 trucks.

The Motor Transport Corps for the "Troops of the Army Service Zone" (Troupes d'Etapes) consisted of:

One M. T. rations platoon (P. A. V.), 22 trucks.

One M T. "Service of the Rear" platoon (S. A.), 67 trucks.

It should be understood that the Army possessed other motor vehicles in addition to the foregoing as, for example, tractors for the heavy artillery, motor trucks for munitions, etc.; these formed an integral part of the batteries. There were also numerous passenger vehicles for the staff services, which are not included in the above.

The number of motor vehicles in the field army on November 11, 1918, was:

Passenger cars	608
Motor ambulances	300
Motor trucks	2,251

The above figures include motor trucks of all kinds, mobile shops mounted on trucks, motorized machine guns, etc.

Various supplies were transported by rail to the divisional railheads. The motor transport columns came to the railheads and received the supplies: motor transport ammunition columns for ammunition, motor transport rations columns for rations, and motor transport supply platoons for clothing, harness, horseshoes, etc.

The motor transport ammunition columns transported the ammunition to certain designated parks, from whence it was distributed and delivered according to needs by horse drawn vehicles. The motor transport rations columns carried the rations to a designated point, whence company supply wagons received their issue.

The trucks of the motor transport supply platoons carried their cargoes to the storehouses of the motor supply platoons and, from that point, after sorting, the supplies were delivered to the units. Theoretically, the trucks of the motor transport ammunition platoons remained constantly loaded but, on account of the great expenditure of munitions, depots were established near their cantonments in order to overcome a possible scarcity of munitions.

In each army division (Division d'Armée) there was a "Motor Transport Reserve Park" (parc automobile de réserve) which constituted a first motor transport reserve. This reserve park contained several motor trucks and passenger cars of the type in use in that army division. There was also a stationary motor transport repair shop, with a personnel of about twenty men, and a mobile motor

transport repair shop consisting of three trucks; one used as a workshop, and two as storehouses for tools and spare parts.

Light repairs were undertaken in the above named shops with the limited personnel and equipment at their disposal.

A "Main Motor Transport Reserve Park" (Grand parc automobile de réserve), located behind the front, formed a second and main reserve of motor transport matériel for use at the front and contained reserve cars, motorcycles, bicycles, and spare parts of all kinds.

This main reserve park followed the field army to which it was attached. It was found advisable to maintain a large repair shop in connection with each army division main reserve park, for the purpose of making repairs which could not be handled by the mobile shops at the front.

Finally, the Belgian Army maintained motor transport construction shops in the rear. These establishments included a large depot, which contained numerous cars and spare parts of all types in use in the Army. Heavy repairs were made in these establishments. It should be noted that such shops are unnecessary in an uninvaded country. These establishments are then naturally superseded by the various factories, located in the interior of the country, which manufacture cars of the types in use in the Army. For this reason it is logical to place these factories under the control of the Minister of War and he should exercise, in connection therewith, the same functions that General Headquarters exercised in its relations with the main motor transport reserve parks of the army divisions.

A fundamental question in the organization of motor transport columns is homogeneity. This facilitates road or emergency repairs, and relieves the columns by reducing the quantities of spare parts which must be carried; it also renders the chauffeurs more efficient and facilitates the work of the chiefs of motor transport columns.

There were special motor transport services for the heavy artillery, cavalry divisions, Air Service, etc. Their organization was similar to that of the motor transport units of the army division, except for a few modifications necessitated by the special conditions under which they worked.

In preparation for an eventual advance, an auxiliary motor transport column was organized for each army and cavalry division, and one for the heavy artillery brigade. The purpose of these auxiliary motor transport columns was to extend the railroad lines should the latter be unable to reach a point nearer than 50 kilometers from the front line of the troops. However, this scheme was later abandoned, as the railway lines could be laid rapidly enough, and the auxiliary motor transport columns were then formed into a reserve under the

command of G. H. Q., and used to transport personnel, ammunition, matériel, etc., whenever the motor transport columns of the army divisions were insufficient.

From the foregoing it will be seen that the Belgian system consisted in providing each army division with a certain amount of motor transportation, constantly available unless higher authority altered this scheme. This system had the advantage of bringing the various services and units of the army division into closer relations with the motor transport columns which served them. The non-commissioned officers and men were better acquainted with each other, and greater speed and efficiency in the operation of the transportation services were obtained thereby. The French system did not permit the permanent assignment of motor transportation to units. The French motor transportation was organized into columns in the large M. T. parks in rear of the front and used, according to type and tonnage, for the transport of personnel, provisions, or matériel. All motor transport movements were controlled by the High Command and effected for and upon the request of the units concerned.

It is believed that the Belgian system, which assigns part of the motor transportation to units and enables the High Command to carry out tactical plans by means of auxiliary motor transport columns assembled in the parks in the rear, not only fulfills all requirements but that it also facilitates speedy and proper operation of the service. Moreover, in a war of movement (open warfare), it is indispensable that each army division should have a mobile ammunition depot constantly at its disposal and in proximity to the troops. This mobile ammunition depot consists of motor transport ammunition columns. There is also a similar depot for provisions.

Concerning motor ambulance columns there is no reason why these should not remain near the troops, since they are employed daily and more frequently in the units, than at any other place. It also seems desirable to have the chauffeurs and medical personnel work together.

Pooling of Motor Transportation.—As already indicated, each army division and unit had a motor transport corps of its own. Subsequently, and previous to the 1918 offensive, a motor transport reserve consisting of trucks of heavy tonnage was formed. This reserve was to be available at all times for use by the Allied troops operating in Flanders.

Traffic Control.—Motor transport traffic was controlled by a regulating commission in the same manner as in the French Army. It was based on a system of reserved (specialized) roads, one way traffic, sectioning of transport columns, etc.

CHAPTER XVI.

SECTION IV.

MOTOR TRANSPORT SERVICE (ITALIAN).

At the beginning of the war the various organizations of the Motor Transport Service were:

a) The *Section of the lines of communication*, of the Army Commissariat, (Intendenza Generale), charged with the ordinary transport service and assisted, insofar as motor transport was concerned, by the technical motor transport service. The principal duties of the latter were to supervise all repairs to motor vehicles and assure the supply of motor transport matériel, etc.

b) The *Administration of the lines of communication*, of the Army Commissariat (Intendenza Generale), charged with the direction of motor transportation in the field army.

c) *Army Motor Transport Parks*, with permanent repair shops, belonging to the lines of communication and composed of as many motor transport detachments as there were army corps. Each motor transport park provided for the needs of one army corps, insofar as the repair of motor transport material and the supply of fuels and lubricants were concerned. These parks also functioned as advanced depots for the supply of matériel for automobiles, motor-cycles and bicycles.

d) The *Central Motor Transport Depots*, which included the establishments for motor vehicles, bicycles and spare parts, and which contained the necessary matériel for the supply of the motor transport parks. Major repairs were also made in these depots.

MODIFICATIONS CARRIED OUT IN THE SERVICES DURING THE WAR.

The war soon demonstrated the necessity for a single and more centralized organization, one not only capable of obtaining the necessary supplies in due time, but which could also assure distribution according to the needs of each army corps. This brought about:—

The organization of a *Motor Transport Section*, which acted as an administrative agency for the motor transport services and whose functions combined those previously exercised by the technical service and the administration of the lines of communication.

The formation of a *Commission for the purchase of motor vehicles and spare parts*, and for the procurement of labor, with the purpose of eliminating competition between the various military organizations (enti).

The establishment of a *Main Motor Transport Depot*, to take the place of the central depots of the army corps.

The creation of an *Office of Consumption* (Ufficio di Consumo) for the centralization and control of the supplies of benzine and lubricants.

The limited capacity of the repair shops of the motor transport parks and central depots resulted in the establishment of large, specialized, motor transport shops for the repair of specified groups and types of motor vehicles, and of a permanent repair shop for the upkeep of motor cycles and bicycles. The central repair shops were placed under the orders of the central motor transport depot.

The increase in heavy artillery matériel necessitated the reorganization of the traction services which had first been assigned, partly to the heavy batteries and partly to the commands (Comandi) of the army corps artillery (Artiglieria d'armata), and their subsequent concentration in *Motor Tractor Parks* under the orders of the chiefs of artillery of the respective army corps.

The necessity for training the new, increased motor transport personnel, caused the formation of *Motor Transport replacement units* (Autoreparti di marcia), (one at each motor transport park), to which troops who had been assigned to the Motor Transport Service by the Supreme Command, were sent, from time to time, for training purposes.

The need of maintaining a reserve nucleus for the formation of new motor transport units and for the replacement of motor vehicles sent by the parks to the repair shops, resulted in the organization of a *Reserve Motor Transport Park*. This park, in conjunction with the *Maneuver Motor Transport Park* of the Supreme Command, served to transport large bodies of troops and effected whatever transports could not be carried out by the ordinary motor transport parks.

A *Technical Motor Transport Control* was created to prevent the abusive use of motor transportation and conserve the gasoline supply.

Organization of the Service at the Date of the Armistice.

(Chart 11, Chapter XVII, Volume I.)

After the above mentioned modifications had been effected, the Motor Transport Service was organized as follows:

ADMINISTRATIVE AGENCIES.

a) The *Motor Transport Section* at the General Commissariat (Intendenza Generale).

b) *The Administrations of the lines of communication*, with the Army Commissariats. (Intendenze di Armata).

EXECUTIVE AGENCIES.

a) The *Maneuver Motor Transport Park* of the General Commissariat, under the orders of the Supreme Command (Comando Supremo).

Which consisted of numerous motor transport groups, each capable of transporting an infantry battalion. Used in mass, the maneuver motor transport park could provide for the transport of several divisions of infantry.

b) *Army Corps Motor Transport Parks*, composed of as many motor transport detachments as there were army corps, reserve motor transport detachments for emergency use, and a replacement motor transport detachment for training purposes. Generally, each army corps motor transport detachment consisted of a number of ordinary motor transport sections (22 motor cars), equal to twice the number of divisions in the corps plus one for the army corps troops.

Motor transport detachments and sections were either placed at the disposal of the commanders of large units or centralized in the motor transport parks, according to the requirements of the transportation situation.

c) *Motor Tractor Parks*, for heavy battery traction and ammunition supply. These were composed of motor transport detachments and sections equipped with tractors and heavy trucks. The motor tractor parks were under the orders of the army corps artillery headquarters (Comando) and its units were distributed so as to conform to the positions of the batteries.

d) *Motor Transport Squadrons* (Auto-drappelli), which were assigned to the Supreme Command, the General Commissariat (Intendenza Generale), the army Commissariats, the headquarters of army corps, divisions, and special units and to various services (Medical, Commissariat, etc.). These squadrons were composed of various types and models of motor vehicles, according to the requirements of the service (motor trucks, passenger cars, or motor cycles).

OPERATION OF THE SERVICE.

In each army corps, the administration of the lines of communication coordinated the motor transport services and satisfied transportation requirements by means of motor or animal drawn vehicles.

Motor transport movements comprised:

a) Ordinary transports.

b) Extraordinary or strategic transports.

Ordinary transports were either periodical or special. Periodical transports assured the daily supply of the troops, the daily evacuation of the sick and wounded, and the normal supply of ammunition. Special transports were those necessitated by particular contingencies, such as battle operations or unexpected emergencies.

These transports usually took place within the areas of the army corps and were regulated as follows:

The administration of the lines of communication determined the routes which were to be generally followed by the periodical or daily transports. This information was communicated to the commander of the motor transport park, to the commanders of the lines of communication, and to the commanders of the units concerned.

The commander of the motor transport park assigned the transportation and prescribed the hour of departure, in accordance with the orders of the administration of the lines of communication. The commanders of the lines of communication assisted all motor vehicles which were in trouble, or which had been slightly damaged, and provided them with personnel and matériel as required.

The operations of loading and unloading were carried out by the dispatching and receiving parties respectively.

Extraordinary or strategic transports, when not carried out under the direction of the commander of the army corps, were regulated by the Supreme Command. The latter determined:

(a) The units to be transferred.

(b) The place, or places, where particular elements were to be loaded or unloaded, as well as the time.

(c) The routes which were to be followed.

(d) The number of motor cars required, in addition to those of the maneuver motor transport park, to effect a particular transport.

The administration of the lines of communication determined which of the motor transport sections at its disposal were to pass under the control of the Supreme Command to complete the number of motor cars necessary. The administration regulated the movement in the interior of the army corps, and issued necessary instructions to the various commands on the lines of communication, through representatives who were stationed there for that purpose.

A permanent *Technical Motor Transport Control* was organized to control the employment of motor vehicles and see to it that the technical rules and regulations concerning the use of motor transportation were followed at all times. This control was exercised by means of special *Inspection Offices* (one for each army and one for the General Commissariat). The inspection offices designated competent

motor transport officers, and the latter established permanent control posts on all the principal roads of the armies.

SUPPLIES.

(Chart 12, Chapter XVII, Volume I.)

The following systems were employed, depending upon the kind of motor transport matériel or supplies involved, whether new vehicles, tires, spare parts, etc., benzine or lubricants.

a) The supply of new motor vehicles devolved upon the Ministry of Arms and Munitions, which provided motor vehicles through a *Technical Military Motor Transport Administration.* The latter made contracts with the automobile manufacturers, in accordance with the programs which had been prepared by the ministry in conjunction with the General Commissariat (Intendenza Generale), and made the necessary inspections and tests of machines before acceptance. Machines were delivered by the factories complete and, after being tested, the motor vehicles were sent by rail direct to the *Reserve Motor Transport Park* (under the jurisdiction of the Motor Transport Section).

The reserve motor transport park used the new vehicles which it received to replace the machines which had been turned in by the motor transport parks and squadrons (auto-drappelli), for extensive repairs or those which had been lost in action.

b) The supply of tires, spare parts, and various materials was entrusted to the *Technical Motor Transport Section.* The latter obtained its supplies through a commission for the purchase of motor transport matériel.

This commission, in accordance with the instructions of the technical motor transport section, effected the necessary purchases and contracts through qualified officers located in the principal markets (piazze). In addition, the commission obtained necessary raw materials from the central storehouses. Spare parts were sent by rail to the central storehouses or depots at the motor transport base, whence these supplies were put into classified storage.

Spare parts, etc., were classified as follows:

Section A.—Spare parts for motor trucks and passenger cars.
Section B.—Spare parts for motor tractors.
Section C.—Spare parts for motor cycles and bicycles.
Section D.—Spare parts for miscellaneous transport materials.
Section E.—Spare parts for tires.

Raw materials and miscellaneous supplies were sent to the repair shops of the central depot for motor transport matériel.

c) Supplies of benzine and lubricants. Supplies of benzine for the Army were obtained by purchases abroad and by home pro-

duction. The Ministry of Arms and Munitions supervised this supply. Benzine purchased abroad was generally transported by sea and stored in large depots at the ports of arrival, while the benzine produced in the interior of the country was sent direct to the large depots in the war zone (Zona di guerra). Supplies of lubricants were obtained in the same manner.

In the war zone, the benzine supply service was regulated by the *Office for the Consumption of Materials*, under the orders of the central motor transport administration. This office had five large benzine depots and three large depots of lubricants at its disposal. These depots supplied the motor transport parks and, in addition, maintained a reserve equal to ten days' average consumption requirements (during the latter part of the war, equal to 20 days). The motor transport parks, in turn, supplied the motor transport sections and detachments. It should be noted that this office also supplied the fuel for the Air Service.

To provide for emergency requirements, the Motor Transport Section of the "Intendenza Generale," built a reserve depot for benzine (500 tons) at Monselice, in close proximity to the troops.

As a rule the parks and large depots received their supplies periodically, and special measures were taken to assure the repair and return of benzine tanks or containers.

REPAIRS.

(Chart 13, Chapter XVII, Volume I.)

The task of the Motor Transport Service was rendered more difficult on account of the numerous types of vehicles used. The following classes of repair shops were established:

Mobile repair shops with the motor transport detachments, capable of making ordinary repairs.

Large mobile shops, located in the motor transport parks, which could undertake medium repairs.

Permanent shops for major repairs.

The permanent shops formed part of the central motor transport depot. There were six of these establishments at the time of the Armistice, classified as follows:

1. Turin, for the repair of motor vehicles manufactured in the Turin district (with the exception of certain types of "F. I. A. T." cars).

2. Bologna, for the repair of machines of the "F. I. A. T." type.

3. Bologna, for the repair of "Spa" type motor cars, as well as motor vehicles of all kinds.

4. Piacenza, for the repair of motor cars manufactured in the Lombardy district and for the repair and construction of radiators.

5. Parma, for motor cycles and bicycles.

6. Bologna, for tractors and tanks (armored cars).

This specialization offered the following advantages:

a) Every unit knew where to send a given type of car for repairs.

b) Each shop manufactured the spare parts for the particular type or types of cars which it handled.

c) The work could be carried out "in series" (fabrication), which was possible because the shops handled only machines of a certain type.

d) Standardization of mechanical equipment, resulting in greater production capacity.

The motor vehicles repaired in the shops of the motor transport parks and detachments, were returned to the original organization. Those repaired in the other shops were generally sent to the motor transport reserve park, where they were tested by a special commission; however, in case of emergency, these cars could be sent direct to the motor transport parks. The motor transport reserve park supplied any deficiencies in motor vehicles in the motor transport parks and sections.

PERSONNEL.

At first, the personnel motor transport companies, which existed before the war, were employed; this personnel was limited but it had been sufficient for peace time requirements. Subsequently, the strength of these units had to be increased and this was done by means of personnel who had followed the special courses of training inaugurated for officers and men, either in the Zone of the Armies or with the above-mentioned motor transport companies. However, experience demonstrated that the quickest and best training was obtained in the Zone of the Armies, where types of motor vehicles similar to those actually in use by the troops in the field were available for the purpose. Mobile motor transport detachments or "*Motor Transport replacement units*" (Autoreparti di marcia) were therefore organized and these became the motor transport training centers of the Army.

CHAPTER XVI.

SECTION V.

MOTOR TRANSPORT (AMERICAN).[1]

A. Organization of Motor Transport.

(Chart 4, Chapter XVII, Vol. I.)

The agencies which directed the motor transport problem for the A. E. F. changed several times during the war, involving a modification of their relations to each other and of the policies to be followed. It is first necessary to consider what these agencies were.

At the outbreak of the war, the functions of the M. T. C. were, in general, under the Quartermaster General. Upon the creation of the A. E. F., the Chief Quartermaster (C. Q. M.), A. E. F. handled the supply of motor transportation as he handled all other quartermaster supplies under the supervision of G-4, G. H. Q. The repair of motor transportation also fell to the C. Q. M.

Motor transport supply grew to such an extent in the American E. F., that it was necessary for the C. Q. M. to establish a separate branch. This was designated as the Motor Transport Service (M. T. S.) and this service was charged with the supply of motor vehicles, spare parts, tools and accessories, gasoline and lubricants, repair of vehicles and technical supervision over the care of motor vehicles. It was specifically not charged with operation.

Later, the Service of Utilities (S. O. U.) was created as a branch of the S. O. S., and, among other things, was charged with motor transport. This resulted in the transfer of the M. T. S. "en bloc" from the C. Q. M. to the S. O. U. It also had the effect of making the M. T. S. somewhat more independent than formerly; probably because the S. O. U., being a new organization and having control of an extraordinary variety of matters, desired at first to exercise only the most general supervision of its component parts (M. T. S., T. D., D. L. R. & R. and D. C. & F.).

During this period, the S. O. S. proper was established. This created an echelon between G-4, G. H. Q., and the various services, namely G-4, S. O. S., thereby involving a further readjustment of

[1] From the report of the D. M. T., reduced to the compass of this chapter by the American Section, M. B. A. S.

policies, resulting in the creation of the M. T. S. as a separate service in the A. E. F. (along the lines indicated in par. 3 above) and making the following additional changes in G. O. 70, of 1917:

(*a*) Authorized representatives of the M. T. S. on the principal staffs of the American E. F.

(*b*) Motor Transport Service (M. T. S.) to have operating control over ordinary cargo and passenger transportation in the S. O. S. (Also, over a paper "reserve" in the armies; which, however, was never created.)

(*c*) Placed the A. S. transportation under M. T. S. control.

(*d*) Removed the supply of gasoline and oil from the M. T. S. It provided for:

(*e*) Control of distribution in France of various types of vehicles.

(*f*) Acquisition of personnel in France.

Up to this time, the M. T. S. still remained under the S. O. U.

In July, 1917, the S. O. U. was abolished; the name of M. T. S. was changed to Motor Transport Corps (M. T. C.) and it was made an independent service.

It will thus be seen that the M. T. C. did not crystallize into its final form in the A. E. F., until four months before the Armistice, and more than a year after the A. E. F. was organized (in the United States, it came at a still later date).

By the Tables of Organization of August 23, the total personnel was 44,485 for an army of 1,300,000. At the time of the Armistice, in spite of the attempt to increase the Motor Transport Corps in proportion to the American E. F., the personnel allotted by the tables of organization (T. of O.) had not yet arrived and the American E. F. exceeded 1,300,000.

On November 11, 1918, the personnel was 25,000, a little more than half of the authorized strength, and a little more than a third of the proportional amount that should have been available had the Corps been maintained in ratio to the combatant forces in France.

B. Extent to Which Motor Transport was Pooled.

The first policy inaugurated as regards operation of motor transportation, was that the M. T. C. should have nothing to do with it. This was changed however, the M. T. C. being given operating control of class "A" transportation, defined as "cargo carrying or passenger carrying vehicles used for general transportation purposes in the S. O. S., and the motorized portions of such reserve trains as may be held in or in rear of an army, under control of the army commander". No such "reserve trains" were ever created and the M. T. C. operated only the S. O. S. vehicles specified.

All such vehicles were assigned by G-4, S. O. S., to the commanders of base and intermediate sections by whom they were assigned to local pools. The truck units were under the command of M. T. C. officers and were driven by M. T. C. personnel. In the case of passenger-carrying vehicles, the pool received applications for transportation and dispatched the necessary vehicles to accomplish the transportation. In the case of cargo transportation, the usual method was for one or more truck units to be turned over to the officer in charge of a certain work. This officer indicated what was to be hauled, where, and when; the M. T. C. officer commanding the units being responsible for the hauling operations.

The question of giving the M. T. C. operating control over trucks in the armies had been extensively discussed. It had been recommended previously by certain officers of the M. T. S. and was forced into attention by the Allied High Command, acting through the M. B. A. S., early in August of 1918. Somewhat later, the Commander in Chief of the Allied Armies asked the American E. F. to adopt this policy, following the general lines of the French system, and including also traffic control. The results gained by centralized control as finally adopted were:

1. Greater service from all vehicles.
2. A decrease in abuse of equipment and in maintenance work.
3. A lessening of empty hauls.
4. A widening of the scope of the service, especially in connection with passenger vehicles.

Transportation pools in the advance section were designated M. T. C. centers. A number of pools were also operated in the intermediate section and a smaller number in each of the base sections and in the Paris District.

Pooling of motor transportation was not followed at first. Gradually, shortages created situations where more transportation became essential and, it being impossible to secure any noticeable increase in shipments from the States, pooling became the only solution. It should be noted that while the principle of pooling truck transportation was never officially recognized by G. H. Q. until publication of the order creating the Interallied Reserve, it was accepted and developed, experimentally, by the units at the front.

THE INTERALLIED RESERVE.

The latter part of July, 1918, the probability of continued Allied advances on a large scale became evident and this would necessitate swift movements over devastated country. In any sector where Ger-

man lines were broken through, there would be no railways to move exploiting troops. The transportation and supply of such troops by motor trucks therefore became of increasing importance. The general shortages of available motor transportation for such service, however, necessitated a general pooling of resources.

An interallied motor transport reserve was therefore proposed by the Allied High Command. The system to be followed was largely based upon that of the French. After various proposals and discussions, the task of the American Army was found to be:

1. *To obtain 8,000 trucks as their contribution to a general reserve of trucks.*

2. *To organize and man them.*

3. *To create an organization for controlling their operation when they were operating directly under the Commander in Chief, A. E. F., which organization would be capable of functioning with similar existing organizations of the other Allied Armies when operating in a combined attack.*

It was understood that the American trucks contributed to the interallied reserve would not be permanently removed from the immediate control of the A. E. F. These were to be trucks which, for the greater part of the time, would probably be operating with the A. E. F. on normal transportation work, but they were to be available, if necessary, for movement to any point in the Allied lines in the case of an Allied offensive. Therefore, any system or any rules and regulations adopted had to be consistent with our general existing system of supply; any bureaus or organizations created had to be capable of functioning in a *milieu* which might be either purely American, purely French, English, etc., or mixed. There could be no question of changing methods of control and operation, channels of command, etc., as the nationality of the armies involved changed. Hence, while the original proposal concerned only an interallied reserve, it immediately necessitated a change in the American system.

This involved a reorganization of the methods of distribution and operation of motor trucks in the American E. F., but this was the only possible solution. The following arrangement was proposed:

(*a*) That the supply and ammunition trains of divisions, corps, and armies, the truck transport trains of corps and armies, and the artillery parks of corps and armies be organized into uniform transportation units, both trucks and personnel to be included therein.

(*b*) The total of such units to be designated as a motor transport reserve and placed under the control of G. H. Q.; an organization being created under G-4, G. H. Q., to operate or distribute the reserve.

(*c*) Units of the reserve to be attached for temporary duty to divisions, corps, armies or other units of the American E. F., in such quantities as would be necessary to handle the actual demands for food, forage, engineering material and ammunition; the quantity of transportation so allotted to be changed as conditions changed.

(*d*) Any portion of the reserve not so allotted at any given time to be held ready for service at suitable points behind the line.

Except for these modifications, the proposed organization, as regards obtaining and organizing the necessary trucks, followed the general lines of the French organization.

TRAFFIC CONTROL.

The only one of the Allied Armies which had a completely organized working reserve of motor transportation was the French Army. An integral part of it was their system of traffic control. This has been built up during the war and was thoroughly organized, which was not the case with any other Allied army. It was therefore necessary that any American system of traffic control, which would have to be built up almost from the foundation, should conform closely to that of the French. Further, the French system was so excellent that it was desirable that any American system should so conform, and in so far as the variations in the structure and tradition of the two armies permitted.

The French system of traffic control was the basis which it was necessary for us to follow, not only on account of its efficiency, but also because we were operating in France.

The traffic control function of the Motor Transport Corps, (or whatever other authority might be in charge of the reserve) was inseparable from the administration and operation of the reserve itself. The whole had to be considered as one scheme. Objections to the pooling of transportation, if considered valid, would also have invalidated the proposed traffic control arrangements.

Up to this time, traffic control had been a function of the military police, but the necessity of placing it under the M. T. C. was obvious, and the final form of traffic control organization followed the general lines of the French system. (For further study, see proposed G. O. appended to reports of G-4-D, G. H. Q.)

MOTOR TRANSPORT SUPPLIES.

The property handled by the M. T. C. may be divided into three main classes:

A. Motor vehicles.

B. Spare parts, tools and accessories.
C. Repair plant.

For each class, there are three operations to be considered:
Determination of needs.
Acquisitions.
Distribution.

The three classes of property will be considered in order.

A. MOTOR VEHICLES AND SOURCE FROM WHICH OBTAINED.

At the beginning of the American E. F., and at a time when supply from the United States was exceedingly difficult, a number of vehicles were obtained in European markets. As a result there were about 160 makes of vehicles in the American Expeditionary Forces at the time of the Armistice, of which 112 (70%) represented only 2¼% of the total number, and a large portion of the difficulties of maintenance were due to this cause.

Owing to the difficulties of supply of spare parts, G-4, G. H. Q., adopted the policy that no vehicles should be purchased for the American E. F. unless approved by the Motor Transport Corps from the maintenance standpoint.

The basis of estimated needs of motor vehicles was the "Tables of Organization" (T. of O.) of the U. S. Army. These were shown in some cases to be quantitatively wrong—prescribing too many or too few vehicles. This is an error unavoidable in peace time determinations and was largely corrected. A more serious error existed in them, however, having its roots in the system by which these tables of organization were drawn up.

Basing themselves on the T. of O., on S. O. S. estimates not covered by these tables and on estimates of replacements, the appropriate bureaus in the United States arranged for the construction and delivery of the vehicles.

Shipments of vehicles to France were arranged as for other property, tonnage allotments were made each month to the various services, which then cabled to the United States what to ship. Up to June 1918, each service imported on its own tonnage the vehicles for whose supply it was responsible. Thereafter, by direction of G-4, G. H. Q., all motor vehicles came on M. T. C. tonnage. This involved close cooperation of the M. T. C. and the other services in the preparation of tonnage cables.

Motor Transport Corps supplies included spare parts, accessories, tools, and repair plant. The main supply depot was established at Nevers and afterwards moved to Verneuil. M. T. C. material was shipped to the main supply depot and it was endeavored to maintain

a 90 days' supply for all vehicles and shops operating in the A. E. F. there. Of this 90 days' supply, the sub depots in each of the base sections and in the advance section endeavored to keep on hand a 30 days' supply of spare parts and other M. T. C. material for the vehicles operating in their section. The M. T. C. officer of each section vised and forwarded all requisitions originating therein to the supply depot of the section.[2]

The second largest depot in France was established at Langres in March 1918, to supply the advance section, and in July, for the fighting then taking place on the western front, a depot was established at Paris, large enough to supply two divisions. It was necessary shortly afterwards to enlarge this depot to supply nine divisions instead of two and it was moved to St. Ouen.

As in other matters of supply, it was supposed that all vehicles shipped to France would be accompanied by a six months' supply of spare parts and so equipped as to permit their being put into immediate service. Up to May 1918, practically no spare parts had been sent to take care of the vehicles in France, then amounting to 25,204. When, in answer to urgent requests, supplies were finally sent many special sizes of tires for Dodge, Ford, and Cadillac cars were not sent in large enough quantities to meet immediate needs. Up to January 1, 1919, less than 50% had been floated due, as in all other instances, to the shipping situation.

The situation was remedied to a great extent by the General Purchasing Agent (G. P. A.), through whom supplies to the value of $9,760,000 were obtained, or 7,200 tons, and this provided urgently needed equipment which it seemed impossible to get floated from the United States.

The M. T. C. supply depots of the American E. F. were located as follows, on November 11, 1918:

Main supply depots	Romorantin, Verneuil.
Advanced depots	Paris, Sampigny, Langres.
Base port, clearing and sorting depots	Le Havre, St. Nazaire, Nantes, La Pallice, Bordeaux, Marseille.

On August 1st, 1918, there were approximately 1,555,408 American troops in France and only 37,959 motor vehicles, while the tables of organization called for 108,106 vehicles, of 118 different types. It was necessary because of this shortage to buy all makes and types of vehicles available in the European markets. This resulted in there being 76 different makes of passenger cars, 78 different makes of trucks and 9 different makes of motorcycles.

[2] See Charts No. 4 and 5. Chapter XVII, Vol. I.

SYSTEM OF STORAGE.

The M. T. C. machinery was as follows: it received vehicles at the various ports. At each port it had a reception park,[3] at which vehicles were set up (if crated), cleaned, oiled, assigned a number and put in running condition. On receipt of issue orders from G–4, G. H. Q., it either delivered the vehicles with its own personnel, or notified the unit to send personnel to take delivery. In general, for units at the front the M. T. C. made delivery as far as its reception park at Dijon, the unit sending there for it; units in the base and intermediate sections sent personnel to base ports. The M. T. C. organized and routed the convoys. It also conditioned vehicles of special types and held them for orders from the chiefs of the services.

DISTRIBUTION.

Distribution of vehicles was in general governed by the rules of G. O. 73, 1917; (and later G. O. 44, 1918). To develop a smooth distributing system and minimize detail work at G. H. Q., the following policies were adopted in this matter:

(*a*) At first, vehicles were distributed by the various services as indicated by tables of organization. This meant that often several services would be distributed the same type of vehicle; and as each service supplied only certain arbitrary units, and as some services were much better supplied than others, there was no guarantee that transportation was not being sent where it was not needed. It was obvious that only one service should handle any one type of vehicle. By G. O. 74, 1918, the M. T. C. was given the distribution of all ordinary cargo carrying and passenger carrying vehicles. By a subsequent decision, it was specified which service should handle each type of the vehicle specified in the tables of organization.

(*b*) As regards the vehicles distributed by the M. T. C. (the only ones under discussion herewith, owing to the chronic shortage in the A. E. F., G–4, G. H. Q., adopted the policy, in March, 1918, of placing these in Class IV, where they remained.

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[3] The reception parks in the American E. F. were as follows:

Reception: Bordeaux, Le Havre, St. Nazaire, Nantes, La Pallice, Marseille.

Sub-reception: Dieppe, Rochefort, Rouen, Bayonne.

Service: Liverpool, London, Winchester, Cherbourg, Coetquidan, Meucon, Lormont, Camp de Souges, Cannes, La Courtine, Limoges, Poitiers, Angers, Le Mans, Tours, Blois, St. Aignan, Châteauroux, Nevers, Valdahon, Is-sur-Tille, Chatillon-sur-Seine, Langres, Chaumont, Dongeoux, St. Dizier, Châlons, Epernay, Triaucourt, Bar-le-Duc, Gondrecourt, Colombey-les-Belles, Mizéville, Nancy, Dijon, Rouen, Bayonne, Le Havre, St. Nazaire, Nantes, La Pallice, Marseille, Paris, Sampigny, Toul.

Reserve: Dijon.

Reconstruction: Romorantin, Verneuil.

Overhaul: Neufchâteau, Dijon, Paris, Sampigny, Toul.

(*c*) A fixed percentage of all incoming vehicles were turned over to the Commanding General, S. O. S., for distribution as he saw fit; with these he was required to handle all S. O. S. needs. The percentage adopted was at first 25%; in the spring of 1918, it was reduced to 10%; where it remained (except for a period in the early fall of 1918 when it was temporarily increased to 30%, to repay certain loans of the S. O. S. to the armies). G–4, S. O. S., handled the distribution of this 10%.

(d) With the remaining 90%, G–4, G. H. Q., handled the needs of combat troops, schools, and miscellaneous assignments.

(*e*) Issues to any unit were the entire allowance of that unit, or such fraction thereof as was available, and were made to the commanding officer of the unit. He had the T. of O. to guide him in making distribution within his unit. This policy was first applied to divisions, independent brigades, etc., and, when the armies were formed, it was applied to them also.

(*f*) Initial issues to units having T. of O. allowances were made without requisition.

(*g*) Replacements were treated like initial issues, except that requisitions therefore were made from time to time.

Based on the above policies, the following was the system of distribution: G–4, G. H. Q., received from the armies their reports of vehicles on hand. It received from miscellaneous sources, not in the army, emergency requests. It received daily from the M. T. C. a list of vehicles that were available for issue. It was informed of the operations contemplated by the Commander in Chief. Based on this, it decided what issues to make, informed the units to whom the issues were to be made; and directed the D. M. T. C. to make issues. The D. M. T. C. was responsible that these issues were made.

SPARE PARTS AND ACCESSORIES.

It was early realized that the problem of spare parts supply (which was the crux of the upkeep problem) would be extremely difficult. A single motor truck has about 3,500 kinds of parts, of which about 80% are peculiar to that make and type.

For the vehicles in France, when the Armistice was signed, 90,000 kinds of parts were in stock—many times the number of individual articles handled by any other service; more than the number handled by all other services combined, (and there were thousands of parts not in stock). A satisfactory solution of the spare parts difficulty involved the following:

(*a*) Information in the hands of manufacturers of the average expenditures of various parts, by a given type of vehicle, in a unit period.

(*b*) A steady supply of parts on this basis.

(*c*) Extensive depots, with thousands of bins for housing the parts.

(*d*) Skilled personnel to handle them.

(*e*) An organized service of distribution.

(*f*) Economy in use.

These requirements were met in varying degrees.

The general organization developed was as follows:

Motor transport supplies were shipped from the United States and received at nine different base ports. They were handled as Class III property, and a freight officer at each port expedited their shipment to the main supply depot at Nevers, later Verneuil. Verneuil was a retail depot for the base and intermediate sections, while it sorted, stocked, and shipped supplies in wholesale quantities to the advance depot at Langres and to the Paris depot. The advance depot made distribution direct, and through auxiliary depots at Neufchâteau and Sampigny, to combat units in the line and to stations in the advance section. The Paris depot distributed to the armies operating with the French during the Château-Thierry drive and supplied the Paris District.

The armies established dumps or distributing points forward of the advance depots wherever necessary. The base depots made detailed distribution to cars for base activities and every transportation facility available was used in making distribution. Requisitions, etc., were handled as for other Class III supplies.

The system of distributing parts by a circulating convoy was first developed, it is believed, by the Air Service, whose units were much scattered and had the first standardized transportation. It was used by the M. T. C. when the First Army was organized, for distribution to divisions. Later, it was largely abandoned. This system required considerable transportation and certain trucks or trailers, but had many advantages, especially for small scattered units. Its possibilities should be given careful consideration in determining future policies.

The supply of tools and accessories was handled along the same lines as that of spare parts.

System of Maintenance.

Repair plant.

The character and use of repair plants is described below. The supply of these plants was partly by specific calls on the United States for unit plants, and partly by an automatic system similar to that for spare parts, the United States shipping monthly a fixed quantity of tools and machinery, as replacements for worn out ma-

and each of the headquarters of the armies would have had its well organized, smoothly running, office of the Motor Transport Officer; further, this would have been carried to the army corps and divisions. In the Services of Supply, the Motor Transport Corps was established at practically every point of France where any activities existed that demanded motor transportation.

The headquarters of the Motor Transport Corps were at Tours. The important divisions of the headquarters were: the Executive, the Supply, the Repair, Operations, Inspection and Engineering, Training, Liason and the Plans and Projects Divisions.

With the Armistice, reorganization was effected to meet the new conditions and several of the branches and divisions were amalgamated, thus cutting down considerable work at headquarters. The reception of new vehicles from the United States continued all through January 1919.

At the time of the Armistice, operations activities of the Motor Transport Corps were as follows, the figures showing the actual numbers of vehicles assigned, which, in many sections, were running night and day:

Section	Trucks	Motor Cars	Section	Trucks	Motor Cars
Base Section No. 1	843	191	Base Section No. 8	25	6
Base Section No. 2	964	215	Intermediate Section	1,535	289
Base Section No. 3	188	123	Advance Section	1,308	299
Base Section No. 4	175	53	District of Paris	207	351
Base Section No. 5	532	54	Tours district	176	199
Base Section No. 6	222	51			
Base Section No. 7	161	37		6,336	1,938

DRAWBACKS IN THE MOTOR TRANSPORT CORPS.

The principal drawbacks that confronted the Motor Transport Service in its early formation, and the Motor Transport Corps in its later functioning, can be summarized as follows:

(*a*) Lack of early organization, which was largely responsible for other services having the opportunity of purchasing "special" types of vehicles, few of which proved practicable, many of which proved almost useless and all of which complicated the problems of supply and repair.

(*b*) Continuous shortage of personnel.

(*c*) The continuous sending over of untrained or semi-trained personnel from the States—men who had to be trained under the stress of war time conditions.

(*d*) Frequent changing of the agency through which motor transportation was controlled.

(*e*) In the armies, because the Motor Transport Corps had no operating responsibility.

Vehicles repaired at a service park were generally returned, after repair, to their units; vehicles sent to overhaul or reconstruction parks were dropped from the records of their units (which were furnished a replacement) and, after repair, were reported by the M. T. C. as available for assignment, the same as new vehicles. These rules were variable.

As regard location of plants, territorially and with respect to units, the following general policies were adopted by G-4, G. H. Q.

(*a*) Service parks with armies: One per division. Per corps, 1 per division in corps. Per army, 1 per division in army. To army artillery and similar units, numbers proportional (by number of vehicles) to division allowance. These to be located at the discretion of division, corps and army commanders.

(*b*) Service parks in S. O. S., at discretion of S. O. S.

(*c*) Overhaul parks: Distributed along the fronts. Average distance from the front, 30 miles; 50% located on railroads and main communications; 19 of these were the allowance for an army of 1,300,000, or, about 1 per 4,500 vehicles (excluding bicycles). Their distribution depended to some extent on the concentration of vehicles. Typically, however, a park should handle certain makes rather than the vehicles of certain units. With the districting of makes in units, this distinction disappears.

(*d*) Reconstruction parks: In intermediate section, on main L. of C., one for foreign makes (Romorantin) and one for American makes (Verneuil).

In practice, these policies were approximated only. The supply of mobile service parks and of overhaul parks never reached that required by the above. Districting of makes by unit was very incomplete when the armistice was signed, and the selection of an overhaul park to do a certain job was usually made territorially.

MOTOR TRANSPORT AT THE DATE OF THE ARMISTICE.

In conclusion and as a summary of the above statement of facts concerning the Motor Transport Corps, its organization and evolution at the time of the Armistice, which was four months after the creation of the Motor Transport Corps as such, the Motor Transport Corps had a complete organization in the American Expeditionary Forces extending from the Atlantic to the armies on the front; from the Mediterranean to the English Channel; in England and in Italy. In spite of the shortage of personnel (not having more than 30% of the number of personnel it was supposed to have, and less than 50% of the equipment), the organization was functioning efficiently and, had not hostilities ceased, long-matured plans would have, in a reasonably short time, been completely carried out

and each of the headquarters of the armies would have had its well organized, smoothly running, office of the Motor Transport Officer; further, this would have been carried to the army corps and divisions. In the Services of Supply, the Motor Transport Corps was established at practically every point of France where any activities existed that demanded motor transportation.

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MAJ. FRÉDERIC HAINAUT

Belgian Member of the Board, July, 1919–February, 1920

(*f*) Careless handling of delicate motor machinery by men over whom the M. T. C. had no direct control, although responsible to a large extent for making good the damage caused by agencies without its control.

(*g*) Lack of vehicles standardization, largely attributable to the reasons brought out in paragraphs (*b*) and (*e*).

CONCLUSIONS REACHED.

There are three points that a complete history of the Motor Transport Corps in the American Expeditionary Forces inevitably bring out, as follows:

(*a*) That to have complete efficiency of motor transportation, there should be a separate corps in the United States military service to procure, supply, maintain, and operate motor transportation in the Army.

(*b*) That there be standardization of motor transportation, possible only through carrying into effect paragraph (*a*).

(*c*) That there be thorough and complete standardization of training for Motor Transport Corps personnel.

(*d*) That there be standardization of repair methods, possible only through carrying into effect paragraph (*b*).

CHAPTER XVII.

SECTION I.

THE SYSTEM OF SUPPLY FOR THE BRITISH ROYAL AIR FORCE IN FRANCE DURING THE WAR.

(Chart 1, Chapter XVIII, Vol. I.)

At the beginning of the war, military aviation was administered by the Military Aeronautics Directorate at the War Office. The Director General of Military Aeronautics dealt direct with the Secretary of State for War. The duties of the directorate were, broadly, to advise the General Staff on all aeronautical matters; the preparation and development of mobilization schemes; the appointment, recruitment and training of all personnel; the provision of technical equipment and the general administration of the Royal Flying Corps. The Corps was organized for field service into squadrons, each of three flights of four aeroplanes, and an Aircraft Park which consisted of a stores section and a workshop section.

When the Royal Flying Corps took the field, it consisted of a headquarters, four aeroplane squadrons and an aircraft park. The aircraft park soon split up into two sections; viz: a port base and an advanced base. After various movements in the early months of the war, by mid-October the port base was situated at Rouen and the advanced base at St. Omer. A little later a second port base was opened up at Boulogne and, at the beginning of 1916, a third was established at Havre. The port base, in addition to being an unloading depot for stores, dealt with big repairs to engines and mechanical transport, and minor repairs to aeroplanes. The advanced base, in addition to the distribution of stores to squadrons, carried out repairs to, and overhaul of aeroplanes, erection of aeroplanes arriving in a partially dismantled condition, and minor repairs to engines. It also held spare aeroplanes which were flown up to the front as required. It was a mobile unit, and able to move completely at twenty-four hours' notice. As the number of squadrons in France increased, they were aggregated into groups of two or more squadrons, these groups being termed Wings, each wing being placed under a separate Wing Commander, and was the unit of the Royal Flying Corps for working with each army. The wing system brought with it the grading of Equipment Officer, whose duties at

first involved administrative work in connection with the storage, maintenance and repair of aircraft, engines and spares, for his unit, but the grading was soon extended to cover specialist officers for wireless, photography, machine-guns, etc.

An equipment officer was allotted to each wing and every squadron was provided with an Assistant Equipment Officer. The system of supply was briefly as follows:—

The Squadron Equipment Officer indented for stores in the wing; the wing equipment officer, after approval, passed on the indent to the aircraft park which then supplied the stores to the squadron. The demands for aviation stores from home were made by the aircraft park with the approval of the Deputy Assistant Quartermaster-General at the Royal Flying Corps headquarters. Stores other than technical were provided by the usual army services.

As the Royal Flying Corps in France expanded, so did the activities of the aircraft park. After the first year of the war, the aircraft park combined the functions of an ordnance store depot, an aeroplane repair section, an engine repair section, and a mechanical transport repair section; in addition it had sub-sections dealing with wireless telegraphy and photography. This tended to make the aircraft park quite immobile.

When the Royal Flying Corps was further decentralized, two or more wings were grouped into brigades, one for each army. To each brigade, which was commanded by a brigade commander, was allotted a Brigade Equipment Officer. Embodied in a brigade organization was a mobile formation to hold a small reserve of stores and to carry out minor repairs to aeroplanes. These were termed Army Aircraft Parks. These carried their stores packed in specially constructed cases, which were loaded on lorries in such a manner that stores could be issued while on the move if necessary.

The engine repair section of the original aircraft park was located at Pont-de-l'Arche near Rouen. This developed into the engine repair shops at the same site and dealt with the repair of engines for the whole corps.

The original aircraft park now became No. 1 Aircraft Depot at St. Omer, a second aircraft depot (No. 2) being formed soon after at Candas. These depots dealt with stores sent from home and with heavy repairs to aeroplanes and mechanical transport. The final location of the aircraft depot headquarters was: No. 1 Aircraft Depot, H. Q., Guines; No. 2 Aircraft Depot, H. Q., Vron.

The aeroplane repair sections of the aircraft depots developed into much larger concerns and became Aeroplane Supply Depots, embracing an issue section and repair park. To No. 1 Aeroplane Supply

Depot, at Marquise, was also attached a Reception Park, where all aeroplanes flown over from England were received.

Brigade Reserve Lorry Sections were also formed to deal with the distribution of mechanical transport vehicles.

The aircraft depots consisted eventually of stores sections, mechanical transport (M. T.) repair sections, an aerodrome maintenance section, a balloon section and accounting sub-sections. The port depots were originally branches of the aircraft depots but in the final organization were independent units.

At the Royal Flying Corps headquarters, there was from the beginning a "Q" branch, under a Deputy Assistant Quartermaster-General, responsible for all supplies of equipment to the Royal Flying Corps units in the field. This branch eventually had four main sub-divisions, viz: "Q. A.," which was responsible for supplies of aeroplanes, engines, mechanical transport, technical stores and all records; "Q. B.," which dealt with experimental work, the technical supervision of all aircraft material and advice to squadrons on its care and upkeep; "Q. C.," which was concerned with everything connected with kite balloons; and "Q. D.," which was responsible for accommodation, Royal Engineers (R. E.) services and non-technical supplies.

The brigade organization of the Royal Flying Corps which had come into being in the early part of 1916, was found adequate for the remainder of the war and, when the Royal Air Force became a separate service in April 1918, the system of supply which had grown up was found sufficient to meet any further expansion of the force. In the final organization, a Royal Air Force brigade consisted of:

One corps wing composed of a number of squadrons equal at least to the number of corps in the army with which the brigade was working.

Two army wings composed of: (*a*) A mixed wing consisting of one or two day bombing and reconnaissance squadrons and three or four fighting squadrons; in addition, a night bombing squadron was usually attached. (*b*) One fighting wing consisting of fighting squadrons up to the number of six.

One balloon wing comprising a number of balloon companies, of two sections each, one company for each corps.

One or two aircraft parks.

Two reserve lorry parks.

One or two air ammunition columns.

One or two salvage sections.

Toward the end of the war, the system of supply was as follows:

1. AEROPLANES.

(Charts 2 and 3, Chapter XVIII, Vol. I.)

(a) *Flown over from England.*—These were received at the reception park of No. 1 Aeroplane Supply Depot at Marquise, where small modifications were carried out and artillery machines were fitted with wireless.

(b) *Sent over in cases with or without engines.*—These were divided between Nos. 1 and 2 Aeroplane Supply Depots at Marquise and Berck-sur-Mer respectively, where they were erected and got into flying order.

(c) *Machines from Paris.*—These were sent to No. 2 Aeroplane Supply Depot at Berck-sur-Mer.

The aeroplanes were issued direct from the supply depots to squadrons. When a squadron had a machine damaged or missing they telegraphed or telephoned direct to "Q. A." at G. H. Q., Royal Air Force (R. A. F.). "Q. A." would then allot an aeroplane by number as a replacement and decide whether it should be fetched by the squadron or flown out by one of the aeroplane supply depot pilots, and in any case, inform the squadron what had been done, issue orders to the depot and confirm by telegram, a copy of this telegram being sent to the brigade equipment officer. This method worked exceedingly quickly, and machines frequently arrived at squadrons within three or four hours after the original one had been damaged or was known to be missing. When there was no fighting going on, this system was conducted by ordinary letter correspondence, in which case machines generally took about 48 hours to get to squadrons after the casualty occurred. The salvaging of crashed aeroplanes became a very important duty. They were originally dealt with at the aeroplane repair sections of the aircraft depots. Later this work was carried out by the aeroplane supply depots. Special salvage sections were attached to each brigade for collecting of crashed machines worth salvaging. These were sent to the aeroplane supply depots where they were stripped and in some cases rebuilt. All serviceable parts from stripped machines were thus available for reissue.

2. ENGINES.

These first went to Nos. 1 and 2 Aircraft Depots, which supplied the brigade aircraft parks, which in turn supplied the squadrons. Squadrons kept a varying number of spare serviceable engines, from

three to nine, according to the particular type in use in their aeroplanes.

The repair of engines was a most important duty. Squadrons carried out a certain amount of engine repairs, but when the work got beyond them—as frequently happened—they would send in their unserviceable engines to the aircraft park and drew serviceable ones in replacement. The park would send the unserviceable engines to the aircraft depot, the depot sending them down to the engine repair shops at Pont-de-l'Arche, near Rouen.

3. MECHANICAL TRANSPORT VEHICLES.

These were received at the aircraft depots from which they were issued through the reserve lorry parks to units.

4. KITE BALLOONS.

These were issued by the aircraft depots direct to the balloon sections.

5. AIRCRAFT STORES (SPARES, ETC.).

These were issued by the aircraft depots through the aircraft parks to squadrons.

6. AMMUNITION.

All the ammunition used by the Royal Air Force was of a special grade and was issued by the aircraft depots in the same way as ordinary stores.

7. BOMBS.

These were divided into two classes: standard and non-standard. The standard bomb was by far the most numerous and was supplied by the Army Ordnance.

These bombs were drawn by special sections attached to each brigade, and known as air ammunition columns. They consisted of six lorries and their drivers, and were controlled by the brigade equipment officer. Non-standard bombs were either experimental types or certain special ones not stored by the Army Ordnance. These were kept by the aircraft depots and issued through the aircraft parks in the usual manner.

Aircraft depots held roughly a three months' supply of all stores for all aircraft parks in their area. These depots submitted fortnightly indents to home headquarters. Aircraft parks normally kept a four weeks' supply for all squadrons in their area. These parks indented fortnightly on the aircraft depots. Squadrons held roughly four weeks' supply. They indented on the wing

and so through the brigade for stores to maintain their authorized establishment. In the event of delay or special urgency, a system of hastening was in force.

During the advance after August 1918, the issue sections from the aeroplane supply depots were moved forward as required, in order to keep close to the squadrons; the main portion, i. e. the repair section, remaining at its original site. Also as the advance continued, it was found necessary to split up the aircraft depots in the same way, sending on an advanced section. This was necessitated solely owing to transport difficulties. The aircraft parks had to be beyond railhead, and owing to the delay in rail transport the majority of the stores had to be moved up from the aircraft depots by road. The distance right away back from the parks to the depots became too great, and so advanced sections of aircraft depots were sent up to railhead, and parks then drew by road from there. These advanced sections carried practically a month's supply of stores and could afford to wait the fortnight or three weeks that it might take to get up stores from the depots by rail. The system of transport repair was also revised, a base Mechanical Transport Repair Depot was formed in the neighborhood of Rouen, which carried out extensive repairs to vehicles, and also overhauled what were known as units; principally engines and back and front axles. Two advanced M. T. sections were then formed, and these were small and mobile and moved up roughly to the line of the advanced sections of the aircraft depots. The duties of these advanced M. T. sections were to replace unserviceable units in vehicles by serviceable units, so as to avoid the transport of a complete unserviceable vehicle all the way back to the base. This system saved a vast amount of road and rail transport. Only when vehicles were completely smashed or required a complete overhaul were they sent back to the base.

For the Independent Air Force a similar supply system was in operation. It had its own aircraft and aeroplane supply depots as well as the usual aircraft parks, reserve lorry parks and air ammunition columns.

CHAPTER XVII.

SECTION II.

SUPPLY OF AIR SERVICE MATERIALS (FRENCH).

I. General Statement.

The supply of materials of all kinds had been thoroughly studied by the "Direction of Aviation" (Direction de l'Aéronautique), in conjunction with General Headquarters. For the supply of airplanes the following monthly rates had been determined upon:

For the front: 50% for pursuit and bombing planes and 33% for reconnaissance planes.

For the interior: 33% for pursuit planes and 20% for other types of airplanes.

Spare parts therefore were supplied by the factories in the proportions fixed by experience and according to the number of complete airplanes. In other words, for each consignment (lot) of 100 completed airplanes there was a number "X" of airplanes in separate parts and the same for the motors.

The rolling matériel was furnished to the Air Service by the Motor Transport Service.

All Air Service matériel produced by the factories was, after receipt by the "Air Service production services" (Services des fabrications de l'Aéronautique—S. F. A.), delivered to the "Services in charge of the Air Service depots" (Services des entrepôts généraux de l'Aéronautique—S. E. G. A.) which distributed it direct to the Air Service units of the interior through two regulating organs: the "General Air Service Reserve" (Réserve Générale de l'Aéronautique—R. G. A.), for airplanes and rolling matériel, and the "2nd Air Service Reserve" for spare parts and ingredients, etc.

2. SUPPLY OF THE UNITS AT THE FRONT.

(Chart 14, Chapter XVIII, Volume I.)

a) *Airplanes and vehicles.*—The units addressed their requests for replacements of airplanes and vehicles to General Headquarters (G. H. Q.) through the Air Service parks. G. H. Q. ordered the R. G. A. to deliver the matériel, and convoy pilots delivered the planes to the units by air route. Vehicles were forwarded to the units by road.

At the date of the Armistice, for 3,609 airplanes in line, the R. G. A. maintained a reserve of 1,960 airplanes and for 7,415 vehicles in service it had 617 vehicles in reserve.

b) *Spare parts and ingredients.*—Each squadron possessed a quantity of spare parts for emergency repairs.

The parks which supplied the squadrons maintained large quantities of spare parts, spare motors and ingredients for each squadron.

The "2nd Air Service Reserve" maintained still larger quantities of spare parts, spare motors and ingredients for each squadron.

The composition of the reserves of supplies maintained in each of these three formations (squadrons, parks and 2nd reserve) was fixed by the allowance tables. These reserves were known as "lots" of supplies.

The squadrons obtained their supplies from the parks, the parks were replenished by the "2nd Air Service Reserve," which, in turn, was supplied by the S. E. G. A.

3. SUPPLIES FOR SCHOOLS AND SQUADRONS IN THE INTERIOR.

The supply was assured in the same way, but by the S. E. G. A. direct.

However, for the aviation matériel of the schools, which consisted for the most part of repaired matériel, there was a special supply depot for the "Air Service supply service" (Service du ravitaillement—S. R. A.)

Requests were controlled by an organ known as the "Central Supply Control" (Contrôle Central du ravitaillement). The units sent their requests to this organ and the latter approved or reduced them. The requests were then forwarded to the S. E. G. A. or to the S. R. A. for fulfillment.

To overcome possible emergencies, the schools and squadrons of the interior maintained reserves of airplanes and spare parts. These reserves were larger than those of the units at the front, but this was because the front line units could not be encumbered by surplus or excessive stores of matériel.

Organization of the Air Service.[1]

The Air Service consisted of two branches: (*a*) the Aviation Service and (*b*) the Balloon Service, operating under the commands of the various echelons.

UNITS COMPOSING THE SERVICE.

(a) *Aviation:*

Army air squadrons (Escadrilles d'Armée) for long distance scouting and pursuit. Composition: 15 planes, consisting of single seaters

[1] Prepared for the Military Board of Allied Supply by the "Direction de l'Aéronautique" at the French Ministry of War.

for pursuit and fast biplanes. The number of these squadrons varied in the armies; generally one squadron was assigned to the two army corps in an army.

Army corps and divisional air squadrons (Escadrilles de Corps d'Armée et de Divisions) for visual and photographic reconnaissances, bombing missions, command and liaison work. Composition: 10 planes, consisting of double or triple seaters.

In each Army Corps.

1. Army corps air squadrons (Escadrilles de Corps d'Armée), charged with visual and photographic reconnaissances, missions of command, observation for the heavy artillery units, etc.

2. Divisional air squadrons (Escadrilles Divisionnaires), at the rate of 2 squadrons per army corps of 4 divisions, and 1 squadron per army corps of 1 division. The functions of the divisional squadrons were to carry out observations for the divisional artillery, liaisons with the infantry, etc.

The above allowances made it possible to assign one air squadron to each division engaged. Normally, a squadron always worked for the same two divisions.

During operations, the army corps air service was reinforced by the air squadrons of the heavy tractor artillery and heavy horse artillery regiments which had been assigned to the army corps.

Artillery Air Squadrons (Escadrilles d'Artillerie).

1. Large caliber heavy artillery squadrons (Escadrille de l'Artillerie lourde à gros calibre). Composition: 15 planes, generally, 10 double and 5 triple seaters. At the end of the war, four air squadrons worked for the large caliber heavy artillery groups, but they were not definitely assigned to a particular regiment.

2. Heavy artillery air squadrons (Escadrilles de l'Artillerie Lourde—A. L.) Composition: 10 planes, double seaters. There was one air squadron for each heavy tractor artillery regiment and one for each heavy horse artillery regiment. These squadrons followed the regiments to which they were assigned. All of the artillery squadrons had observers (usually officers) who formed part of the staff of the squadron.

3. Combat squadrons (Escadrilles de combat). Composition: 15 single seater planes. These units were constituted into "Combat Groups" (Groupes de combat) and formed combat squadrons or isolated combat groups.

4. Bombing squadrons (Escadrilles de bombardement): Day squadrons and night squadrons of 15 planes each.

These units were constituted into bombing groups (groupes de bombardement) and formed bombing squadrons or isolated bombing groups.

The combat and the bombing squadrons or groups were under the orders of the Commander in Chief and he could place them for a specified length of time at the disposal of a corps or of an army.

The personnel of the squadrons, according to the type of squadron, consisted of from 6 to 15 officers and 90 to 130 men; with from 20 to 25 automobiles. (These figures are merely mentioned to give an idea as to the personnel strength.)

Photographic Sections (Sections photographiques).

These were of two types: (*a*) Army photographic sections, composed of 1 officer, 13 men, and 3 automobiles; and (*b*) Army corps photographic sections, composed of 9 men and 2 automobiles.

One photographic section of this type was assigned to each army corps squadron. The combat and bombing groups also had photographic sections.

(b) *Balloon Service* (Service des aérostiers):

Balloon companies (compagnies d'aérostiers) were of two types:

Type 1. All vehicles were motorized. These units had the necessary trucks for the transportation of their personnel. Composition: 6 officers, of whom 4 were observers; 154 men; 16 automobiles and 10 trailers.

Type 2. All vehicles were motorized, but the number of trucks at their disposal did not permit the transportation of the personnel. (These companies were formed after the reorganization of the old type companies which had been equipped with animal transportation.) Composition: 6 officers, of whom 4 were observers; 154 men; 12 automobiles and 5 trailers.

The type 1 balloon companies could move rapidly and were reserve elements. Balloon companies of type 2 could not cover long distances readily. A balloon company, generally of type 2, was assigned to each army corps and followed it in its various movements. The other balloon companies, particularly those of type 1, formed a reserve force which was available for use as reinforcements in sectors of attack.

II. Supply of Material.

In each army, an "Army Air Park" (Parc aéronautique d'Armée) supplied all of the Air Service units (army corps and artillery air squadrons, balloon companies). It was purely a supply organ and could undertake minor repairs.

The army air park included: A park staff and train, storehouses, transportation, mobile repair shops and a section for the upkeep of the hangars. It had: 6 officers, 276 men; 38 automobiles and 35 trailers.

In addition, army air park "mobile reinforcement crews" (Equipes mobiles de renfort de parc) consisting of 38 men, with 7 trucks and 2 trailers, made it possible to reinforce army air parks which were to supply more than 8 air squadrons at one time. (One crew per 4 squadrons at the most.)

Each combat squadron or isolated combat group, and each bombing squadron or isolated bombing group, had a park similar to the army air park.

The "Main Aviation Park" (Parc aéronautique principal) was charged with the repair of airplanes and motors belonging to the armies and groups of armies.

The "General Air Service Reserve" (Réserve générale d'aéronautique), at Le Bourget-Dugny supplied airplanes. It maintained a number of branch establishments (annexes) near the front which supplied planes to the armies and groups of armies.

The "2nd Air Service Reserve" (2e Réserve), which supplied the entire Air Service, was located at Versailles and handled the supply of all aviation matériel except airplanes.

Shipments from the "2nd Air Service Reserve" were forwarded to the regulating stations and one of the permanent services of the regulating station concerned forwarded the supplies to the armies or groups of armies to which they were destined.

III. Inspection of Air Service Matériel.

An "Inspection service for aviation matériel" (Inspection du matériel aéronautique—I. M. A.) was responsible for the upkeep of the matériel and reported to General Headquarters concerning the condition of the aviation matériel in the armies.

IV. Personnel.

(Chart 16, Chapter XVIII, Volume I.)

Personnel was furnished by various establishments, namely:

The group of training divisions (divisions d'entrainement), at Le Plessis-Belleville, for the training of pilots and which served as depot for pilot personnel.

The training center (centre d'instruction) at Sommesous, for the training of observers, squadron commanders, and officers destined to command Air Service units.

The training centers for the personnel of the Air Service combat and bombing units.

The depot for technical Air Service personnel (dépôt du personnel technique aéronautique—D. P. T. A.) at Le Plessis.

V. Aviation Matériel in the Armies.

1. *Airplanes.*

Army corps airplanes	1,591
Pursuit planes	1,471
Bombing planes	547
	3,609
Army Air Service schools	635
General Air Service Reserve and branch establishments	1,960
Total	6,204

2. *Balloons.*

Balloons in service	75

VI. Supply of Balloon Companies During the War.

(Chart 15, Chapter XVIII, Volume I.)

All necessary matériel and gas for the balloon companies were furnished by the "Central Depot for Balloon Matériel" (Etablissement Central du Matériel d'Aérostation). This depot supplied:

(1) Balloon matériel to the "2nd Air Service Reserve" which, in accordance with the requirements, sent it to the air parks (parcs aéronautiques), where a balloon section (section d'aérostiers) supplied the balloon companies.

Theoretically, the "2nd Reserve" maintained a reserve equal to one half of the matériel in use in the units in the field. At the "Balloon Park" (Parc d'Aérostation): one balloon per company.

(2) Rolling matériel to the "General Air Service Reserve." The system of supply was the same as above. Theoretically, the "General Reserve" maintained a reserve equal to one tenth of the vehicles in use, but no reserves were held in the air parks.

(3) Hydrogen gas was generally sent direct from the producing establishments in the interior to the "Gas depots" (Dépôts de tubes) of the armies, which were under the air parks, and from there to the balloon companies.

As regards shipment of gas, the "2nd Air Service Reserve" informed the factories as to the requirements of the various gas depots. The latter were normally supplied by certain designated plants and returned the empty gas tubes direct to the factories concerned.

The number of gas depots per army varied according to the number and location of balloon companies which were to be supplied. These depots were located near a railway station, in order to reduce transportation by motor truck to a minimum. On an average, the depots maintained 120 tubes of gas for each balloon company. All shipments of matériel or of gas were convoyed.

CHAPTER XVII.

SECTION III.

AIR SERVICES (BELGIAN).[1]

Part 1.

HISTORICAL.

In August 1914, the Belgian Air Service only had a limited number of planes (about 30). The "Air Park" (spare parts, fuel, raw materials) was located in the fortified position of Antwerp. There were no work shops and repairs were made by civilian concerns.

Upon the retreat from Antwerp to the Yser, the air squadrons were located, first, at Dunkerque (St. Pol), and later, when the front was stabilized, near Furnes. The air park was moved to Calais and established itself in the hamlet of Beau Marais, at 5 kilometers from the city. There was a municipal aerodrome and a small hangar at that place. Gradually, workshops, storehouses and hangars were established and this developed into the organization which was in existence at the date of the Armistice.

ORGANIZATION OF SUPPLY.

(Charts 4 and 5, Chapter XVIII, Vol. I.)

The Belgian Air Service was comparatively small. The air squadrons were located in the region of the Yser, the aviation school at Juvisy (near Paris), and the supply center, repair and assembling shops were established at Calais (Beau Marais).

AIRPLANES FOR THE FRONT.

The airplanes and spare parts were furnished by the British and French Governments. Those coming from Paris were brought to Calais either cased or by air, usually the former. British airplanes came to Calais by air from the depots on the continent (Saint Omer, Marquex) or from England. However a number of aeroplanes were also sent from England in cases.

[1] Prepared for the M. B. A. S. by the Commandant of Aviation, Belgian G. H. Q.

Shipment by air was the more rapid but also the most expensive means, as more than 10% of the airplanes were destroyed incidental to the trip, particularly when they came from Paris, (300 kilometers). All airplanes were examined, verified, and tested at Calais.

This consumed time, but it prevented sending unsatisfactory equipment to the front as well as losses and accidents.

Spare parts were sent from France and England to the supply center at Calais, where they were stored.

REPAIRS.

All important repairs were made at Calais. A great deal of repair work was necessary because the number of airplanes furnished by the French and British was insufficient, as these countries were experiencing difficulties in supplying the requirements of their own armies. Consequently, the repair shops at Calais were thoroughly equipped.

PURCHASES.

Reserve airplanes and various accessories were purchased in accordance with the requests of the Commandant of Aviation. These supplies were purchased either in Paris, by the "Director of the Armament and of the Technical services of the Army" (D. G. A. S. T. A.), or in London, by the "Belgian Supply Commission" (Commission de ravitaillement). These organizations were directly under the Minister of War, and an officer was attached to each one and charged with looking after the interests of the Air Service.

CONTROL.

Each year, after conferring with the Commandant of Aviation, General Headquarters sent the Minister of War the Air Service program for the coming year and determined the number of planes which would be required.

After approval, the Commandant of Aviation prepared his estimate for the coming year. He kept account, first of the number of planes in service, the number of reserve planes, machine guns, motors, salary of personnel, and necessary reserve stores. This estimate was then sent to the Ministry for approval. The first of August of each year, if the Commandant of Aviation foresaw that his appropriations would be insufficient, because of necessary modifications either in the number of squadrons or on account of the rapid changes in certain types of planes, he prepared a supplementary estimate and submitted this request for additional appropriations to the Minister of War.

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As an example, there is submitted below the estimate prepared in October 1918, for the year 1919. It was based on the 1919 air program, which provided for the following organization:

9 army corps squadrons	12 planes (each).
2 army squadrons	15 planes (each).
1 heavy artillery squadron	10 planes.
4 combat squadrons	15 planes (each).
1 bombing squadron	15 planes.

Purchases for replacements and new matériel.

	Francs.
200 Biplanes, complete, at Frcs. 70,000	14,000,000.00
225 Monoplanes, complete, at Frcs. 60,000	13,500,000.00
72 Training biplanes, at Frcs. 35,000	3,520,000.00
64 Training equipment (cellules) (for construction at Beau Marais) at Frcs. 15,000	960,000.00
150 Airplane motors, at Frcs. 20,000	3,000,000.00
1,500 Propellers, at Frcs. 300	450,000.00
Armament and munitions	1,500,000.00
Navigating instruments for airplanes	150,000.00
Equipment for aviators	150,000.00
Tools, large and small	200,000.00
Photographic material	150,000.00
Extinguishers and charges	30,000.00
Hangars, for spare parts	1,000,000.00
Towing apparatus	100,000.00
Electrical apparatus (front excepted)	50,000.00
Total	38,760,000.00

Cost of operation and maintenance.

	Francs.
Maintenance hydroplane squadron	250,000.00
Spare airplanes	2,000,000.00
Spare motors	1,500,000.00
Spare parts for machine guns	25,000.00
Various lubricating oils for airplane motors	1,000,000.00
Various woods	200,000.00
Textile materials	350,000.00
Various metals	150,000.00
Bolts for airplanes	175,000.00
Bolts, screws, nails, rivets, eyebolts, staples, etc	75,000.00
General (miscellaneous) hardware	135,000.00
Chemical articles, brushes, cordage, paints, varnish, leathers, jute, soaps, rubber, carbide, etc	250,000.00
Steel cables and wire	100,000.00
"Enamelite" (Emaillite) and special varnishes for airplanes	200,000.00
Alcohol for photography	50,000.00
Photograph products	400,000.00
Total	6,850,000.00

Memorandum.—Gasoline, various fuels furnished by the "Intendance." Electrical matériel (front) furnished by "Signal Corps" (Projecteurs).

General expenses and miscellaneous.

Stationery and office supplies	30,000.00
Pay (salary) of subaltern personnel	650,000.00
Pay of flying personnel	2,000,000.00
Upkeep of installations	35,000.00
Rental of airdromes, damages through bad landings, telephone service, cost of experiments, studies, purchases of new matériel for testing purposes	25,000.00
	2,740,000.00
Total francs	48,350,000.00

TRAINING PLANES (AVIONS D'ECOLE).

The training planes were all of French or British origin and were sent direct from French or British centers to Juvisy. The planes which were unsuitable for use at the front were repaired and overhauled at Calais, and sent to Juvisy by air or in cases.

The school maintained extensive repair shops. Most of the repairs were made in these shops, except major repairs which were made at Calais. The Calais services sent a great deal of reserve matériel to Juvisy. The Calais services manufactured this matériel themselves because of the difficulty in procuring the necessary reserves of spare parts for training planes.

BELGIAN MILITARY BALLOONING (AEROSTATION).

ORGANIZATION OF THE BALLOON SERVICE.

1. On a war footing this service consisted of:

a) A staff and technical direction. The latter made technical studies, supplied the Balloon Service with whatever was needed for its operation, and maintained the standards of the service up to latest developments.

The Commandant of the Balloon Service was at the same time the technical director. The personnel of the service consisted of:

b) Three companies, each serving two balloons.

c) A meteorological service, attached to the staff, and whose duty it was to furnish necessary meteorological data to all of the organizations of the Army.

d) The balloon park (parc d'aérostation) formed part of the "Services of the Rear" and functioned at the base. This organization maintained shops and depots and was responsible for the upkeep and repair of balloon matériel; the supply of special matériel and equipment to the units in the field; the construction of special equipment, and the making of tests and experiments pertaining to balloon matériel.

e) A carrier pigeon service.

2. Each company was composed of the personnel indicated in the tables of organization, which gives the composition of a motorized company.

Two of the companies were provided with motor transportation; the third was mounted (horses). The composition of the mounted company was almost the same as that of the motorized companies.

The group of observers was under the orders of an artillery officer who was thoroughly qualified in all matters pertaining to observation.

3. The matériel of each company comprised:

a) Three ballons, complete, with all accessories for the proper operation of the service. One of these was held in reserve to replace any balloon which might be either completely or temporarily put out of commission, as well as three "gazometer balloons" (balloons carrying a reserve of gas and which do not ascend).

Each balloon, plus one "gazometer balloon," with all matériel and equipment required for inflation of the balloon, was transported on a 2-ton truck with trailer attached.

b) Two windlasses, equipped with accessories and having a spare cable.

c) A mobile gas-works carried on two wagons.

d) Two 2-ton trucks with trailers, for the transport of the chemicals required for the manufacture of 2,400 cubic meters of hydrogen gas.

e) One 2-ton baggage truck with trailer.

f) One 1-ton or ¾-ton truck for the transport of the telephone material and for the maintenance and laying of lines.

g) One 1-ton or ¾-ton truck for the transport of rations or kitchen equipment, etc.

h) A trailer-model field-kitchen.

i) An "office-car" which, during movements, was to serve as an office for the observers on duty on the ground and which was also used as a telephone "central."

j) A passenger-car.

In addition thereto, a windlass and a gas-works were kept in reserve at the headquarters of the Balloon Service.

BRIEF HISTORY OF THE CAMPAIGN.

In 1914, the service provided for the operation of four aeronautical stations of one balloon each: one at Liège, one at Namur, and two at Antwerp.

Balloon parks, which included permanent installations for manufacturing and compressing gas and the matériel for each section, existed in each of these strongholds.

The mobilization of the Balloon Service was accomplished normally.

On the 3rd of August, the balloons were ready to be inflated at Liège and Namur. At Liège, the balloon was inflated in the Barchon–Charday Sector on August 4th. This balloon effected several ascensions and made a few observations. The system of telephone liaison, however, left much to be desired. The rapidity of events and the retreat did not permit the saving of the matériel.

At Namur, circumstances rendered inflation of the balloon impossible and the matériel had to be destroyed so as not to fall into the hands of the Germans.

At Antwerp, the first balloon section effected ascensions in the Third Sector, from September 28th to October 6th. Numerous observations were made, but unsatisfactory telephone liaison did not

allow the service to produce the best results. Part of the matériel was lost during the retreat.

The second balloon section had received orders to make ascensions in the Fourth Sector when the order for the retreat was given. All its matériel was saved and the permanent installations were destroyed.

However, the Balloon Service was completely disorganized after the retreat. Manufacturing or compressing apparatus was nonexistant and there remained but one windlass and two balloon envelopes (gas bags).

The Balloon Service had to be reorganized along new lines and it was at that time that mobile gas-works were introduced. Prevailing difficulties were due to the fact that the French Balloon Service was in an undetermined state during this period, while the British Balloon Service did not exist. The matériel of the first balloon section was ready by the end of December 1914 and, on January 15, 1915, this section left for the front and occupied an emplacement at Forthem. On May 15th this balloon was transferred to Linde-Pollinchove.

On May 15th, the second balloon section was sent to the front, at Kruisse-Abeele.

During 1915, the Balloon Service located a large number of batteries and regulated numerous artillery actions, particularly for the batteries firing against the Predikboom battery which was bombarding Dunkerque.

In the spring of 1916, General Headquarters decided to organize a third balloon section, which was placed in service at Eikhoeck on August 15th, and this section replaced a French balloon which had been ascending on this emplacement since 1915.

In the early part of 1916, the first motor windlasses were put into operation and in October the first "Caquot" windlass was employed. In August 1916, the mobile motorized gas-works were used for the first time. During the same year the Balloon Service located many batteries and carried out numerous artillery adjustments. During the winter of 1916–1917, it was decided to create a fourth balloon section. This section arrived at the front, April 1, 1917, and was stationed at Westvletteren.

At the time of the Flanders offensive, in July 1917, the emplacements of the balloon sections were changed.

There was a balloon at Zandekemolen, one at Kruisse-Abeele, one at Forthem, and one at Zavelhoeck. There were also two French balloons at Zavelhoeck. The emplacements to the south of the Yser were occupied by French and British balloons.

On October 23, 1917, at the close of this offensive, the Kruisse-Abeele balloon was sent south to Oostvletteren (Lion Belge).

During the same year the "Delahaye–1916" windlasses were put into service, as well as the "R–type" balloons and the "Caquot type" gas-works.

During the actions in April–May, in the southern sector, and in liaison with the British (attacks of Wytschaete and Messines), the artillery fire adjusted by balloon observers attained considerable importance. The Flanders offensive also enabled the Balloon Service to effect numerous and most profitable observations.

Toward the end of 1917, it was decided to increase the number of balloons to six by creating three double companies.

On March 21, 1918, the two new balloons were in operation. There were then one balloon at Steenkerke, (a little later at Furnes), one at Zandekemolen, one at Forthem, one at Zavelhoeck, one at Oostvletteren, and one at Lion Belge.

After the taking over of the southern sector by the Belgians, the Oostvletteren balloon took station near Elverdinghe.

In September 1918, in view of the forthcoming offensive, six French balloons were assigned to the Belgian Army. The emplacements occupied at the beginning were as follows:

Balloon No. 2 Belgian Kruisse-Abeele	2 & 5th Army Divisions (D. A.)
Balloon No. 5 Belgian Forthem	Heavy Artillery
Balloon No. 85 French Zavelhoeck	4th Army Division (D. A.)
Balloon No. 94 French Loo	Northern group
Balloon No. 62 French Fintelle-Turkeyen	Northern group
Balloon No. 73 French Oostvletteren	Northern group
Balloon No. 3 Belgian Lion Belge	Central group
Balloon No. 6 Belgian Noordhoeck	Central group
Balloon No. 70 French Woesten	Central group
Balloon No. 1 Belgian Elverdinghe	Southern group
Balloon No. 4 South of Elverdinghe	Southern group
Balloon No. 77 French Brielen	Southern group

Thereafter the balloons followed the advance of the troops.

SEARCH LIGHTS (PROJECTEURS).

Before the war search lights were only used in the fortresses and in the coast defense service.

In 1914, special units were organized for the fortresses of Liège and Namur. After the retreat to the Yser, in the fall of 1914, the Search Light Service ceased to exist. In 1915, it was reorganized and one platoon was assigned to each army division, each platoon being supplied with two 90 cm. and 60 cm. searchlights, three 30 cm., and twenty 15 cm. searchlights.

In 1916, a search light unit for General Headquarters was organized and equipped with six 90 cm. search lights.

In 1918, this service was reorganized and the reorganization was based on reduction of personnel and elimination of apparatus least

used. The divisional search light platoons were done away with and two 15 cm. search lights, for use in special cases, were assigned to the engineer companies attached to each infantry division.

The "Searchlight Battalion" of the Army consisted of two search light companies and one company of electricians. Each search light company had ten search lights, varying in diameter from 60 cm. to 1½ meters in diameter. The 30 cm. search lights no longer formed part of the equipment after the reorganization.

CHAPTER XVII.

SECTION IV.

AVIATION AND BALLOON SERVICES (ITALIAN).

THE AIR SERVICE AT THE OUTBREAK OF THE WAR.

In May 1915, the Air Service included:

1. Airships (dirigibles, etc.);
2. Airplanes;
3. Military balloons;
4. A meteorological service;
5. A photographic service;
6. A radiotelegraph (wireless) service;
7. An aviation ordnance service;
8. Aeronautical supervision;
9. A motor transport service.

These branches were presided over by the General Administration of the Military Aviation at the War Office, in conjunction with the Aviation Inspection of the Admiralty.

1. For *airships and dirigibles* there were:

a) An Aeronautical Headquarters (airship and balloon personnel);

b) A Central Aeronautical Institute, charged with the technical study of dirigibles and military balloons;

c) An Air Service manufacturing establishment, for the design and construction of airships and balloons;

d) A battalion of airship personnel, for navigation purposes and for the operation of air stations. The commands of the air stations were responsible for the supply of spare parts and accessories, as well as for the supply of hydrogen gas, (which was produced by two national laboratories).

e) Hangars (Aeroscali) 7, of which two belonged to the Royal Navy;

f) Airships (9).

2. *For airplanes there were:*

a) An Aviation Headquarters (aviation personnel);

b) A battalion of aviators, composed of thirteen squadrons, (8 squadrons were mobilized at the beginning of the war.)

c) A battalion school for aviators, consisting of 8 schools;

d) A technical aviation administration, charged with the preparation of specifications and testing of machines, motors, propellers, etc.:

e) An aviation depot;

f) Three repair shops.

Italy possessed three factories for the manufacture of airplane motors, three for the construction of airplanes, and one for airplane propellers (eliche).

3. *Military balloons:* In addition to the aeronautical headquarters, the Central Aeronautical Institute, and the factories for the construction of airships and dirigibles, there were also:

a) A battalion of balloon personnel;

b) A group of artillery specialists, all concerned with the supply of hydrogen gas to balloons (dirigibles, etc.).

4. The *Meteorological Service* had:

a) An administrative office;

b) A meteorological section, (which formed part of the battalion of dirigible personnel).

c) Thirty-two meteorological stations.

Most of the material and equipment for this service were obtained commercially. Sounding balloons were manufactured by private plants.

5. The *Photographic Service* consisted of: a photographic section (which formed part of the battalion of dirigible personnel) subdivided into photographic and telephotographic squadrons, squadrons for the siege parks and laboratories attached to the air squadrons.

Technical equipment for this section was obtained by purchase from commercial establishments.

6. The *Aeronautical Radiotelegraph (Wireless) Service* was composed of a radiotelegraph section (which formed part of the airship personnel). This section maintained its own laboratories and obtained the necessary technical equipment commercially.

7. For the *Aviation Ordnance* there were:

a) An ordnance office (in conjunction with the technical aviation administration) charged with designing ordnance equipment for airplanes;

b) A detachment of aviation ordnance (which was attached to the Air Service manufacturing establishment), hcarged with the production and installation of armament on airships and dirigibles.

The ordnance office had recourse to private industries for the supply of necessary equipment, although the greater portion of these supplies were furnished by the Air Service manufacturing establishment, ordnance factories and the aerial artillery detachment.

8. For *aeronautical construction* there were:

a) A construction office (which formed part of the Air Service construction establishment), charged with drawing the plans for hangars etc., for airships and dirigibles;

b) A building office (attached to the Administration of Military Aviation) which provided for the construction of airplane sheds etc.

9. Insofar as the *Motor Transport of the Aviation Service* was concerned, this service was directed by its own office, in conjunction with the technical aviation administration. The motor transport office provided for the purchase or requisition of vehicles and coordinated the issue of vehicles, spare parts, and accessories to the squadrons.

DEVELOPMENT AND ORGANIZATION OF THE AIR SERVICE DURING THE WAR.

As a result of the rapid development of the Air Service during the war, it became necessary to reorganize and enlarge the administrative agencies and increase the number of factories and laboratories.

AVIATION.

(Chart 17, Chapter XVIII, Vol. I.)

To provide airplanes, balloons, etc., a *Technical Administration of Military Aviation* was established. This organization was directed by the General Air Service Administration at the War Office (the latter, in turn, was in close contact with the office of the Air Service at G. H. Q.). It established the Air Service programs, made contracts with manufacturers, prepared specifications and plans, conducted experiments, tested machines and motors, selected factories and assigned production orders.

In 1917, the Technical Administration was subdivided as follows: *Technical Administration of Military Aviation*, charged with the manufacture and testing of aviation ordnance, motors, machines, wireless telegraph apparatus and buildings, as well as the selection of personnel.

Supply Administration of Military Aviation (*rifornimenti*), for the procurement of supplies from the factories and distribution to the various Air Service units.

Administration for the Supply of Raw Materials for Military Aviation, with separate sections which maintained offices abroad for the acquisition of raw materials.

Administration of the Motor Transport Service, which procured and supplied all that pertained to the motor transport services of the aviation, such as motor trucks, passenger cars, etc.

Repair and Salvage Administration, for the repair and salvage of aviation matériel and equipment.

A Military Aviation Experimental Board, for the study and design of airplanes and motors and the examination of designs submitted to the board.

Urged on by necessity, Italy enlarged her existing factories for the construction of airplanes and the manufacture of airplane accessories. Moreover, certain plants were converted, others were assisted by the Government and the establishment of new factories was encouraged. At the date of the Armistice, Italy possessed 107 factories as compared with the 17 which were in existence at the end of 1915.

All factories operated to maximum capacity. In every important factory, the Technical Administration of Military Aviation maintained a technical office to control the work, test materials, and inspect the finished products.

The General Air Service Administration expanded steadily and in 1918, it became the *General Air Service Commissariat.*

At the same time, the office of the Air Service at G. H. Q. became the *Superior Command of the Air Service* and it directed supply activities and enlarged existing facilities for supply *in the war zone.* It established a storehouse for supplies in one of the central permanent camps and this establishment later became a general Air Service depot. This depot distributed aviation matériel to the advanced Air Service storehouses which supplied the squadrons.

The supplies for the schools were provided through detached sections, assisted by the Technical Administration of Military Aviation.

Dirigibles and airships constituted separate units by themselves. The hangars were located close to the main lines of communication, but sufficiently to the rear to avoid undue danger. The increasing needs of the Army and Navy resulted in the construction of some sixty airships which were provided, for the most part, by the *Administration of Aeronautical Construction*, particularly the gas bags (*involucri*). The balance of the construction was carried on in four large national factories which specialized in the manufacture of airship parts. Two establishments in Italy constructed airships completely.

An *Administration for the Supply of Hydrogen Gas*, was organized and regulated national production. In the armies, *Gas Supply Columns*, supplied the gas cylinders as well as the materials for the field gas generators.

All supplies for airships (spare parts, motors, gas materials, etc.) were forwarded to an advanced storehouse and from there they were distributed to the various airships. (Chart 18, Chapter XVIII, Vol. I.)

The establishment for the manufacture of Air Service Matériel provided the gas bags (involucri) for airships. During the war, it produced four hundred gas bags for observation balloons and six hundred for airships and dirigibles.

For the supply of the mobile units, hydrogen gas was sent to the gas supply columns, while other stores were concentrated in a central Air Service depot which supplied the various units direct.

The apparatus and instruments for the meteorological service were provided by the national industries. These supplies were under the control of the meteorological sections of the various stations, or of the administrative organ of the service at G. H. Q. Meteorological centers, for administrative and supply purposes, were established in Southern Italy, the Lower Adriatic and the Ionian Sea. (Chart 19, Chapter XVIII, Vol. I.)

On account of the augmentation in the number of air squadrons and air stations, the duties of the photographic service were increased and an advanced storehouse for photographic matériel was established to provide for the supply thereof (machines, plates, paper, chemicals). The various units were supplied from this advanced storehouse through the administration of the photographic service at G. H. Q. Most of the photographic matériel was produced by private national industries.

Recognizing the necessity for the employment of radiotelegraphy (wireless) in aviation, an Air Service radiotelegraph section was established at G. H. Q. The pre-war radiotelegraph section, which had not been mobilized, provided equipment, batteries, matériel. In 1917, the Air Service radiotelegraph organization was combined with the general radiotelegraph service of the Army. A central depot for radiotelegraph matériel issued the supplies to the army radiotelegraph sections and these, in turn, supplied the radiotelegraph stations and Air Service units.

As a result of the development of aerial warfare, the Aviation ordnance detachment became the *Administration of Aviation Ordnance*, with offices, laboratories and detached sections, which were charged with the manufacture of explosives and ordnance matériel for the Air Service. The aviation ordnance matériel was forwarded to a section of the central Air Service depot and from there it was sent to the advanced storehouses and squadrons. An officer was assigned by the Superior Command of the Air Service at G. H. Q., to co-ordinate the aviation ordnance supply service.

The progress of aerial warfare also brought about an increase in the number of Air Service camps and the enlargement of certain others (schools, camps for the organization of squadrons and camps for anti-aircraft units). All of these establishments, with the ex-

ception of the squadron camps, were located in the Zone of the Interior. The materials for the construction of these establishments were furnished, for the most part, by the national industries. The construction services were administered by the *Building Office of the Technical Administration*, which maintained sections in various large centers. In the Zone of the Armies this service was assisted by Air Service and Engineer units.

With the development of the air squadrons and aviation schools the *Motor Transport Service* of the Technical Administration of Military Aviation became successively, an autonomous territorial motor transport park, and, the *Administration of the Aviation Motor Transport Service.* This service consisted of motor transport platoons, located at a distance from each other, and operating in the centers of Air Service activities. It was charged with the supply of spare parts, materials and tires. The motor transport administration supplied the Air Service units with motor vehicles and furnished the motor transport platoons with necessary supplies.

In the Zone of the Armies, the "7th Mobilized Motor Transport Park" was responsible for the supply of machines and spare parts to the air squadrons.

Air Service organizations in the interior made contracts and purchases, examined and tested materials and sent them to the units in the field, generally by rail, except airplanes and dirigibles which were sent under their own power to their respective camps. These organizations provided supplies for the air squadrons, military balloons, and for all the field units.

The national resources supplied the greater portion of the materials required for Air Service construction, only certain finished products, such as harmonic steel wire, unsoldered steel tubes, lubricants (lubrificanti) etc., and certain raw materials, such as iron, aluminum, nickel, wood, etc. had to be imported from abroad.

In connection with the industrial mobilization, the *Air Service Committee* generally decided all legal and disciplinary questions concerning establishments engaged in aviation production but, in case of necessity, it appealed to the Central Industrial Mobilization Committee, at the Ministry of Arms and Munitions.

REPAIR OF AIR SERVICE MATÉRIEL.

Airplanes: In the Zone of the Armies, airplanes requiring extensive repairs were sent to the advanced storehouses and from there to the central Air Service depot. From the central depot, the planes were sent to one of the various repair establishments. Unserviceable matériel which could not be repaired was sent to storehouses in the interior, under the jurisdiction of the Air Service

salvage administration, where it was dismantled and all serviceable parts recovered.

However, the camp schools sent their unserviceable airplanes for repair to the nearest Air Service technical section or to the factories, in accordance with the instructions of the technical section.

The same methods were adopted for the repair of airplane motors.

Airships and dirigibles: Repairs to airships were made in their hangars by the local repair-shops. Airships which were no longer suitable for war service were sent, either by rail or under their own power, to the territorial hangars.

Balloons: Major repairs to the gas bags (*involucri*) were made either in the supply sections or by the gas supply columns.

Meteorological and photographic apparatus: This equipment was sent to the meteorological and photographic sections and was repaired there or sent to the manufacturers.

Radiotelegraphic apparatus: This matériel was sent, first to the radiotelegraphic section and afterwards to the central depot for radiotelegraphic matériel for necessary repairs.

Aviation ordnance: The artillery (ordnance) section of the central Air Service depot maintained an ordnance shop for minor repairs. Equipment requiring extensive repairs was sent to the Air Service artillery administration, which provided for the replacement and repair of the matériel, either direct or through the manufacturing establishments.

Motor vehicles: The "7th Mobilized Motor Transport Park" maintained its own repair shop, which provided for the repair and speedy return of motor transport matériel to service.

CHAPTER XVII.

SECTION V.

ORGANIZATION OF THE AIR SERVICE (AMERICAN).[1]

The Air Service, American Expeditionary Forces, was organized on the principle that the Air Service was an integral combat (and not a staff) arm of the Army, whose employment was always based on and combined with all other arms of the Army. The units of the Air Service were organized as integral parts of the divisions, army corps, armies, or G. H. Q. reserve, and were therefore commanded, in the full sense of the words, by the commanding generals of these large units, whose decisions were executed by their General Staff, the Air Service staff officers acting as technical advisors. The execution of the assigned task rested on the Air Service officer commanding the unit or units employed. The execution of the task did not rest upon the Chief of Air Service nor on any Air Service staff officer, except in the case of the unit under the direct command of the latter officers. The Air Service originated and suggested employment for its units but the final decision rested upon the general commanding (Chart 6, Chapter XVIII, Vol. I.)

Responsible to the Commander in Chief for the organization, training, material, equipment, methods, and all other matters affecting the efficiency of the Air Service, was the Chief of Air Service, A. E. F., whose official headquarters on November 11, 1918, was at G. H. Q., A. E. F. The Chief of Air Service, assisted by his Chief of Staff, Air Service, established all general policies, but for the administration of matters not affecting policies, there were two Assistant Chiefs of Air Service, one at the headquarters, S. O. S., and the other in Paris. There was also an Air Service representative in London charged with the responsibility for Air Service matters in Great Britain and Ireland, and an officer in Italy with similar duties.

The Paris office maintained liaison with the Allies and with the United States Navy. The Assistant Chief of Air Service at the headquarters, S. O. S., was charged with the keeping of personal records, with the supervision of training, with the administration of

[1] Prepared for the M. B. A. S. by the Chief of the Air Service, U. S. Army.

Air Service centers in the S. O. S., and with the supervision of the Balloon Division, Air Service, which maintained schools for training and centers for equipment and repair. The Assistant Chief of Air Service at Paris was in command of all Air Service personnel in that city. His most important duties were those connected with the supply of aviation material and he was responsible to the Chief of Air Service for the provision of the material and equipment necessary for the carrying out of the Air Service program. Under him were Air Service Sections making and supervising contracts with Allied and neutral governments and with individual concerns, and receiving, assembling and dispatching airplanes, engines and war material for all Air Service purposes secured from the United States, Allied countries and neutral territory; also a Technical Section, Night Bombardment Section and Aircraft Armament Section, the latter operating directly under the Chief of Ordnance, but in close accord with the Air Service.

The construction of Air Service projects was under the control of the Director of Construction and Forestry, but the Air Service was responsible for the selection of sites, the preparation and approval of plans, the necessary surveys and drawings, and for procuring the needed sanction of headquarters for the execution of each project.

Flying personnel was supplied directly to the zone of the advance from Air Service schools. Upon arrival in France, flying officers were sent to the Air Service concentration barracks at St. Maixent, from which point they were forwarded to the flying schools as rapidly as vacancies occurred. The First Air Depot, in the Advance Section, S. O. S., gave daily notice of the needs of the front. Based upon this information, officers ready for active flying service were ordered direct to the First Air Depot and from there were distributed to the units on the front as they were needed for replacement purposes.

All Air Service troops arriving in France passed through the Air Service concentration barracks at St. Maixent. The individuals were trade tested and assigned to units, which were formed in accordance with authorized tables of organization. The unit, as soon as organized, was moved for temporary duty to a training center or to some other Air Service activity in the S. O. S., where it could gain familiarity with its future duties. The units were then forwarded to the First Air Depot as soon as equipment and flying personnel were in readiness. Upon its arrival, it was reported to G–3 at G. H. Q., by whom it was later assigned to an army.

Aviation material was secured from two sources, European and American, and the supply system was built up accordingly. Aviation Acceptance Park No. 1, at Orly, received and dispatched

material from European sources, and Air Service Production Center No. 2, at Romorantin, assembled all airplanes and engines received from the United States and dispatched them to their destinations. From these two major centers, and also directly from factories in France, England, Italy, the United States, Spain and Switzerland, material of all sorts was shipped to air depots by rail, by motor, and by air. The air depots supplied the air parks, which in turn furnished supplies to the units actually operating against the enemy. The squadrons on the front were complete and self-sustained, but for material not carried by the squadron or for work which the squadron itself could not do, it applied to the air park, at which point was a limited quantity of spare parts for immediate needs and where facilities for making minor repairs and for the installation of new engines were maintained. Repair work which could not be done at the air parks was performed at air depots some 20 to 50 miles further to the rear. Major repairs, overhaul and rebuilding of engines, and salvage were carried on at Air Service Production Center No. 2, at Romorantin.

Air Service activities in Italy were confined to a small amount of training and a still smaller amount of operations on the Italian front.

Air Service activities in England were mainly concerned with the training of mechanics, in accordance with the agreement between the A. E. F., and the British, dated December 5, 1917, with the assembly of night bombardment "Handley-Page" airplanes from parts fabricated in the United States and shipped to England for assembly in compliance with the agreement of January 26, 1918, and with the training of American flying personnel, of which 216 were completely trained and sent for service with the R. A. F. in the field, 96 were sent to the American E. F., 20 were transferred for final training to France, and 60 were returned to the United States upon the signing of the Armistice.

THE SUPPLY SYSTEM OF THE AIR SERVICE, AMERICAN E. F.

Equipment and general materials for the development and maintenance of an Air Service functioning overseas being secured from two general sources—the home production base or factory, and the emergency base or foreign market—the supply system of the Air Service, A. E. F., was, therefore, developed on the basis of this fundamental partition in procurement. The organization and the apportionment of duties of the divisions of the Supply Section, Air Service, were a direct but gradual evolution of the demands of this dual source of equipment and were, therefore, the result of experience and immediate necessity. The elements of the supply system were

inter-related and devised to provide an orderly dispatch of materials from foreign markets and base ports, through acceptance parks and production centers, through reserve warehouses and base supply depots to air depots normally in the Zone of Advance, thence to Air Parks, and finally to the combatant units—service squadrons and balloon companies.

Items of Aeronautical Supply not furnished by A. S.—The material development of the Air Service was in some respects dependent upon important aid rendered by other arms. The Aircraft Armament Section, while acting in close liaison with the Supply Section of the Air Service, was under the direct control of the Chief Ordnance Officer. It was in full charge of the supply of aircraft armament. A large portion of radio supply work, as well as radio activity in the Air Service, was accomplished in close cooperation with the Signal Corps. After August 15, 1918, the Motor Transport was in charge of the procurement and allocation of transportation to the Air Service. The supply of building material and the construction of Air Service projects after December 30, 1917, was in the hands of the Director of Construction and Forestry of the Corps of Engineers. The uninterrupted supply of gasoline and lubricating oil was assured by the Quartermaster Corps. All gasoline was obtained from the United States and castor oil was procured largely from the French.

Some Principles Evolved From Past War.

U. S. AIR SERVICE.

A Combatant Arm and Staff Corps.—It must be remembered, in connection with any exposition of the supply system of the American Air Service, that this service is a combatant arm, in addition to being a staff corps. It meets the enemy in battle, and yet, is responsible for the procurement and distribution of its aeronautical material. This dual function necessarily exercised some influence in the development of an organization. Air Service supply, no less than Air Service operation, tactical and strategical, was an untried venture to the United States in 1917. Experiments were necessary, not all of which proved successful. Principles were adopted, discarded, modified or built upon, in accordance with their worth. The organization of Air Service supply as finally evolved is clearly illustrated in charts 7 to 13, Chapter XVIII, Volume I.

Supply System Must be Adequate in Scope.—In the midst of this lack of experience, however, certain axioms became clearly emphasized. It was found that the system of supply of an Air Service must be adequate in scope, in adaptability, in material facilities, and in personnel. To be adequate in scope, means that the scheme of

supply must possess a margin of capacity over and above that needed to meet the recognized program of development, otherwise it cannot survive the strain of emergency. Remedies are not possible over night and the inevitably high wastage in aeronautics demands uninterrupted replacements.

Adaptability Necessary.—Air Service supply must, in particular, be resourceful and adaptable to new conditions. The frequent change in aeronautical equipment and the development of new devices demand that constant experimentation be maintained and that speed characterize the production and delivery to schools and to the zone of operations of new and accepted types of material. The supply system must be prepared to manufacture or to secure in the open market any of the manifold commodities which it is called upon to furnish.

Expanse of S. A. Stations.—Material demands in an Air Service are essentially vast and comprehensive. Shops must be built and equipped for the acceptance, assembly, repair and dispatch of airplanes, engines, airships, balloons, miscellaneous equipment and accessories. There must be varied training centers, ample warehouses and forwarding facilities, and mobile stations in the zone of operations. Large amounts of construction work are essential in the development of an air program; Air Service installations are really industrial centers with damp-proof storage space, machine shops, aircraft repair shops, offices, barracks, and motor transport facilities. An Air Service center of any consequence must have good roads, rail trackage, subsoil drainage, sewage systems, water lines and water tanks, electric illuminations and other such equipment. All this is responsible for the formulation of extensive demands upon the Air Service's own system of supply.

Supreme Importance of Adequate Trained Personnel.—There should never be an undue fear of placing with the supply and instruction centers a large proportion of the soldiers of the Air Service. An undermanned service of supply is a vital handicap to the front. Above all is this true during the period of development of the rear, for it is impossible for an insufficient number of personnel to complete the construction of a station while unsatisfactorily accomplishing the production or training expected there. The presence of 10,000 additional soldiers at the Air Service supply and instruction centers in France in the early spring of 1918, would have advanced the program and status of the American Air Service on the front by approximately four months. More man power means little, however, save as a means to an end, for unless this personnel is sufficiently trained, trade-listed and properly allocated, the front will profit but little. There must be in the Services of Supply

a personnel commensurate with the industrial, technical, and transport enterprises which are the essentials of supply.

Office of Supply near Production Center.—An important axiom in connection with Air Service supply developed during the experience of the A. E. F. is that the office of the Chief of Supply should be in the section of the Services of Supply where the center of Air Service business is located, where is conducted the development and manufacture of aircraft, engines, spare parts, equipment and accessories. In no case should the direction of supply be so located that the conduct of the business of aeronautics be brought out of its normal channels for the convenience of the military organization. Quantity production of service airplanes, on a satisfactory basis, demands continual cooperation. If supply maintains its operating control at a distance from the business of aeronautics, valuable time must inevitably be lost in the dispatch of requisitions, in subsequent exchange of views, in the multiplication of correspondence, in the maintenance of an elaborate courier service and in the interchange of experimental types of equipment. These facts were proved during the spring of 1918, when the Supply Section of the Air Service, A. E. F., attempted, with costly results, a removal from Paris to Tours, France, although practically all French aviation manufacture, on which the Air Service, A. E. F., was most dependent, existed at and near Paris. This temporary removal delayed the Air Service program on the front by about two months. To this same axiom of Air Service supply is due also the fact that sufficient quantities and a proper quality of air material was not in all cases furnished from the United States, or only at the sacrifice of a period of time which spelled the difference between the superiority of that material and its mediocrity in comparison with newer equipment of the Allied or enemy forces.

OUTLINE OF SUPPLY STATIONS.

(Chart 8, Chapter XVIII, Vol. I.)

Base Ports.—The Air Service employed seven base ports, maintaining at each an Aviation clearance office with a comparatively small number of Air Service officers and soldiers engaged in the identification, record and dispatch of Air Service equipment. These ports were Bordeaux, Brest, Le Havre, Marseille, Nantes, Saint Nazaire and La Pallice. Airplanes were shipped from base ports to Production Center No. 2, Romorantin, spare engines and spare parts were shipped to either of two spare parts depots, general material went to one of three base supply depots, and balloon material was forwarded to the balloon supply depot at Romorantin.

Production Center for U. S. Supplies.—The production center (which should normally be combined with a base supply depot, the two being called a base air depot, in contrast to the air depot in the Zone of Advance) assembled, remodeled (if necessary), equipped, tested, and dispatched airplanes, and conducted salvage and repair of airplanes, engines, accessory equipment and balloons.

Receiving Stations and Acceptance Park for Foreign Market.—Foreign-made spare engines, equipment and accessories were tested for acceptance at the American depots or warehouses where they first arrived, while airplanes purchased in Europe were tested and accepted or rejected, first, at the foreign field and again at American Aviation Acceptance Park No. 1, Orly. From this point foreign-made airplanes, after being completely equipped, were sent by air to schools and to the Zone of Advance. There were four base supply depots. To them was sent, from home and foreign markets, general Air Service material.

Base Supply Depots.—Supply Depot No. 1, at Clichy, near Paris, was largely a warehouse center for the temporary storage and forwarding of materials. It was also a balloon reception depot. Supply Depot No. 2, at Tours, was a small post which functioned normally in the receipt and dispatch, on requisition, of balloon and photographic supplies. Supply Depot No. 3, at Romorantin, was the general base supply depot for all classes of air materials; in conjunction with it, a balloon supply depot was maintained. An advance supply depot existed at Is-sur-Tille, the Army's regulation station, for the housing of surplus equipment and the supply of air depots and units of general equipment.

Spare Parts Depots.—A spare part receiving station was conducted in conjunction with the French Air Service at Nanterre, near Paris, while Spare Parts Depot No. 1, was developed at Châtenay a few kilometers north of Paris, for the concentration of spare engines and parts for airplanes and engines. Until Châtenay was completely equipped as a spare parts depot, Spare Parts Depot No. 2, at Romorantin, supplied parts for D. H. 4, airplanes and Liberty engines.

Air Depots.—Four air depots were operated, of which three were in the Zone of Advance, and the first was the largest and most important. These air depots concentrated, for issue and supply to organizations on the front, all types of Air Service material, and performed major airplane repair and minor engine repair. The 1st Air Depot was at Colombey-les-Belles, the 2nd at Latrecey, the 3rd at Orly, near Paris (being employed for the Château-Thierry offensive, and then in the Zone of Advance) and the 4th at Vinets, These were the final units of supply in any way under the Services of Supply. Other air depots were planned for construction: one

near Brabant-le-Roi, to serve the Meuse-Argonne sector; one at Ravennefontaines or near Charmes, to supply a proposed offensive in the Nomeny-Baccarat sector and one near Luxeuil, to supply the needs of a proposed offensive in the Belfort sector. Only the air parks intervened between the air depots and the service squadrons and balloon companies on the line.

Air Parks.—These air parks were mobile stations functioning under the army Air Service commander. Located near a communication center, thus attended to the immediate wants of the combatant organizations.

MOVEMENT OF AIRPLANES.

(Chart 7, Chapter XVIII, Vol. I.)

Comparative Source of Airplanes.—The French Government was the most prolific source of airplanes for the American Air Service overseas, furnishing 4,886 machines of all types, out of a total of 6,688 received before December 31, 1918. The United States supplied 1,443, England 291 and Italy 68. All airplanes from the United States were of one type, an American adaptation of the English de Haviland 4, equipped with the 450 H. P., 12 cylinder, Liberty engine, although normally an observation machine, the DH–4, was also successfully adopted for day bombardment. By the end of October, 1918, it was being received in quantities more than sufficient to supply squadrons available for assignment to the armies.

Production Center At Romorantin Assembles and Equips American-made Airplanes.—Airplanes made in the United States were forwarded from the base ports to Air Service Production Center No. 2, Romorantin. Any necessary alterations having been made, these airplanes were assembled and, in accordance with the use to which they were to be put, equipped with instruments, armament, bomb sights and carriers, radio, photographic equipment and all proper accessories. In this form, they were turned over to the acceptance field at Romorantin; responsibility by the Production and Maintenance Division of the Supply Section then ceased and was assumed by the Airplane and Motor Division. Having reached the acceptance field, airplanes with their equipment were given a thorough ground inspection and air test. For their dispatch to schools or to the Zone of Advance, a pool of ferry pilots was maintained.

Acceptance Field at Orly equips and forwards foreign-made airplanes.—Airplanes purchased from foreign governments, including France, England and Italy, were received at the American aviation acceptance park, at Orly, near Paris. The only exceptions to this scheme consisted of airplanes received before Orly was established and of a very few Italian machines sent to Romorantin. Before

being sent to Orly, airplanes manufactured by the Allies were inspected and flight-tested at the factories where produced. This was accomplished by the Airplane and Motor Division which sent out test groups, consisting of a pilot, an inspector, an airplane mechanic, an engine mechanic, and a clerk. From these foreign centers, airplanes were flown to Orly, where they were subjected to a second series of exhaustive examinations and tests. It was frequently impossible for the Allies to supply the United States with complete airplanes; at Orly it was necessary, therefore, to install instruments and equipment based on the type and future use of each machine. On some occasions, airplanes were forwarded from Romorantin to Orly for such accessory equipment. Not more than two or three days normally elapsed between the arrival of a machine at Orly and its dispatch, and although it was expected that but 25 could pass through the successive stages each day, as many as 91 were ferried from the acceptance park within 24 hours. For delivering airplanes, a quota of ferry pilots was maintained, as at Romorantin. Both the acceptance park and the acceptance field at Romorantin kept complete records of the receipt, dispatch, and equipment of machines, forwarding this information daily to the Airplane and Motor Division for central statistical record.

Airplanes were flown to flying schools direct from Romorantin and Orly.

Air Depot Distributes direct to Combatant Units.—Airplanes for the Zone of Advance were delivered from these two centers to an air depot, each of which maintained a flying field for the purpose of receiving and dispatching airplanes. To facilitate the ferrying of machines, three emergency landing fields were authorized—construction, however, had not been begun before the Armistice. On the receipt of a machine at an air depot, it was inspected, put in proper condition if damaged in ferrying, completely equipped in any respect which had not been accomplished in the rear, and stored ready for dispatch by air direct to the combatant units.

Relation of Advance Air Depot to Movement of Airplanes.—The advance air depot, first at Vavincourt, later at Béthonne, became an important station for the receipt and assignment of airplanes. Most of the machines passing through this advance depot were sent from the 5th Air Depot, Vinets, although in some emergency cases, they were supplied from the stock at Colombey-les-Belles.

Air Depot for Night Bombardment.—To supply units to be placed on the front in accordance with the American "Multi-Engine night bombardment" program, the 2nd Air Depot at Latrecey was established. The first night bombardment squadron reached the front only a few days before the Armistice and Latrecey, therefore, did not begin active functioning.

MOVEMENT OF SPARE PARTS.

(Chart 11, Chapter XVIII, Vol. I.)

Continued Shortage of Spare Parts.—As a general principle, spare parts were obtained from the same government that furnished the finished airplanes and engines. This item in Air Service supply was always a most complicated one and it cannot be said that there was ever any satisfactory reserve of parts on hand, this in spite of continued effort in that direction. As a portion of the system of base supply depots operated by the Material Division, Supply Section, the Airplanes and Motor Division maintained at Châtenay and Romorantin two spare parts depots, which were in reality but specialized base supply depots. Spare Parts Depot No. 1, Châtenay, was developed after experience had shown the necessity of concentrating all spares at one point, conveniently located with reference both to the air depots and to the sources of supply. Spare Parts Depot No. 2, Romorantin, stored and distributed spare parts for American-built airplanes and engines until Châtenay was able to include all items of this nature. Spares were received at these depots by rail and by motor truck and dispatched by the same means.

Schools, the acceptance park at Orly, and the production center at Romorantin, were supplied direct from these two depots.

Spare Parts For Zone of Advance.—In the Zone of Advance, parts were received at air depots and from them forwarded through air parks to operating units. The advance air depot, Béhonne, served for spares, as it did for airplanes and general supplies (as an intermediate distributing station between the air depots and the air parks. A plan not consummated before the Armistice provided that the 5th Air Depot, Vinets, be stocked with large quantities of spare parts for the immediate supply of squadrons on the front.

MOVEMENT OF GENERAL SUPPLIES.

(Chart 10, Chapter XVIII, Vol. I.)

Sources and Immediate Destination of General Supplies.—From the United States and five countries in Europe, general aeronautical supplies were procured for the Air Service. These countries were France, England, Italy, Spain and Switzerland. Material from all of these sources was sent to Supply Depots No. 1, Clichy, and No. 3, Romorantin. Some supplies from France and the United States were shipped to the smaller Supply Depot No. 2, Tours, while still others from France, the United States and England, were forwarded direct to the advance supply depot, Is-sur-Tille, a station intermediate between the rear and the front serving for overflow storage

and forwarding its stocks eventually to the air depots, air parks or direct to the combatant organizations.

Flying schools in the S. O. S. were supplied from the three supply depots, while the acceptance park at Orly and the production center at Romorantin received general material equally from the two supply depots at Clichy and Romorantin.

Air Depots the Distributing Base for Zone of Advance.—With the exception of that equipment shipped from Is-sur-Tille to air parks and squadrons, all general supplies for the Zone of Advance passed through an air depot to an air park, thence to the squadron. Three air depots were in operation at the time of the Armistice, but of the three, Colombey-les-Belles alone was functioning normally. Latrecey had just begun to operate, designed as it was to serve the American night bombardment program. Vinets had not been stocked with most general supplies, although it was handling large quantities of gasoline and oil. Colombey-les-Belles, however, had been in operation many months; on November 11, 1918, it was receiving, storing, and forwarding practically all the general supplies needed by the Air Service with the armies. Although admirably situated in the geographical center of the American sector, as it existed in the summer of 1918, Colombey eventually became inconveniently separated from the units operating between the Meuse and the Argonne. An advance air depot was, therefore, established at Béhonne (temporarily at Vavincourt). Supplies from Colombey-les-Belles and from Vinets were sent to air parks, either direct or through this advance air depot.

MOVEMENT OF BALLOON SUPPLY.

(Chart 12, Chapter XVIII, Vol. I.)

Balloon Section Closely Reduced to Supply Section.—Balloon supplies were obtained from France and from the United States. Commercial firms in France and the French Government provided for the Balloon Section of the Air Service until the United States was able to send balloons and accessory equipment overseas. The Balloon Section secured all of its equipment through the Supply Section as an intermediary. Contracts and purchases in France and requisitions on the United States were originated by the Balloon Section, but were accomplished through the usual agencies of the Supply Section. Space for balloon material was allotted at various Air Service base supply depots, air depots and air parks. Balloon supply officers utilized the same bill of lading and car tracer service as was provided for aviation supplies. The Balloon Section did not undertake to receive and to supply from its depots, arma-

ment, motor transportation and Quartermaster supplies, but arranged to have the proper service deliver these to the balloon company on its arrival at its first station, France, and at the First Air Depot, Zone of Advance.

Only Technical Equipment Carried by Companies to Zone of Advance.—Material from French sources was delivered to the Air Service at the balloon reception depot, Clichy, near Paris. This material and also that from the United States was sent from Clichy to the balloon supply depot at Romorantin, where it was made up into unit company equipment and delivered by convoy to each company on its arrival at a training center or in the Zone of Advance, if that was its first station. On the departure of a balloon company to the front, after service in the S. O. S., only its technical equipment was carried with it: each balloon firing center was allotted a certain amount of equipment which remained with it and was not taken by any company to the Zone of Advance.

Balloon Department At First Air Depot.—All balloon supplies for the Zone of Advance, both the initial equipment for companies and replacement material, was sent direct from the balloon supply depot, Romorantin, to the First Air Depot, Colombey-les-Belles. The First Air Depot, Colombey-les-Belles, maintained a balloon officer in charge of a Balloon Department and functioned for balloon supplies exactly as it did for aviation supplies. From the air depot material was shipped direct to balloon companies in operation. In order to facilitate supply and particularly in order to establish a hydrogen dump comparatively near the front, a balloon field distributing station was opened at Ippécourt.

Advance Balloon Supply Depot.—At the time of the Armistice, Is-sur-Tille, which had been a balloon repair depot, was being converted into an advance supply depot for balloon material, in order not only to have a stock of balloons and equipment nearer the front than Romorantin, but to provide a special building where balloons and parachutes might occasionally be unrolled, aired, dried and inspected.

MOVEMENT OF PHOTOGRAPHIC SUPPLY.

(Chart 13, Chapter XVIII, Vol. I.)

The Photographic Section was located at Tours, France, but maintained a Supply Division at Paris, in conjunction with the Supply Section. Photographic supplies were received from France, the United States and England, the proportion being in the order named. All such material was delivered at Air Service Supply Depot No. 1, Clichy, a suburb of Paris. Throughout the period of the A. E. F., this depot was the main distributing base of the Photographic

Section. In June, 1918, however, the possibility of the fall of Paris and the continual bombardment of Paris necessitated the organization of Air Service Supply Depot No. 2, Tours, to which was shipped a large portion of the photographic stock on hand.

From both of these depots materials were dispatched to schools and laboratories in the S. O. S., to the production center at Ramorantin and to the acceptance park at Orly, for equipping and repairing American and foreign-made airplanes. Equipment for the Zone of Advance was sent from the two supply depots to the First Air Depot. Colombey-les-Belles, from where distribution was made to the photographic sections with the armies, whether direct or through air parks, and to base laboratories and training centers in the Zone of Advance.

Requisitions for material were made direct from centers of the S. O. S., and from the First Air Depot to the Photographic Supply Division Paris.

ROUTING OF REQUISITIONS.

(Chart 9, Chapter XVIII, Vol. I.)

Requisitions for Airplanes.—Requisitions for airplanes passed from the combatant squadron through the group supply officer to the chief of Air Service of the army, who forwarded such requisitions as were approved to the air depot. If the necessary airplanes were on hand at the latter station, pilots from the squadron secured them and flew them direct to their organization. If no such airplanes were available, the requisitions were sent to headquarters of the Supply Section and were then filled from the acceptance park at Orly or from the production center at Romorantin.

Requisitions for Spare Parts and Spare Engines.—Requisitions for spare parts and spare engines did not pass through the chief of Air Service of the army, but were sent from the squadron through the group supply officer to an air park, which filled the request or forwarded it to an air depot. Here, also the requisition was completed from stock on hand, if possible, if not, it was forwarded to headquarters, Supply Section, which shipped material from either of the two spare parts depots at Châtenay or Romorantin.

Requisitions for General Material.—Requisitions for general material followed channels similar to those for spare parts, passing from the squadron to the group supply officer, air park, and air depot to headquarters, Supply Section, which in turn forwarded it for approval to one of the three supply depots or to one of the two spare parts depots. Emergency requisitions which could not be met at the air depot were frequently sent from that station to the Advance Supply Depot, Is-sur-Tille. Requisitions for special

material passed from the air depot to the Air Service supply officer at General Headquarters, who forwarded if approved.

Requisitions for Balloon Supplies.—Requisitions for balloon supplies passed through channels similar to those of requisitions for heavier-than-air material, although the balloon supply system was administered by special balloon personnel. Companies in the S. O. S. made requisitions direct upon the equipment officer of the Balloon Section, and shipments were made direct from the balloon supply depot, Romorantin. Requisitions from balloon companies in the Zone of Advance, with approval of the balloon company commander, passed through the Advance Balloon Depot, Ippécourt, or direct to the First Air Depot. Telephone orders from operating companies were permitted in order to facilitate and hasten the arrival of equipment. No requisitions from balloon companies in the Zone of Advance were made direct to the equipment officer of the Balloon Section. As stocks in the advance balloon depot became depleted, the local balloon supply officer called directly upon the air depot for replenishment. The balloon supply officer of the air depot submitted requisitions to the equipment officer for stocks in accordance with estimates based on future requirements. Such requisitions were filled usually from the balloon supply depot, Romorantin, but also in case of necessity from the balloon stock of the French Government or by means of local purchases.

Salvage and Repair.—The principles on which the system of salvage and repair were based were determined by harmonizing two conflicting forces. Naturally, it was essential to conduct salvage and repair as close to the front as possible, in order to speed up this work and in order to save motor and rail transportation; on the other hand, salvage and repair required quite permanent installations and from a military viewpoint it would have been impossible to permit such plants close to the lines. The air park, therefore, was permitted to conduct only the minor repairs as their own equipment permitted. The air depot conducted the major airplane repair and minor engine repair. Engines, being of small bulk, were forwarded to Air Service Production Center No. 2, Romorantin, for major repair, totally crashed airplanes in many cases were also forwarded to this center, which was capable of manufacturing new machines and new engines from spare parts and salvaged material. The 3rd Aviation Instruction Center, Issoudun, the 2nd Aviation Instruction Center, Tours, and the 7th Aviation Instruction Center, Clermont-Ferrand, possessed machine shops and airplanes and engine repair shops, where they did much of their own work, but all schools likewise depended upon Romorantin, either in whole or in part, for the salvage and repair arising from their operations.

AIR SERVICE A. E. F.

SUPPLY STATIONS IN FRANCE.

1917–1918.

BÉHONNE, Meuse:
- Advance Air Depot (Sept. 21, 1918, —)

BORDEAUX, Gironde:
- Aviation Clearance Office, Base Section, No. 2.

BREST, Finistère:
- Aviation Clearance Office, Base Section, No. 5.

CHÂTENAY, Seine-et-Oise:
- Spare Parts Depot No. 1.

CLICHY-sous-BOIS, Seine-et-Oise:
- Supply Depot No. 1
- Balloon Reception Depot
- Photographic Supply Depot

COLOMBEY-les-BELLES, Meurthe-et-Moselle:
- First Air Depot
- Balloon Depot

COURBEVOIE, Seine:
- Armament Factory

DIJON, Côte d'Or:
- Railhead and Storage Depot

IPPÉCOURT, Meuse:
- Balloon Field Distributing Station.

IS-sur-TILLE, Côte d'Or:
- Advance Supply Depot
- Advance Balloon Supply Depot
- Balloon Repair Depot (April, 1918, to October 31, 1918)

La PALLICE, Charente-Inférieure:
- Aviation Clearance Office, Base Section, No. 7.

LATRÉCY, Haute-Marne:
- Second Air Depot

Le HAVRE, Seine-Inférieure:
- Aviation Clearance Office, Base Section, No. 4

MARSEILLE, Bouches-du Rhône:
- Aviation Clearance Office, Base Section, No. 6

NANTERRE, Seine:
- Spare Parts Receiving Station

NANTES, Loire-Inférieure:
- Aviation Clearance Office, Base Section, No. 1

ORLY, Seine:
- American Aviation Acceptance Park, No. 1
- Fourth Air Depot
- Technical Test Field
- Photographic Experimental Laboratory
- Aircraft Armament Experimental Field.

PARIS, Seine:
- Aircraft Armament Depot, 10 Rue Huyghenas

ROMORANTIN, Loire-et-Cher:
- Air Service Production Center No. 2
- Acceptance Field
- Supply Depot No. 3
- Spare Parts Depot No. 2
- Balloon Supply Depot
- Balloon Repair Depot

ST. NAZAIRE, Loire-Inférieure:
- Aviation Clearance Office, Base Section, No. 1

TOURS, Indre-et-Loire:
- Supply Depot No. 2
- Photographic Supply Depot.

VAVINCOURT, Meuse:
- Advance Air Depot (Sept. 6–20, 1918).

VINETS, Aube:
- Fifth Air Depot.

CHAPTER XVIII.

SECTION I.

TANKS (BRITISH).[1]

REPAIR AND MAINTENANCE.

1. GENERAL DEFINITION.

The increasing use of petrol (gasoline) driven machines for Army purposes makes it advisable that the whole question of their repair and maintenance in the field should be closely examined in order that we may arrive at the most efficient organization to carry out this work. During the war the rapid growth in the use of motor lorries, Holt tractors, tanks and motor bicycles resulted in the springing up of a large number of repair organizations, each to deal with its own particular class of machine. The work done in the field may be divided under two headings: repair and maintenance.

Repair may be defined as the mending of anything broken or damaged, while maintenance may be defined as the replacing of damaged or broken units by new ones. It is most important in a consideration of the problems involved that a clear understanding should be arrived at as to the difference between the functions of repair and maintenance.

2. EXPERIENCE OF THE TANK CORPS.

Generally speaking, the experience of the engineering side of the Tank Corps during a period of two years has been that the most efficient organization is:

(*a*) No repairs to be carried out in the field (i. e. with units).

(*b*) All maintenance to be carried out by the crews of the machines themselves.

When the Tank Corps was first formed, each company of tanks was provided with its own workshop, and this system lasted throughout the year 1916. At the end of 1916, company workshops were abolished and battalion workshops were formed. Towards the end of 1917, after long consideration had been given to the question,

[1] Prepared for the M. B. A. S. by Col. C. H. Gay of the Quartermaster General's Office, British G. H. Q.

battalion workshops were abolished, or merged into brigade workshops, while a small number of skilled workshop men were left with each company. In 1918, it was realized that the gradual withdrawal of special workshop facilities back from the company organization to the brigade had resulted in a considerable improvement in the skill and ability of the tank crews themselves in the maintenance of their tanks. It was decided, therefore, to go one step further and not only withdraw all brigade workshops into a central organization (i. e., the central workshops), but also to withdraw the special workshop men from the companies, while tank crews themselves were made entirely responsible for the maintenance of their tanks.

In this way it was possible to draw a clear line between maintenance (i. e., the replacing of damaged parts, which was done entirely by the crews) and repairs (i. e., the mending of broken parts, which was done entirely by the central workshops). The argument is frequently heard that the man who uses the machine should be able to repair it, and that, if all repair work is done by a different organization from that which actually fights the machine, there will be a serious loss of mechanical efficiency. This idea is to a large extent based upon a misconception of the difference between the functions of repair and maintenance. On the contrary it has been found in the Tank Corps that the engineering efficiency of the crews has been increased some hundreds per cent since the workshops were withdrawn from the units, and the crews themselves were made responsible for the maintenance of their machines. It is found necessary, however, in carrying out this system, that stores and spare parts should be readily available in the field, in order that broken and damaged parts may be quickly obtained for replacement by the crew.

3. CENTRALIZATION OF REPAIRS.

One very great advantage of this centralization of repair work is the considerable saving effected in man-power by employing all skilled men exclusively on some particular job. As an example, broken unions of petrol pipes commonly occur in all petrol engines, and if a small unit workshop exists, the brazing out and repair of such broken unions can be carried out there. In order to do this a coppersmith must be kept at the unit workshop, and only part of his time will be employed in this work of brazing petrol unions. If now, however, we abolish the unit workshops, and all broken units, from every unit, are sent back to a central workshops for repair there is sufficient amount of work of this description to keep one man, or possibly two or three men, fully employed all their time.

These men become absolute experts in brazing broken unions and before very long can do in a few minutes a job of this sort which

would take a coppersmith with the unit workshop considerably longer.

Similarly in the case of a bolt with a damaged screw thread; this can certainly be repaired by the unit workshop if the necessary machine is available, but this is a much more extravagant method than bringing all bolts with damaged screw threads back to a central workshops where one man does nothing but mend them all day. In this centralization of repair work, therefore, we find a very great economy in the man-power and machinery required for a given amount of repair work.

4. MECHANICAL ENGINEERING DEPARTMENT.

We had a small workshop responsible for the repair of Holt "caterpillars," another workshop responsible for the repair of motor lorries, another workshop which worked principally on the repair of R. E. machines, such as petrol pumps, electric motors, etc., while we also had a separate organization which dealt with tank repairs. This was much the same system as that of the veterinary work of the Army before a special Army Veterinary Corps was formed in the year 1903. Every unit had its regimental sick lines and its small veterinary organization to deal with sick and wounded horses. This system was abolished by the formation of the Army Veterinary Department, and thereafter the mobile veterinary section with a division dealt with all damaged horses of that division, whether they came from the gunners, the Infantry, or the Army Service Corps (A. S. C.)

It is suggested that the repair work of petrol engine machines with the Army should be centralized on similar lines. It is suggested that there should be a separate mechanical engineering department responsible for the repair of all petrol machinery; this central organization to be divided into sections each of which would normally deal with motor lorries, tanks, tractors, etc.

When there is not very much tank work required, a part of this section could very easily be switched over to carry on work on motor lorries and vice versa. The principle should be enforced that all repair work is done by this central organization which, if necessary, can create one or two advanced depots to deal with all the repair work of an army or group of armies, while the maintenance of the machine they are using becomes the duty of the crew.

SYSTEM OF SUPPLY.

(Chart 1, Chapter XIX, Vol. I.)

All ordinary ordnance stores which were common to the rest of the Army, i. e., clothing, equipment, guns, machine guns and ammunition, were obtained through the R. A. O. C. in the normal manner.

All tanks and stores of tank supply, i. e., stores peculiar to tank services, were sent direct by the Mechanical Warfare Supply Department at the War Office. The Tank Corps took delivery at Erin railhead. There was a party of one officer and four men belonging to the Tank Corps stationed at the base port, but they were lent to the Mechanical Warfare Supply Department, whose transportation branch remained responsible.

This system was radically changed however and the R. A. O. C. was made responsible for all tank stores.

Total number of tanks delivered in France.

Marks I and II	175	Medium "A"	192
Mark IV	968	Guns carriers	46
Mark V	603	Salvage tanks	2
Mark V*	399		
Mark IX	3	Total	2,388

(1) TANKS EMPLOYED.

On November 11, 1918, the British Tank Corps was armed with the Mark V, Mark V* and Mark IV heavy tanks and with the Medium "A" or "Whippet" light tanks in the proportion of 78% Marks V and V*, 11% Mark IV and 11% Whippets. In addition to these there were a number of converted Mark IV tanks used as supply and carrier tanks and about 30 gun carrier type allotted to various units for the same duties.

(2) NUMBERS IN OPERATIONS AND RESERVES.

(Chart 2, Chapter XIX, Vol. I.)

The number actually engaged in operations on given dates is given in Appendix "A". The numbers held in reserve depended largely on the nature of the operation to be undertaken. It was only on rare occasions, however, that this reserve was not used at some period of the battle, in which case it would be included in the number of tanks shown as in action in Appendix "A".

The holding of adequate reserves was always a matter of great difficulty, as the demand for tanks invariably exceeded the supply. Thus at no time was it possible to retain as many tanks in reserve as the operation really required, and at certain times, notably at Cambrai (21st November, 1917) and Amiens (8th August, 1918), every available tank was used on the first day, no reserves being allowed at all. When a general reserve was held by General Headquarters, it usually consisted of such battalions as had been withdrawn from a heavy series of actions to refit.

(3) RATE OF EXPENDITURE.

Appendix "B" attached shows the number of tanks engaged on various dates and the number knocked out.

(4) TANK CORPS PERSONNEL IN LINE AND ON LINES OF COMMUNICATION.

Appendix "C" is a table showing the approximate proportion of Tank Corps personnel employed with the fighting units (combatant) and with lines of communication units (non-combatant) for the period 1st January, 1918, to 31st October, 1918. These figures are the authorized establishments which, as a matter of fact, were never complete. A table of casualties incurred is also shown.

(5) SYSTEM OF STORAGE, REPAIRS AND MAINTENANCE.

The question of storage did not arise, as there were never superfluous tanks in France and all machines were issued as soon after arrival in the country as possible. A central stores and various advanced stores were formed to facilitate the issue of tanks, spare parts for maintenance, and stores and supplies generally throughout the Corps.

The locations of the various units and departments were as follows:

	"A"	"B"
Hdqtrs., Tank Corps	Bermicourt	Bermicourt.
Tank Corps workshops	Teneur	Teneur and Bernaville.
Tank Corps stores	Erin	Erin and Bernaville.
Ordnance	Erin	Erin.
M. T.	Auchy-les-Hesdin	Auchy-les-Hesdin.
Supply	Teneur	
Hdqtrs., Tank Group		At Army Headquarters.
Bridges Advanced stores Field companies	Variable according to operations.	

APPENDIX A

The following is a Summary of the Tank Corps operations during the period September 1916, to November 1918.

Year	Number of days on which tanks were engaged	Total number of tanks that were actually engaged during the year [1]	Successful	Moderately successful	Unsuccessful
1916	6	73	4	4	1
1917	22	988	13	9	14
1918	55	2,327	47	21	9

[1] The greatest number of tanks employed on any date was 430, on 8th Aug. 1918.

APPENDIX B.

Summary of casualties in tanks and personnel sustained in the Tank Corps between August 8, 1918, and October 24, 1918.

Date.	Number of tanks.	Tanks knocked out.	Per cent of tanks hit.	Per cent of crew of 8 or 3 men per tank hit.	
				Killed.	Wounded.
August:					
8th	[1] 421	109	25	9	47
9th	[1] 143	39	24	17	74
10th	85	36	42	6	46
11th	38	9	23	3	54
21st	184	40	21	13	78
22nd	24	9	37	11	62
23rd	103	28	27	15	81
24th	[1] 63	15	24	2	37
25th	42	10	24	17	89
26th	[1] 11	7	64	12	32
29th	4	1	25	62	162
30th	21	5	24	7	37
31st	19	3	16	Nil.	100
September:					
1st	6	----------	0	[2]	[2]
2nd	81	28	34	14	61
3rd	9	1	11	200	433
18th	20	7	35	5	16
21st	9	6	66	4	75
24th	19	8	42	6	48
27th	[1] 68	26	38	14	68
28th	6	6	100	10	23
29th	181	81	44	12	54
30th	[1] 21	5	24	10	133
October:					
1st	16	6	37	8	28
3rd	39	22	67	13	46
5th	18	2	11	6	87
8th	82	29	35	14	43
9th	13	1	7	25	62
11th	7	2	29	6	43
17th	48	13	29	10	52
20th	4	2	50	Nil.	12
23rd	37	8	22	6	38
24th	6	1	17	25	75
Total	1,848	565	30	10	51

[1] These figures differ slightly to those shown in "Summary of Tank Corps operations, Part IV" published in "Weekly Tank Notes" of November 30, 1918. This is due to the Tank Corps armoured cars being added or deducted from the figures already issued.

[2] No tanks knocked out. Casualties 1 killed, 12 wounded.

APPENDIX C.

Strength and establishment of the Tank Corps from 1st January to the 31st October, 1918.

New units formed during the month.	Establishment.						Casualties Per cent.[2]	
	Officers.		Other ranks.		Strength in action.			
	Combatant.	Non-combatant.[1]	Combatant.	Non-combatant.[1]	Officers.	Other ranks.	Officers.	Other ranks.
Existing on 1st Jan. 1918: Hdqrs. Tank Corps, 1st, 2nd & 3rd Bdes. inc. 16 Bns., Central Workshops, Nos. 1 & 2 Salvage Coys., No. 1 Coy. & 2 Sections G. C. Tanks	993	24	6,577	1,085	898	7,185	----	----
Formed during January: 4th Bde. Hd. Qrs., Nos. 11 & 12 Tank Bn., Central Stores, Nos. 1, 2, and 3 Advanced Workshops, No. 2 Coy. G. C. Tanks completed Salvage Coys., renamed Tank Field Coys.	1,188	54	7,750	1,709	1,079	7,999	0.01	0.04
Formed during February: No. 13 Tank Battalion	1,233	54	8,335	1,709	1,162	8,798	0	0.02
Formed during March: 5th Bde Hdqrs.	1,238	54	8,343	1,709	1,194	8,546	3.5	3.2
Formed during April: No. 17 (Armd. Car) Tank Bn., No. 4 Advanced Workshops	1,234	58	8,536	1,783	1,240	9,232	8.2	6.6
Formed during May: Nos. 1 & 2 Tank Supply Coys.	1,294	58	8,868	1,783	1,355	9,873	2.5	2.4
Formed during June: No. 14 Tank Bn., Nos. 3, 4, & 5 Supply Coys.	1,444	58	9,961	1,783	1,509	11,131	0.6	0.2
Formed during July: No. 15 Tank Bn., No. 5 Adv. Workshops, Hdqrs. Carrier Units	1,538	62	10,548	1,857	1,589	11,747	1.9	0.9
Formed during August: No change	1,538	62	10,548	1,857	1,267	10,731	19.6	10.0
Formed during September: No. 16 Tank Bn., Inspec. of Tank Machinery	1,628	65	11,145	1,869	1,383	11,315	6.1	3.7
Formed during October: Hdqrs 6th Tank Bde., No. 18 Tank Bn.	1,723	65	11,750	1,869	1,291	11,064	11.4	7.0

[1] Non-combatant personnel is composed of workshop personnel.
[2] Casualties are those incurred in action only.

CHAPTER XVIII.

SECTION II.

SUPPLY OF THE TANK UNITS (FRENCH).[1]

HISTORICAL.

At the time of its creation the French Tank Service was dependent upon the Motor Transport Service from a triple standpoint: procurement of new matériel, repairs, and supply. With the development of the Tank Service this organization was gradually modified, but the supply organs of the Motor Transport Service continued to furnish a large part of the Tank Service requirements and even supplied spare parts. The "Main Motor Transport Depot" (Dépôt Central Automobile), at Paris, thus remained the supply agency of the army tank parks throughout the war. This made it possible, particularly when only a small number of tanks were assigned to an army, to use the army corps and army motor transport parks as liaison organs between the tank units and the main motor transport depot. There were not enough tank parks and tank supply units to assure the supply along the entire front, especially during 1918, when the front was changing constantly. No doubt some other system of supply will be adopted in the future in case of another war.

SUPPLY OF NEW TANKS.

Theoretically, after a battle tank units were to receive a number of new tanks in perfect running condition equal to the losses incurred, under the same conditions and at the same time as their replacements in personnel. This method necessitated maintaining a sufficient reserve of tanks in the parks and at the main depot to rapidly meet the requirements of the tank units, based on the number of tank units assigned to each park for supply purposes.

This reserve was to be formed by matériel coming from the repair establishments, or, in the case of the "Brigade Parks" (Parcs de Brigade), from matériel produced by the factories or supplied by the main depot. However, in actual practice this system of supply

[1] Prepared for the Military Board of Allied Supply by the office of General Estienne, Chief of the French Tank Service, "Sub-Direction of Tanks" (Sous-Direction de l'Artillerie d'Assaut), at the French Ministry of War.

was found impracticable, because the output of the factories and repair shops was always inferior to the requirements, and it was therefore impossible to accumulate a sufficient reserve of matériel.

SPARE PARTS FOR TANKS.

When tanks were ordered from a factory it was specified that an initial supply of tools (O1) and spare parts (R1) be delivered with each tank. Moreover, every order for the delivery of 25 light tanks, or of 15 medium tanks, was to be accompanied by a second supply of tools (O2) and spare parts (R2).

Another and third supply of tools (O3) and spare parts (R3) was to be furnished simultaneously with the delivery of "n" tanks from the factory and, finally, an additional or fourth supply of tools (O4) and spare parts (R4) was to accompany the delivery of "N" tanks. The figures "n" and "N" varied according to the model of tank which had been ordered.

The various supplies of tools and spare parts were called "Lots" and were known as "Lots O1–R1; O2–R2; O3–R3 and O4–R4," respectively. These were to provide the equipment and reserve of spare parts for the tanks, as well as for the tank company (light tanks) or for the tank group (heavy tanks) of the tank repair sections and parks. In actual practice, only the first and second "Lots" of supplies (O1–R1 and O2–R2) were furnished regularly. The mistake made in connection with the obtention of the other "Lots" of supplies, particularly "Lot O4–R4," was the failure to compel the manufacturers to furnish "Lots O3–R3 and O4–R4" immediately upon delivery, under contract, of the first tank of the series which had been ordered.

Such large quantities of spare parts were used that the parks were unable to furnish the necessary supplies in time. The parks and the repair sections were consequently obliged to call upon the main motor transport depot in order to satisfy their requirements, as well as those of the tank units, with the result that long delays occurred which might have been avoided.

REPAIR OF TANKS.

Theoretically, owing to the relative ease with which tanks (at least light tanks) could be replaced, tank units were only to carry out minor repairs. Important repairs were to be made only at the tank parks, while the salvage of badly damaged tanks, which the units were unable to handle, was to devolve upon the repair and wrecking sections.

In practice, on account of the slowness in the delivery of new tanks, many of the units which were equipped with sufficient means were obliged to undertake fairly important repairs.

SUPPLY OF GASOLINE, AMMUNITION AND VARIOUS MATERIALS.

The tank units had no supply organs of their own, except for the supply of special, technical, tank matériel. They received their gasoline, maintenance ingredients and automobile spare parts, etc., from the army corps and army motor transport parks and, except for the special tank ammunition which was furnished them by the tank parks, they obtained their ammunition, etc., from the artillery parks. To simplify matters and reduce displacements, the supply and wrecking sections, as well as the parks, often served as liaison organs.

ORGANIZATION OF THE SERVICE.

(Charts 6 and 7, Chapter XIX, Volume I.)

1. *With the armies.*—The real supply organ of the combat tank units was the "Brigade Park" (Parc de Brigade). Owing to the small number of these parks (three) and on account of their distance, they often had to be divided according to needs. The supply sections which, unfortunately, were not always supplied rapidly enough, served as transport and liaison organs. Each tank unit, upon arrival in the "zone of action" of a park, was attached to that particular park for supply purposes. Insofar as their employment was concerned, the brigade parks were under the orders of the brigade commander in charge of operations within the zone of action of the park; the brigade commander was thus responsible for supply.

The "Main Tank Park," which was only organized in 1918, was to store all supplies coming from the factories and then distribute them among the parks; moreover, it was to undertake the greater part of the important tank repairs. However, in actual practice, the deliveries of matériel were insufficient to meet the requirements of the summer campaign of 1918, so that the main park was unable to completely fulfill its functions.

2. *In the interior.*—

a. *New tanks.*—The new tanks coming from the factories under the Ministry of Armament, were examined, accepted and received by the Ministry of War (Sub-Direction of Tanks—"Sous Direction des Chars de Combat), after being tested at the experimental field at Chalais-Meudon. The tanks which had been accepted received their equipment (O1–R1) from the manufacturers and were then

sent direct, according to circumstances and needs, either to the army parks, as reinforcements, or, to the "Organization Center" (Centre d'Organisation) at Cercottes, where new tank units were organized, and they then served to equip the new formations.

b. *Spare parts.*—The main motor transport depot which, from a motor transport standpoint, was subordinate to both the armies and the interior, had a special organ for the supply of tank matériel at its disposal. This section of the main motor transport depot was under the orders of the "Sub-direction of Tanks" at the Ministry of War and had a dual responsibility:

1) It ordered spare parts and tank matériel from the manufacturers, in accordance with the requests of the tank parks and of the main tank park and within the limits specified in the lists of "Lots of spare parts" mentioned above. For the supply of other matériel, it was necessary to obtain authorization from the General Commanding the Tank Corps or from the Sub-Direction of Tanks. This for the purpose of avoiding competition as much as possible.

2) It delivered all the matériel which had been ordered to the tank parks and to the main tank park.

For the delivery of this matériel, the main motor transport depot employed the motor transport convoy services and these supplied the tank parks and the motor transport parks at the same time. Thanks to this combined supply system, the repair and wrecking units or sections could be supplied direct by the main motor transport depot, through the motor transport parks which were connected therewith.

USE OF TANKS.

(a) Employment of tank matériel in use or under construction at the date of the Armistice.

(b) Plans for the employment of tanks in the future.

a) *Employment of existing tank matériel:* Two types of tanks are in existence, i. e.: heavy tanks and light tanks.

1. Heavy tanks under construction and their technical specifications: Weight 67 tons; enveloping tractor; electric propulsion (gas engine, dynamo, etc., somewhat similar to the St. Chamond type); spring suspension above parts bearing on the ground; electric control; two turrets: one for 75 mm. gun and one for machine gunners; 2 machine guns in front for pursuit; stromboscope; anticipated speed: 10 kilometers per hour; ability to cross all battlefield obstacles.

2. Light tanks: The present Renault type will be used, with as many improvements as possible (ventilator, lighter armor with equal powers of resistance, automatic revolver affixed in driver's blind to

enable him to defend himself without raising the blind; improvements in the oiling and greasing systems, etc.)

b) *Plans for future tank operations.*—(a) Elaboration of a system for crossing marshy ground. (b) Perfecting a tank with crane and windlass for extrication work.

The heavy tank will continue to be used, but its weight will probably be increased.

The light tank of today is the ideal infantry weapon, but its difficulty in making rapid progress (marches) over roads often necessitates transportation by motor truck (camion), hence the desirability of lightening the tank.

If the light tank could make rapid progress over roads its weight would be no detriment, taking into consideration, of course, the limitations encountered in the carrying capacity of existing railway flat-car equipment. As a matter of fact, instead of being detrimental, the weight of the tank would enable it to make wider breaches and it would be possible to provide it with a better armament.

Hence the desirability of constructing a tank capable of rapid progress over roads, well armed, and of a weight of from 10 to 12 tons. The phrase: "capable of making rapid progress (marches) over the road" should be construed as the ability, in case of need, of making from 80 to 100 kilometers in one day. Whether it can equal this speed or not, the light tank will be the ideal infantry weapon and in open country it should be able to take the place of the cavalry advance guard.

RECAPITULATION—THE FUTURE OF THE TANKS.

(1) *Heavy tanks:* To be as heavy as possible, well armed, well armored, capable of proceeding against strongly organized support points, of providing passages for the light tanks by levelling trenches, of raking openings for the infantry and artillery; liaison by means of powerful wireless equipment.

(2) *Light tanks:* Should be able to move over rough country and to progress at a good rate of speed over roads—the infantry weapon, also the advance guard or reconnaissance tank in open warfare; weight to be governed by the carrying capacity of the railway flat-cars.

CHAPTER XVIII.

SECTION III.

TANKS (ARMORED CARS) (ITALIAN).

Tanks were not used on the Italian front during the war, either by the Italians or by the enemy.

As soon as this new weapon made its appearance and was employed by the other Allied Armies, its adoption and use were considered by the Supreme Command and the Ministry of Arms and Munitions; although at the time, on account of local conditions, the employment of tanks in the Italian theater of operations was impracticable.

Negotiations with the Allies for the cession of a certain number of tanks did not accomplish the desired results. (For experimental purposes, France delivered: one Schneider tank in 1917, one Renault tank in May 1918, and three other tanks in September 1918). While these negotiations were in progress, the Ministry of Arms and Munitions prepared a tank construction program and, according to this program the national industries were to furnish:

1,400 Renault type tanks, modified to conform to the model designed by the F. I. A. T. plant. (In 1916, a study had been made of a heavy type of tank (type 2.000) for experimental use in Lybia).

150 motor tractors and 100 7-ton motor vehicles.

840 light 37-caliber " S. A. Puteaux " guns, adapted for the use of Italian projectiles.

560 Hotchkiss and 800 " S. I. A." machine guns.

The first delivery, to consist of 260 tanks, was to have been made on the 1st of May and this was to have been followed by periodical deliveries, at the rate of 200 tanks per month, until the total number (1,400 tanks) had been delivered.

With the signing of the Armistice the work was suspended and the fulfillment of this program was never realized. The two types of tanks adopted by the Italian Army are indicated above.

Simultaneously with the placing of the orders for this matériel, the Supreme Command provided for the necessary operating personnel.

A tank school was organized in the Zone of the Armies, under the control of the Motor Transport Section of the General Commissariat, for the instruction and training of tank personnel. The Schneider type tank and the two Renault tanks furnished by the French were assigned to this school for training purposes.

CHAPTER XVIII.

SECTION IV.

THE TANK CORPS (AMERICAN).[1]

(Chart 3, Chapter XIX, Vol. I.)

1. *Types employed:* On November 11, 1918, there were in the possession of the American Tank Corps 207 light Renault Tanks, 12 Mark IV heavy British tanks, and 14 Mark V Star heavy British tanks. The 14 Mark V Star tanks referred to were with the 301st Heavy Battalion on duty with the British.

2. *Number actually in active operations and number in reserve. Rate of expenditure, proportion of reserve to active:* The total number of tanks actually in active operation with American troops consisted of 144 light Renault French tanks and 47 heavy British tanks of various types. The number of light Renault tanks held in reserve varied at different times. The rate of expenditure, and the proportion of tanks held in reserve to those actively employed varied so greatly that it is difficult to make a definite statement except that pertaining to definite dates. The following data in this particular is given in order to show how the rate of expenditure and the proportion of those held in reserve to those actively employed varied.

The 301st Heavy Battalion, Tanks Corps, was in active operations on the British front from September 27th to October 1st, 1918, in what is known as the Le Catelet-Bony offensive. This battalion started with 40 heavy tanks in active service and 7 in reserve. During the operations the 7 heavy British tanks held in reserve were placed in active combat. Of the total number of those employed, 33 were rendered useless.

The First Tank Corps Brigade entered the St. Mihiel drive, September 12th to 15th, 1918, with 2 light battalions. Each of these battalions had two companies in active operations and one in reserve, each company being equipped with 24 light Renault tanks. During the progress of this drive each of the reserve companies was thrown into the fight. During the whole of these operations only 3 American tanks were rendered useless.

[1] From report prepared for the M. B. A. S. by the Chief of the Tank Corps, A. E. F., May 3, 1919.

During the Meuse-Argonne drive, on September 26, 1918, the 344th Battalion, Tank Corps, entered the fight with two companies in the line and one in reserve. The 345th Battalion, Tank Corps, fully equipped with tanks, was held in reserve for the purpose, at a later date, of leap-frogging the 344th Battalion. On September 28th, the two battalions were merged into one unit, and at that time had 107 light Renault tanks in active operations, and 27 light Renault tanks in reserve. From September 29th to October 4th, 1918, the number of light Renault tanks held in reserve, as well as those in active combat, varied daily. However, at that time there were 13 light Renault tanks in reserve, while the number in active combat varied from 40 to 80. Early in October a "Provisional Company," with 10 tanks in operation and 5 tanks in reserve, was formed. In addition to these 15 light tanks, there were many other light tanks undergoing minor repairs, and which were shortly made available for use. For instance, on September 29th, there were 55 light Renault tanks ready for action out of the original 141; on October 4th, there were 72 light Renault tanks ready for action with 70 light tanks more or less disabled. (This included a French light tank which had been picked up in the theatre of operations). October 5th, there were 30 light tanks ready for action; October 6th, 17 light tanks ready for action; October 7th, 24 light tanks ready for action; October 8th, 26 light tanks ready for action, although only five of them were in first-class condition; October 11th, 48 light tanks ready for action; November 11th, 96 light tanks ready for action.

The date relative to the number of light tanks ready for action, as well as the number disabled, pertains to the number that originally entered the Meuse-Argonne drive, namely 141. On November 11th, there were, in addition to those indicated, 83 light Renault tanks and 12 heavy Mark IV British tanks at the 302nd Center, Tank Corps. All of these tanks were being used for training purposes.

In regard to the rate of expenditure of tanks in the Meuse-Argonne drive, it is to be noted that by the morning of September 27th, 1918, 43 tanks out of a total of 141 had been put out of action. In a great majority of cases tanks went out of action on account of mechanical trouble, not because they had been rendered unserviceable by enemy fire.

3. *Number with the American Army:* The total number employed with the American Army during active operations was as follows: 144 light Renault tanks and 47 heavy British tanks of various types in active operations, while 83 light Renault tanks and 14 heavy British tanks were used for training purposes.

4. *The Tank Corps Personnel with the Armies and on the lines of communication.*

(a) *With the First Army—*

September 1st, 859 enlisted men and officers.
October 1st, 844 enlisted men and officers.
November 1st, 1,098 enlisted men and officers.

(b) *With British—*

October 1st, 731 enlisted men and officers.
November 1st, 709 enlisted men and officers.

(c) *In advance Section—*

September 1st, 2,169 enlisted men and officers.
October 1st, 3,072 enlisted men and officers.
November 1st, 3,723 enlisted men and officers.
December 1st, 9,985 enlisted men and officers.

5. A brief statement of the original sources to which further study by officers in the American services should be directed.

(*a*) Report of operations of American Tank Corps in France.

(*b*) Reports covering various operations of the British Tank Corps since its organization. Copies of many of these reports are on file at the headquarters of the Tank Corps.

(*c*) Reports on operations of the French Tank Corps. There are on file at the headquarters of the Tank Corps copies of several reports of tank operations in the French Army.

(*d*) In the various manuals and pamphlets that have been published by both the British and French in reference to tank matters. There is also in process of preparation a "Drill Regulation for American Tanks." It is assumed that these will be issued at a further date.

(*e*) It is believed that the War Department has in its files many reports and publications, in addition to those indicated above, relative to Tank Corps matters. Such publications will most probably be printed in sufficient quantities at a future date to supply the needs of those officers who desire to devote their time to studies of this nature.

6. *System of Storage, Repairs and Replacements:* Whenever tanks were received from the Ordnance Department they were immediately put into use, either for training or issued to troops for combat. At no time were there sufficient tanks on hand for the problem of storage to become a matter of importance. (Charts 4 and 5, Chapter XIX, Vol. I.)

Each battalion had a repair unit and was supposed to have one artillery repair and one artillery supply truck, although it was seldom possible for the repair and supply truck to accompany the battalion into action. The battalion repair unit attempted only

minor repairs, or those requiring but a brief period of time. In each tank brigade there was a repair and salvage company consisting of 4 officers and 146 enlisted men. This repair and salvage company accompanied the brigade in the field and salvaged wrecked and disabled tanks, either by putting them in running condition on the spot or, if this was not practicable, by towing or hauling them to a repair park, which was normally kept well forward, just out of range of the enemy's artillery fire. The original plan provided that damaged tanks, which were beyond the capacity of the repair and salvage company to repair, be shipped to some Ordnance tank repair shop. These shops, however, were not completed at the time of the signing of the Armistice. As it was apparent that such Ordnance tank repair shops would not be ready for a considerable time, machinery of various kinds was obtained and a medium sized repair plant was installed at the 302nd Tank Center, near Langres. Although the Chief Ordnance Officer, A. E. F., designated three Ordnance repair shops to which tanks could be sent for repairs, yet all repairs were made in the plant at the 302nd Tank Center.

In the matter of supplies common to other branches of the service, troops stationed at the 302nd Center, Tank Corps, were supplied as provided for units stationed in the Advance Section, S. O. S.; those at the 301st Center, which was on duty with the British, were supplied through Base Section No. 3. Due to the difficulty in obtaining tank parts and to intelligently estimate the needs in advance, arrangements were made with the Chief Ordnance Officer, A. E. F., to have all tank parts turned over to the Tank Corps at the 302nd Center, rather than issued to Ordnance depots. While at the front, Tank Corps troops obtained supplies in the usual manner from the dumps of the armies or corps with which such troops happened to be stationed. Such tank parts as were available were forwarded by truck from the 302nd Center as required. It was not possible to obtain a sufficient stock of spare parts, as a great many parts gave away in greater numbers than was expected by either the American or French Tank Corps authorities. This condition of affairs necessitated the purchase of a large number of articles from manufacturers. The need of certain of these articles was not only urgent but vital, and telegraphic requisition was made on the Chief Ordnance Officer, the requisition being repeated to the Chief Purchasing Officer, Ordnance Department, in Paris, requesting that immediate steps be taken to purchase items desired and thus save time. In at least two instances the need was so great for certain items such as fan belts, tank pins, and a few other articles, that it was necessary to send them direct from Paris in a fast motor car.

In a number of instances when Tank Corps troops were operating in the front lines, pack trains were made use of to bring up oil and gasoline.

A light tank battalion was equipped with 72 tanks, exclusive of signal tanks. Of these, 48 constituted the regular fighting equipment in the first line, 24 (8 per company) being used for training and reserve purposes. The first line was replaced from this reserve when necessary. The small number of tanks available and the heavy duty required of them in the Meuse-Argonne, destroyed all chances of maintaining a reserve. It was a question of salvaging tanks and getting them in fighting condition in the least practicable time and then sending them in again. In the Meuse-Argonne drive the tanks actually put out of commission, requiring either to be towed or to be hauled to a repair park, resulting in a majority of cases from mechanical trouble, amounted to 24 per cent of the number engaged.

The only heavy battalion equipped and in action was the 301st Battalion. It was brigaded with the British Tank Corps and was equipped and maintained by the British in accordance with the manner in which British Tank Corps troops were equipped and maintained.

In regard to the early difficulty in securing tanks for the American Tank Corps it may be stated that, prior to the arrival of the A. E. F., the American Military Mission in Paris had, by direction of the Chief of War Council, investigated and submitted a report under date of May 21, 1917, giving the latest British and French technical and tactical ideas on the use of tanks.

By April 1917, the French had only two types of tanks. They were not tanks in the sense of later development. They were more properly artillery carriers. They had to be preceded by a group of skirmishers who indicated the route for them to follow. They were poor cross-country machines, under-powered, badly arranged, and it was fatal to the crews if they were struck.

A joint British and French "Tank Board" met in London early in May 1917, but were unable to reconcile their ideas as to machines or tanks. The British preferred the heavy tank to be used in advance of the infantry, while the French desired the light tank which they were building, to be used in close liaison with the infantry, their normal position to be with the battalion support and only to advance when the infantry was held up.

A project for an overseas Tank Corps, based on 20 combat divisions, consisting of the necessary headquarters, 5 heavy and 20 light battalions, employing 375 heavy and 1,500 light fighting tanks, was approved by the Commander in Chief, American E. F., on September 23, 1917, and sent to the War Department. In order to coordinate the production efforts, an Inter-Allied Commission was ap-

proved and Major Drain, of the Ordnance Department, was appointed the American member thereof. He was directed to proceed, in an attempt to get an agreement with the British and French, as to the best type of tank to be constructed and coordinate the production efforts so as to get the largest number of tanks in a minimum time. The efforts of the British were successful and an Anglo-American Commission designated the heavy tank, which was nothing more or less than an enlarged Renault, and started design. The French, while approving, would take no active part. On December 6, 1917, the American member of the Supreme War Council, with the approval of the Commander in Chief, cabled the War Department and got an approval to enter into an inter-allied agreement for the joint production of 1,500 of the Liberty Mark VIII tanks, and for the allotment of 1,500 Liberty engines for the same. The 1,500 heavy tanks were to be produced by the 1st of October, 1918.

A meeting was held in Paris on the 25th of December with the Chief Ordnance Officer, A. E. F., the Chief of Tank Corps, and the American Tank Commissioner. The Mark VIII with the Liberty motor were formally approved and steps taken to speed up the completion of design and work on drawings. The Liberty or Mark VIII tank was to be a joint production of the British and the United States. 50% of the components were to be furnished by each nation and the tanks were to be assembled at Neuvy-Pailloux, near Châteauroux. This tank was to be built and delivered entirely by the Anglo-American Commission. This was confirmed by treaty agreement between Great Britain and the United States, signed in London, January 22, 1918. Deliveries were to begin in July and schedule completed by the 1st of October. However, the failure of the aviation program prevented us getting the engines and the March offensive of the Germans prevented the British producing their components.

When the Armistice was signed, November 11, 1918, no Mark VIII heavy tanks had been produced nor had even any of the parts actually arrived at Neuvy-Pailloux.

However, it was the intention, as these Mark VIII heavy tanks were to be produced at Neuvy-Pailloux, to send trained heavy Tank Corps battalions to Neuvy-Pailloux, where such battalions would be equipped with heavy tanks and, as soon as these battalions had tuned up their heavy tanks sufficiently, they were to be sent to such points as required their presence.

All tanks for the light battalions that were employed by the American troops previous to the signing of the Armistice, November 11, 1918, were secured by the Ordnance Department from the French Renault works, near Paris. However, steps were already taken to have the French Renault tank manufactured in the United

States. Request was made on the War Department for rapid construction of the Renault tank in America. Steps were taken to secure and send specifications, as well as Renault tanks, to the United States. As the Renault tank was manufactured by a private concern the negotiations were slow and tedious.

When the light Renault tanks had been decided on, a number of improvements were added. It was to have a bulk-head, separating the gun room from the engine, so that the crew could not be burned to death; it was to be equipped with a self-starter; its gasoline tank was to be double-cased with one inch of felt lining, so that, when penetrated by bullets, there would not be leakage of gas, and it was to have an inter-changeable mounting, so that the tank could carry either a machine gun or a 37 mm. gun.

A cable from the United States on the 2nd of February, announced that the estimate of deliveries of the American-built Renault was as follows: 100 in April, 300 in May and, 600 monthly thereafter until completed. On November 11, 1918, the date of the signing of the Armistice, no tanks had been received from America by the Tank Corps.

Two American-built Renaults were received on November 20th and eight others at a later date, these ten being the only American-built Renault tanks actually received in the A. E. F.

For the necessary trucks, trains, and tractors for transporting and supplying tanks, it was decided to use commercial machines, or those already in production.

At the time the Armistice was signed, the Tank Corps was on the point of entering into the following agreement with the Ordnance Department in regard to matériel to be furnished by the Ordnance Department to the Tank Corps, especially so, as the tank is a special weapon, continually attached to other units and is normally based on a center to which, in ordinary cases, it looks for the spare parts required for immediate service:

(*a*) There are provided in the Tank Corps organizations repair and salvage Companies, manned by Tank Corps personnel, which perform substantially the same functions as the Ordnance personnel attached for repair purposes to regiments of artillery. Both tanks and Tank Corps personnel are more liable to return to a definite home center from time to time than other organizations of the army definitely attached to tactical organizations, after repairs that will normally be made, and during these periods all ordinary repairs can conveniently be made at the tank center. The tank center will also serve, in effect, as an advance Ordnance base depot for the supply of tank units in the field.

(*b*) The Chief of Tank Corps will be responsible for such repairs and arranging for the supply of parts and special matériel in ad-

vance of the tank center. He will also be responsible for the proper performance of such repairs as are practicable at the tank center with the facilities provided, and that requisitions are placed in ample time to secure an adequate supply of spare parts and matériel at the tank center to maintain in the field the tanks based on the center.

(*c*) The Ordnance Department will supply the Tank Corps a heavy mobile Ordnance repair shop manned by Ordnance personnel as called for in tables of organization, which is at the disposal of the Chief of Tank Corps, either for service at the tank center or in the field, to supplement the work of the repair and salvage companies. It will also furnish to the tank center a sufficient supply of small tools and machinery to enable ordinary repair work on the tanks based on the center to be carried out.

(*d*) In rear of the tank center the Ordnance Department will operate the supply and repair service in the same manner as for other matériel and is responsible therefor.

(*e*) The Ordnance Department will have one or more officers whose exclusive duty will be to follow closely the needs of the Tank Corps and see that all necessary steps are taken within the Ordnance Department to fill the needs of the Tank Corps. This officer will spend a large proportion of his time at the tank center to insure that he is at all times familiar with the needs of the Tank Corps, in so far as the Ordnance Department is concerned. It is not, however, his duty to place requisitions for matériel, etc., necessary at or in advance of the tank center, but to follow up these requisitions after they have been placed.

(*f*) The duties of the "Artillery Armament Officer," referred to in G. O. No. 186, paragraph II, 3c, in so far as the Tank Corps repairs are concerned, will be of an advisory nature. He will, however, be given the same facilities for inspecting this matériel as are extended by the artillery and will report on the condition thereof to the Chief of the Tank Corps and to the Chief Ordnance Officer of the army.

(*g*) The Tank Corps will, in general, extend to properly accredited officers of the Ordnance Department ample facilities to permit the Ordnance Department to be advised of whether or not the matériel is giving satisfactory service and whether it is being properly maintained. This necessary liaison work may be effected either through the army inspection service by attaching Ordnance officers to tank organizations, or in such other manner as may be mutually agreed upon by the Chief of the Tank Corps and the Chief Ordnance Officer, A. E. F. Copies of any report made by these officers will be furnished the Chief of Tank Corps.

(*h*) Subject to the approval of the commanders under whom they may be operating, mobile Ordnance repair shops and other Ordnance repair units in the field will assist the repair and salvage companies when this can be done without interfering seriously with the work for which they are intended.

(*i*) Tanks so badly damaged that they cannot be taken care of with facilities under the control of the Chief of Tank Corps, will be evacuated to designated Ordnance base repair shops and will either be replaced by the Ordnance Department, or, upon completion of repairs, returned to the tank center.

LIEUT. COL. A. E. M. BORGERHOFF
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CHAPTER XIX.

SECTION I.

SIGNAL SERVICE (BRITISH).[1]

The Signal Service of the British Army on the western front was under the technical control of the Signal Officer-in-Chief at General Headquarters. This officer received his instructions from the General Staff branch at General Headquarters, and was responsible for the general organization and control of the Signal Service throughout the theatre of war, for the general shpervision of signal training, for the allotment of available Signal stores throughout the Army and for the periodical revision of war establishments of Signal units to meet the changing needs of the situation.

Attached to the headquarters of armies and corps were Chief Signal Officers who received their orders from the General Staff of the formation, while the officers in charge of signals of divisions performed the same duties for their formations. Their duties were defined generally as follows: (Chart 1, Chapter XX, Vol. I.)

"The organization and control of Signal Communications is the duty of the Senior Signal Officer in each formation. This Officer acts as Staff Officer for inter-communication to the Commander of the formation.

In this capacity, his duties and responsibilities are as follows:

Each Chief Signal Officer (C. S. O.) of an Army, Chief Signal Officer of a Corps and Officer in charge of Signals of a Division is directly under the orders of the Commander of the formation.

He is technical advisor to the latter on questions of inter-communication, and is responsible to him for the efficiency of the Signal Communications within the formation.

As representative of his Commander he will co-ordinate and supervise generally the whole of the Signal Communications in the formation, including those of the subordinate formations and units.

He receives instructions on technical matters from the Signal Officer of the next higher formation, and will, on behalf of his Commander, issue the necessary technical instructions to the Signal Officers of the lower formations and units."

[1] Prepared for the M. R. A. S. by the Director of Army Signals, British Expeditionary Forces in France and Flanders.

For the lines of communications, Signal communications were under the control of a Deputy Signal Officer-in-Chief, who was responsible for all negotiations in regard to permanent lines with the French authorities, for the maintenance of Signal communication with England, for Signal communication between the base ports, General Headquarters (G. H. Q.), and the headquarters of armies, and for the construction and maintenance of railway telegraphs in the British zone. He was also responsible for the Signal parks at the base ports and for the supply of permanent line stores to the units in the field.

The Signal Service was responsible for the provision, working and maintenance of all forms of inter-communication (with the exception of carriage of despatches by aircraft and the postal service, and wireless communication between aircraft and ground) from the base ports to the headquarters of infantry battalions and artillery batteries. Within batteries and battalions and other similar units, Signal communication was provided by specially trained personnel of the units, but the Signal Service was responsible for coordinating their efforts, for the training of regimental instructors and for the general supervision of the signalling instruction carried out in units.

The organization of Signal Service units was changed considerably during the war in order to meet the changing needs of the situation but at the time of the Armistice was as follows:

ON THE LINES OF COMMUNICATION AND AT G. H. Q.

Five Telegraph Construction Companies to provide the trunk lines connecting armies with the base and with G. H. Q., and for work on the lines of communication, at bases, and for Royal Air Force (R. A. F.) special communications.

These companies formed part of "L" Signal Battalion, the remainder of which provided the operating and maintenance personnel for the main bases, H. Q. of the lines of communication area, G. H. Q., and the large depots and camps on the lines of communication. Included in this battalion were the motor cyclist despatch riders for the despatch rider letter service which carried urgent letters in accordance with a time table all over the lines of communication.

At G. H. Q., but not forming part of "L" Signal Battalion, was a Wireless (W/T) Observation Group and "W/T" Sections for communication with armies, French General Headquarters, etc.

A G. H. Q. "pool" of eight motor airline sections was formed early in 1918, in order to provide a means of reinforcing the signals of any army requiring construction power beyond its normal establishment.

At the time of the Armistice, there were six railway telegraph companies and five light railway Signal companies that constructed and maintained (and in the case of the light railway Signal companies to some extent operated) the railway telegraphs, both on the broad gauge and narrow gauge systems.

SIGNALS OF AN ARMY.

These consisted of an army H. Q. Signal company composed of the personnel for operating the headquarters and subsidiary army Signal offices and for maintenance of lines, of a wireless (W/T) section for communication with corps and G. H. Q. and of a "W/T" observation group for intercept and direction-finding work and of motor-cyclist despatch riders for the D. R. L. S. to corps, etc.

For construction work each army had a Signal construction company (consisting of an administrative headquarters and two sections of about the same strength as airline sections) intended for permanent line construction, three airline sections for semi-permanent and airline construction and three cable sections.

These units formed a "pool" under the direct control of the Chief Signal Officer which permitted him to reinforce corps which were in need of extra assistance.

Area Signal detachments for the maintenance of buried cable routes in the army area were also attached to the army Signal company, the number varying with the extent of the army front and the number of divisions in the line.

The Chief Signal Officer of the army had attached to his H. Q. an "Officer for W/T duties" who was in charge of all the army H. Q. wireless and was responsible for the co-ordination of all wireless communications throughout the army.

Army Signals were generally responsible for the Pigeon Service in the army area and allotted lofts to corps for use by the divisions forming part of the corps.

SIGNALS OF A CORPS.

These Signal units were organized on the same principles as those of the army.

They consisted of a headquarters company for the operation and maintenance of the headquarters Signal office with a motor-cyclist despatch rider section, a "W/T" section, and a corps heavy artillery section.

Each corps had normally two motor airline sections and two cable sections which might be reinforced from the army or the

G. H. Q. pool. Each heavy artillery brigade had a Signal sub-section for the communications between the brigade and its batteries, administered and controlled by the O. C. Corps, H. A. Section.

In position warfare, the Chief Signal Officer of the corps was responsible for the execution of the buried cable scheme under the general supervision of the C. S. O. of the army and assisted as far as possible by divisional Signals.

A Signal squadron with a special cable section of three detachments was attached to the headquarters of the cavalry corps.

SIGNALS OF A DIVISION.

The Signals of the infantry division were composed of a headquarters consisting of operating and maintenance personnel, two cable sections (four cable wagons and detachments), a visual signal section, a wireless section, a motor-cyclist despatch rider section, and an artillery (R. A.) headquarters section. Each artillery brigade had a Signal sub-section for the communications between the brigade and its batteries, and each infantry brigade had a Signal section to provide communication with its battalions. There was also a section for the machine gun battalion.

Each cavalry division had a Signal squadron consisting of a headquarters and a Signal troop for each cavalry brigade.

TANK CORPS.

A special Signal organization was provided for the Tank Corps consisting of a headquarters section, wireless section and a brigade Signal company for each tank brigade.

SCHOOLS.

To meet the pressing need for regimental instructors and trained reinforcements and to instruct personnel of units in the new apparatus introduced from time to time in the Signal Service, army and corps Signal schools were formed. A central wireless school was also formed on the lines of communications and a noncommissioned officers' school, where selected men from units were put through a course of physical training, interior economy, discipline and technical subjects, was also brought into being at the beginning of 1918.

These schools were created to meet the urgent necessities of the situation, but the general tendency towards the latter part of 1918, was to abolish corps Signal schools and it was considered that the most satisfactory arrangement would be to have only one central school under the direct control of G. H. Q.

SUPPLY OF SIGNAL EQUIPMENT.

(Chart 2, Chapter XX, Vol. I.)

The Director of Ordnance Supplies arranged for the delivery to the two Signal parks (at Havre and Calais respectively) of all Signal Service equipment in such proportions as were indicated to him by the staff officer to the Signal Officer-in-Chief, whose particular duty this was.

The Chief Signal Officer of each army submitted weekly to the Signal Officer-in-Chief a consolidated indent for Signal stores required by the Signal units in his army. The Signal Officer-in-Chief allotted stores, in accordance with the available supply and the tactical situation, against these indents, and they were then sent forward from the Signal parks to the army Signal "dumps" where the Chief Signal Officer of the army retained a certain surplus in order to meet unforeseen contingencies. Chief Signal Officers of armies and corps then issued to the Signal units of the lower formations stores to meet the indents previously submitted, having regard to the deficiencies of the units and any projected operations involving the expenditure of abnormal quantities of equipment and stores.

Certain classes of equipment and stores, such as "Telephones portable D. Mk. III," Fullerphones and field and buried cables, the supply of which was often inadequate to meet demands, were "controlled" under the system explained above, but other classes in which there was no serious shortage were issued on demand by the Ordnance Department without Signal Service "control."

STORES REQUIRED BY SIGNAL UNITS.

1. The equipment required by Signal units was obtained from four sources:

(a) From Ordnance (See paragraphs 2 and 3).

(b) From Signal park (See paragraphs 4, 5, 6, 7 and 8).

(c) From supply column of unit—motorcycles and spare parts for motor transport of the Signal unit (See paragraph 9).

(d) From O. C. Electric Lighting Sets, G. H. Q., for all stores for electric lighting sets (See paragraph 10).

SUPPLY FROM ORDNANCE (DIRECT ISSUE).

2. All stores on the A. F. G. 1098 of the unit, except those under headings (b) and (c) above were to be indented for from Ordnance.

Any applications for an increase in the scale authorized for these stores had to be made to the headquarters of the formation to which the Signal unit was attached, and not direct to the Signal Officer-in-Chief.

SUPPLY FROM ORDNANCE CONTROLLED ISSUE.

3. Cable D. 5, D. 3, and D. 1, also telephones portable C. 2 and D. 3.

The supply of the above equipment was limited, and it was not always possible to meet the demands in full.

For this reason it had been found necessary to control the issue.

All units including Signal units entitled to any of the above equipment indented on Ordnance for a supply to meet requirements.

The O. C. Signals of a Division obtained from the Ordnance officer a list of the requirements of the units of the division and submitted to division headquarters any demands which appeared excessive or unnecessary.

The O. C. Divisional Signals then forwarded a consolidated return of the requirements of the division to the O. C. Corps Signals, who in similar manner scrutinized the demands of divisions and forwarded consolidated return for the corps to O. C. Army Signals.

O. C. Army and Cavalry Corps Signals forwarded the consolidated return for the army and cavalry requirements so as to reach the Director of Army Signals early Monday morning in each week.

General Headquarters decided what allotments should be made, and the Chief Signal Officer informed O. C. Signals of Armies and Cavalry Corps of the allotments authorized for the army and cavalry corps.

The headquarters of armies then allotted to headquarters of corps, corps to divisions, and divisions to their units, informing the Ordnance officer concerned of the amounts authorized for supply.

In order to make the allotments to the best advantage the O. C. Signals of formations had to keep in close touch with the urgent requirements and be prepared to advise their headquarters of how best to allot what was available.

Every effort had to be made to recover cable, and to repair or return to Ordnance all damaged instruments.

It was generally possible to provide cable for very urgent requirements within the formation, or by the assistance of the next higher formation.

SUPPLY FROM SIGNAL PARKS (DIRECT ISSUE).

4. Signal units indented direct on Signal parks for all stores shown in sections 28 (b) and 29 (a) A. F. G. 1098 of the unit with the exception of cable D. 5, D. 3, and D. 1, also telephones port-

able C. 2 and D. 3, which were supplied from Ordnance under special conditions given in paragraph 3.

Also all stores on the A. F. G. 1098 not in the above sections required for 1st, 2nd and 3rd class offices and normal airline and cable stores (except the cable itself). (See Field Service Manual for the unit.)

SUPPLY FROM SIGNAL PARKS (IMPROVISED AIRLINE STORES).

5. Small porcelain bobbins and light iron wire were stocked at the Signal parks for the construction of improvised airline. Terminating bobbins were normally issued on the scale of one to nine ordinary bobbins, they were only to be demanded in large proportions in exceptional circumstances.

Units demanded these stores direct from the Signal park at their base.

Demands which appeared excessive were referred by the Signal parks to the Signal Officer-in-Chief.

SUPPLY FROM SIGNAL PARKS.

6. The following stores, though not on the A. F. G. 1098 of units, were demanded in reasonable quantities direct from the Signal parks by O's C. Signal units.

The Signal parks had instructions to refer any demand which appeared excessive or unreasonable to the Signal Officer-in-Chief before issuing.

Wire electric T. 3 (single copper cotton covered).
Wire electric T. 5 (single copper rubber and cotton covered).
Wire electric T. 11 (twin copper cotton covered).
Wire electric T. 13 (twin copper rubber and cotton covered).
Terminals, electric, instrument.
Connectors, wing, nut.
Funnels, battery, cell.
Staples, insulated, saddle.
Tape, rubber, primed (to be demanded in lbs.).
Wires, jointing and binding.
AA. 13 (for cable).
AA. 3 (40 lb. copper).
Cells, dry, P. O. pattern.
Bell-pushes, circular.
Bell-pushes, pear shaped.
Iron, soldering, 9-oz.
Iron, soldering, 4-oz. hatchet head.
Lamps, blow, spirit.
Nuts, brass.
Screws, brass and iron.
Solder, silver.
Wire, electric "WW. 32" (double silk-covered copper).
Counters, bone.
Couplers, cable Mk. II.
Dischargers, lightning, bobbin.
Dischargers, circular, double bases.
Suspenders, cable.

SUPPLY FROM SIGNAL PARKS ON AUTHORITY OF THE SIGNAL OFFICER-IN-CHIEF.

7. Equipment authorized as a temporary issue in excess of establishment shown on the A. F. G. 1098 of the unit.

For Corps Headquarters Signal Company.

20-line telephone switchboard (P. O. pattern)	1	Protectors H. C. & F. 2/2	20
10-line telephone switchboard (P. O. pattern)	1	Protectors H. C. & F. 20/20	1
Magneto ringing telephones	20	Protectors H. C. & F. 40/40	1
		Transformers, 7-terminal	6

For a Divisional Signal Company.

15-line telephone switchboard (P. O. pattern)	1	Protectors H. C. & F. 2/2	12
10-line or 5-line switchboard	1	Protectors H. C. & F. 20/20	2
Magneto ringing telephones	12	Protectors H. C. & F. 10/10	2
		Transformers, 7-terminal	4

Demands to make up equipment to these scales were sent to the Director of Army Signals through the officers in charge of corps or army Signals.

SUPPLY FROM SIGNAL PARKS, OR AUTHORITY OF D. A. SIGNALS.

8. Technical stores in excess of those mentioned in the foregoing paragraphs required by Signal units for special purposes.

Application for issue was made by letter (in urgent cases by telegram followed by letter) to Signal Officer-in-Chief, through the O. C. Signals of higher formations explaining the special reasons for the demand.

The stores required were described by their "Vocabulary" or Post Office Rate Book" designation.

Some of the stores demanded in this manner were:

In excess of those laid down in paragraph 7—
- Metallic circuit telephone switchboards.
- Magneto ringing telephones:
  - Trench pattern.
  - Office table pattern.
- Protectors for switchboards and telephone transformers.

Instruments, telegraph and telephone, not included above.

Bridging coils.
Special cables for burying and river crossing multi-core cables.
Bells, Magneto, "P" "Q" & "R"
Belts, safety.
Condensers, 1.25 mf.
Switches, single, 2-way.
Switches, telephone, intermediate, "B"

STORES FROM SUPPLY COLUMN.

9. Motor cycles, and spare parts for lorries, motor cars or motor cycles.

(General Routine Orders Nos. 692, 898, 901, 1056).

I. *Motor Cycles.* In demanding motor cycles to replace unserviceable machines—

Demand will be made on the proper form, which can be obtained from the O. C. Supply Column.

The unserviceable machines should be returned complete with all parts. When this is impossible a certificate will be furnished with the demand stating that the demand is to bring the unit up to authorized establishment and the circumstances which prevent the return of the whole damaged machine or parts. A motor cycle or parts to complete establishment will be issued on the certificate of the O. C. Signal Unit and the issue will not be held up pending enquiry into the reasons for the demand.

O's C. Signal Units are responsible that every effort is made to return the unserviceable machines complete to the Supply Column, and that the report of how deficiencies occurred is complete.

II. *Motor Cyclists* supplied from the Signal Depot to replace casualties will be sent up without motor cycles except in cases where the casualty has also involved the loss of a machine, and this must be stated on the demand.

III. *Spare Parts.* All spare parts for mechanical transport will be demanded by Signal Units through the O. C. Supply Column from which the unit obtains it supplies.

STORES FROM O. C. ELECTRIC LIGHTING SETS. G. H. Q.

10. All demands for stores and replacements in connection with portable electric lighting sets were made to: Officer i/c Portable E. L. Sets, c/o Director of Army Signals, G. H. Q.

Demands in excess of original equipment, and any large demands to replace breakages had to be accompanied by an explanation of the special circumstances.

SIGNAL OFFICER-IN-CHIEF (CIRCULAR MEMORANDUM NO. 62).

Instructions issued by the General Staff called attention to the absolute necessity of greater economy being exercised in the expenditure of Signal equipment by all units wwhether of Signal Service or not.

Force of circumstances has caused too much haphazard laying out of lines on no definite system, and the running of wires to give direct communication between points which could have been connected up through existing Signal offices.

Officers i/c Signals of formations in their capacity of technical advisory on Signals to their Headquarters must point out to their Headquarters how the necessary communications can be most economically effected.

(II) It is necessary for economy of line material that the positions of Advanced or Battle Headquarters should be previously decided on, in order that the lines may be run so that a minimum of change is required when these Headquarters are occupied.

(III) There are probably a good many messages sent by telegraph to addresses within the areas of Divisions, Corps and Armies, which could equally well be sent by the D. R. L. S.

Telephone communication has been greatly extended, and is available for urgent matters to be dealt with by conversation between the Officers concerned.

Constant scrutiny should be made of the telegrams passing through Signal offices, and the attention of the Headquarters directed to messages sent as

telegrams which might have been otherwise disposed of. There is much need for conciseness in telegrams and the only way to secure improvement is by having the attention of the sender drawn to the messages.

(IV) "Getting through" on the telephone requires speeding up. The attention of the Headquarters should be called to all undue delay in gaining attention, or by the telephone being used for an excessive length of time. When telegraph communication exists the telephone should not be used by office clerks for sending written messages, but only for conversation between offices.

(V) Signal Officers within the area controlled by them will report to their Headquarters all lines which require better maintenance or to be recovered whether Signal Service lines or not.

(VI) Signal Officers will within their formations see that diagrams of *all* lines are kept up to date by the Units concerned, and before forwarding demands for further material satisfy themselves for what purpose it is required.

(VII) When formations change their front the responsibility for seeing that the existing lines and the diagrams are handed over to the incoming formation rests with the next higher formation.

Yearly issues of various signal stores for 1916, 1917 and 1918.

	1916	1917	1918 (only 10 mos.)
Telephone Sets Portable 'D' III	23,402	28,960	26,430
Instruments Telegraph Sounder translating	1,106	1,370	1,270
Galvanometers Sets Q. & I	4,095	4,596	5,112
Insulators No. 2	1,017,857	1,587,096	1,516,964
Cells dry X	37,064	799,642	1,017,699
Switch Units buzzer 4 x 3	Nil.	2,059	5,654
Switch Units Magneto 5 line	429	369	921
Tel: Sets Dumb working Intermittent	552	537	615
Tel: Sets Duplex	60	108	78
Tel: Sets Simplex	410	516	528
Telephones No. 100	2,006	1,209	179
Telephones No. 110			4,730
Switchboards:			
5-line		1,073	449
10-line		896	1,241
20-line	149	133	198
30-line	43	160	126
40-line	46	81	129
50-line	33	154	191
Transmitter Wheatstone Automatic	42	85	82

Following was the procedure in the manufacture of stores for the Signal Service:

(1) Experimental instruments and patterns were made by Chief Experimental officer.

(2) Experimental instruments were approved by Signals Experimental Committee, etc.

(3 Sealed patterns and samples were sent to Chief Inspector Royal Engineer Stores.

(4) Chief Inspector Royal Engineer Stores or Deputy Director of Ordnance Stores submitted demands to War Office.

(5) War Office passed demands to Ministry of Munitions (Supply) who obtained the supply from trade.

(6) Ministry of Munitions issued tender forms to firms, saying patterns and samples and specifications with Chief Inspector Royal Engineer Stores.

(7) Tenders were made by firms to Ministry of Munitions and passed to War Office for concurrence in acceptance of tender.

(8) Contractor whose tender was accepted passed instruments as made to Chief Inspector Royal Engineer Stores for inspection.

(9) Chief Inspector Royal Engineer Stores, handed to Deputy Director Ordnance Stores for storage or issue all instruments which passed inspection.

(10) Deputy Director Ordnance Stores issued instruments, or sent shipping demands to War Office who gave Deputy Director Ordnance Stores shipping instructions.

(11) When contract was completed War Office informed Ministry of Munitions who arranged payment of contractor.

— OR —

1, 2, 3, 4, as above.

(5) War Office instructed Deputy Director Ordnance Stores to transmit demands to W. D. Signal Factories that made the instruments, and the latter when made passed to Chief Inspector Royal Engineer Stores.

(6) Chief Inspector Royal Engineer Stores handed instruments which passed inspection to Deputy Director Ordnance Stores.

(7) As 10 above.

CHAPTER XIX.

SECTION II.

TELEGRAPH (SIGNAL) SERVICE (FRENCH).

I. FUNCTIONING OF THE MILITARY TELEGRAPH SERVICE.

The Military Telegraph (Signal) Service of the Army had for its object: the organization and operation, insofar as the needs of the Command were concerned, of electrical and visual communications to connect Great General Headquarters with the territory, groups of armies with the armies, each army with the territory or with neighboring armies and, finally, to assure intercommunication between the units of an army.

In the zone of operation of the armies, all necessary communications by telephone, telegraph, wireless, visual signals, etc., required by the Command were secured as follows:

1. By the use of the civil telegraph and telephone systems in the Zone of the Armies and placed under the Commander in Chief. Personnel of the "Postal and Telegraph Administration" (Administration des Postes et Télégraphes) which was not mobilized but which remained on the spot, received their orders (insofar as technical matters were concerned) from the military authorities.

2. By additional installations established by the "2nd Line Telegraph Service" (Télégraphie Militaire de 2ème Ligne), units of "Telegraph Engineers" (Sapeurs télégraphistes) and signalmen of troop units.

The units of the "2nd Line Telegraph Service" (Télégraphie Militaire de 2ème Ligne) were composed of mobilized employees, agents and officials of the Postal and Telegraph Administration. The units of telegraph engineers were organized by the 8th Regiment of Engineers and were to include a determined number of men from the Postal and Telegraph Administration.

The telegraph (Signal) detachments of the troop units formed an integral part of such units.

In the order in which they are enumerated above, these various Signal organizations were echelonned from the rear toward the front, and the lines which they established and operated were connected so

as to form a homogeneous plant which assured communications from the rear to the front, inversely from front to rear, as well as lateral connections, with maximum rapidity.

A. UNITS OF THE MILITARY TELEGRAPH SERVICE OF THE SECOND LINE.

(Charts 7 and 8, Chapter XX, Vol. I.)

These included technical sections at the disposal of the "Directions of the lines of communication" (Directions d'Etapes) and of the "Military Transportation Direction" (Direction des Transports Militaires) of the armies. In 1916, a number of labor detachments were also organized (placed at the disposal of General Headquarters).

All these units were under the orders of the "Director of the Military Telegraph Service of the 2nd Line" (Directeur de la Télégraphie Militaire de 2ème Ligne) at G. H. Q. This director was a high official of the Postal and Telegraph Administration and he was under the orders of the Director of the Rear (Directeur de l'Arrière).

The units of the "Military Telegraph Service of the Second Line" were charged with the establishment and operation of telegraph and telephone connections in the zone of the lines of communication (Zône des Etapes).

For the organization of this system, the Director of the Rear received the following information from the Chief of Staff of the Army:

1. The locations of the headquarters of armies and other organizations which were to be connected with G. H. Q.

2. Fortified places and cities in the territory which were to be included in the signal system of the armies. In addition, he received information concerning the relative importance of the various communication lines which were to be established.

Acting upon this information, the Director of the Rear then proceeded as follows:

1. He instructed the authorities under his orders concerning the method of employing the civil wire system and as to the additional communications which were to be established.

2. He distributed the technical sections, or detachments of these sections, among the armies.

B. TELEGRAPH SERVICE OF THE FIRST LINE (G. H. Q.)

The Telegraph Service at G. H. Q. consisted of: (a) A directing agency. (b) An executive agency.

a) *Directing Agency.*—The Chief of the Telegraph Service of the Army was the technical adviser of the Commander in Chief in all matters concerning electrical and visual communications. He, as well as officers under him, were attached to the Third Section (3e Bureau) of G. H. Q. His duties were:

1. To organize the telegraph services in the armies and distribute the telegraph units among the armies.

2. To take charge of the technical administration of the telegraph, radio and optical services.

3. The centralization of recommendations from the armies for modifications in the telegraph, radio and visual signalling matériel.

4. The general supervision of the training of the various telegraph units.

5. Supervise personnel, replacements and supply signal matériel.

6. Centralize all recommendations concerning officer personnel of the Signal Service (promotions, decorations, etc.).

b) *Executive Agencies.*—A company of "Telegraph Engineers" (Sapeurs Télégraphistes), charged with assuring the radio communications of G. H. Q. This unit was also responsible for the operation of the lighting plant at G. H. Q.

The Commander in Chief had certain telegraph units of the first line at his disposal as a general reserve. This reserve consisted of:

1) 7 telegraph companies, (motorized units).

2) 4 radiotelegraph (wireless) sections.

3) 18 light radio sections (army type).

ARMY GROUP.

The army group had no representative of the military Telegraph Service of the first line. A detachment of "Telegraph Engineers" was attached to the army group. This detachment consisted of:

a) A mobile (motorized) radio station (T. S. F.)

b) An electric light plant.

ARMY, ARMY CORPS, INFANTRY DIVISION, CAVALRY DIVISION.

Each large unit, i. e. army, army corps, division, was provided with telegraph (Signal) services which included:

a) A directing agency.

b) Executive agencies.

c) A supply agency (for armies only).

The chiefs of the telegraph services of large units were charged with:

1) Regulating and coordinating the use of means of communication (telegraph, telephone, wireless, ground telegraphy, visual and

acoustic signalling), in accordance with the instructions of the High Command.

2) Supervising the training of the personnel.

3) Improving the technical training of the personnel in the subordinate units, including the training of line troops.

4) Supervising the upkeep and use of signal matériel.

5) Assuring the supply of signal matériel.

To enable them to carry out their duties efficiently these chiefs of telegraph services received timely information concerning the plans of the Command and for this reason were attached to the Third Section (3e Bureau). Moreover, in technical matters, they were under the orders of the chiefs of the telegraph services of the next higher units.

In the larger units the executive agencies consisted of:

1. One telegraph company or detachment.
2. A radio detachment or section and, eventually, reserve elements.

C. DETACHMENTS WITH THE TROOPS.

(Ateliers des Transmissions des Corps de Troupe.)

The troop units had a number of Signal installations (telephone and radiotelegraph) at their disposal for their interior communications.

The chiefs of communications (signals) of the units were under the technical orders of the chief of the telegraph services of the large organization to which their unit was attached.

The radio communications of the Air Service were carried out by the 8th Engineers; those of the Artillery by the radio operators of the 8th Engineers and by artillery troops.

II. GENERAL ORGANIZATION FOR THE SUPPLY OF SIGNAL MATÉRIEL.

(Charts 9 and 10, Chapter XX, Vol. I.)

A. Telegraph Service of the Second Line.

This service employed telegraph matériel of the "Postal, Telegraph and Telephone Administration" almost exclusively and was supplied by the central depot of the latter (Paris).

During the war secondary depots, at the disposal of the Director of the Military Telegraph Service of the 2nd Line, were organized in the Zone of the Armies at Foulain (Haute-Marne) and at Saint-Florentin (Yonne). The signal supplies of the Ministry of War were placed in the "departmental depots" of the Postal, Telegraph and Telephone Administration (entrepôts départementaux des P. T. T.).

Supply operations were coordinated in the office of the Direction of the Military Telegraph Service of the 2nd Line, at G. H. Q.

This direction supplied the following units with signal matériel from the Postal and Telegraph Administration:

1) the technical sections and labor detachments.
2) the telegraph service of the first line.

B. Telegraph Service of the First Line.

At the beginning of the war, telegraph matériel was handled in the same way as was other engineer matériel. Only small stocks of signal matériel were held by the units or were stored in the army engineer parks and these were solely for use by the regular telegraph units, to the exclusion of other combat units.

The army parks drew their supplies from the "First Supply Reserve" of the Engineers (at the regulating stations). In the interior, these supplies were known as "second reserves".

It was soon evident that this method was unsatisfactory. Trench warfare necessitated large signal installations and the telephone system rapidly increased beyond all expectations. On the other hand, the Telegraph Service gradually became the source of supply of telephone matériel for all the units and services of the field army.

It thereupon became necessary to organize a well stocked "Telegraph (Signal) Park" (Parc télégraphique) in each of the armies, equipped with the necessary facilities to undertake repairs. These parks received their supplies, first, from the "First Supply Reserve" of the Engineers and, later, direct from the interior. From then on, the Telegraph Service became independent of the Engineers insofar as supply was concerned.

The Signal supply system was organized as follows:

Depots (entrepôts) were organized in the interior at Vaudoire, Estressin, and Angers. A fourth depot, established later at Brétigny, was particularly charged with the supply of matériel for permanent lines. These depots were at the exclusive disposal of G. H. Q. which employed them to supply the army telegraph parks. G. H. Q. only called on the Ministry for such matériel as was unavailable in the depots.

The matériel requested from the Postal, Telegraph and Telephone Administration was furnished to the "Telegraph Service of the First Line" by the "Director of the Military Telegraph Service of the 2nd Line", at G. H. Q.

In the armies, there was only one source of supply—the army telegraph park, under the chief of the army telegraph services.

However, in order to avoid too frequent shipments of matériel, the chief of the army telegraph services could place a reserve of ma-

tériel at the disposal of the chiefs of the corps and divisional telegraph services.

The army telegraph services supplied: The telegraph units of the army; the army corps telegraph services; the units attached to an army or stationed in its zone.

The army corps telegraph services supplied: The units of the army corps; the divisional telegraph services; the units directly attached to the army corps.

The divisional telegraph services supplied: The various divisional units and such units as were attached to the division.

The units and services sent their requests to the chief of the telegraph services of the large unit of which they formed part (army corps or division). The chiefs of the telegraph services in the various echelons consolidated these demands, examined them, and filled them by means of the stocks at their disposal. These stocks were replenished by requests upon the chief of the telegraph services of the next higher echelon.

In order to keep his park supplied, the Chief of the Telegraph Service addressed his demands, as already stated, either to the depots, to the "Director of the Military Telegraph Service of the 2nd Line", at G. H. Q., or, to the Ministry (4th Direction, 2nd Bureau).

III. STUDIES FOR THE IMPROVEMENT OF THE MATÉRIEL.

At the beginning of the war, a single establishment was charged with making studies concerning telegraph, telephone, radio and visual signal matériel. This establishment simply made contracts and received the matériel. It was under the orders of the Engineer Direction.

On account of various complications and the increase in production, another establishment was organized and charged with handling telegraph, telephone, visual signal and carrier pigeon matériel. Subsequently, an office known as the "Direction of Telegraph (Signal) Matériel" (Direction du Matériel de la Télégraphie) was established to coordinate all questions pertaining to signal supplies, and it functioned under the direct orders of the Minister. The Telegraph Service then became absolutely autonomous, insofar as the manufacture of signal matériel in the interior was concerned, as well as for the supply of such matériel to the armies.

Periodical conferences were held between the representatives of the Minister, the Direction of (Signal) Telegraph Matériel, and the Telegraph Service of the Army, for the purpose of securing close cooperation between the manufacturers and the Army. These conferences were primarily held for the study of radio questions but,

at the end of the war, they included all questions pertaining to telegraphy.

Special conferences were also held with members of the American Signal Corps for the study of questions relating to the two armies.

APPENDIX—CHAPTER XIX—SECTION II (FRENCH).[1]

Statement on Radio (T. S. F.) matériel furnished to the Allied Armies by the "Central Establishment for Radio Telegraph Matériel" (E. C. M. R.) of the French Army, from October, 1917, until the Armistice.

Summary.	Details.	Specification of materials and articles.	Quantities.
I	a	Stationary radiotelegraph stations of from 0 to 2 kw. inclusive	8
	b	Stationary radiotelegraph station of from 2.5 to 10 kw. inc	3
	d	Sending (transmitting) stations for wireless	1,058
	e	Receiving stations for wireless	953
	f	"Mixed" (combined) wireless stations	780
	c	Motorized wireless stations mounted on two cars—various	2
	y	2 kw. radiotelegraph stations mounted for pack use, model 1915	3
	d^1	Radio and telephone stations, type E–3, mounted on 1gt. motor trucks	40
	c^1	Radio and telephone stations, type E–3, for transportation on motor trucks	27
	f^1	Radio and telephone stations, type E–3, for transportation on vehicles of bomb-carrying type	22
	g^1	Radio and telephone stations, type E–3, for transportation on various types of vehicles	194
	i^1	Radio and telephone stations, type E–3, mounted on 1gt. motor trucks	23
	k^1	Radio and telephone stations, type E–4, mounted for pack use	6
	o^1	Portable wireless stations (sets)	803
	s^1	Light sending (transmitting) stations (sets) for airplanes	708
	t^1	Receiving stations (sets) for use *aboard* airplanes (telegraph and telephone)	435
	u^1	Combined receiving and transmitting sets for use *aboard* airplanes (telephone and telegraph)	13
	v^1	Terrestrial receiving set for receiving airplane messages	2,062
	x^1	Radiogonometric station, with hut	45
	y^1	Type E–8 station	15
	z^1	Type E–10 station	464
	a^2	Type E–9 station	2
	b^2	Type E–2 station	2
	c^2	Type E–4 station	1
	d^2	Radiotelegraph, transmitting, receiving set, mounted on bicycle	2
89	56	Milliammeters	18
	68	Various transmitters	204
	101	Rheostats for wireless	376
	123	Transformers for wireless—various	2,425
	126	Various vibrators	903
	129	Various wireless alternators (A. C. generators)	1,796
	130	Morse apparatus, model 1907	63
	135	Double head-sets (receiving), various	328
	138	Various wireless condensers	799
	142	Various wireless interrupters	1,497
	144	Milliammeters—voltmeters	7
	145	Portable Ohmmeters	21
	169	Inductance coils for antennae wireless—various	2,027
	176	Various wireless detectors	610
	184	Various commutators	517
	186	Various "senders" (keys, etc)	3,891
	201	Various rheostat resistance	136
	204	Various wireless resonators	93
	a	Various ammeters (amperemeters)	203
	a^1	Amplifiers (audio)	1,285
	a^2	Amplifiers (radio)	341
	b	Various resonating-boxes	213
	b^1	Wireless compass	42
	b^3	Receiving-boxes, type E–3	11
	b^5	Receiving-boxes—various	21
	c	Telephone head-sets (receivers)	3,179
	c^{10}	Oscillating circuit with variometer and connections	7
	c^{11}	Wavemeter with inductance coils—T and T [2]	144
	c^1	Oscillating circuit for radio stations of from 0 to 2.5 kw	118
	c^5	Wavemeters No. 1	175
	c^6	Wavemeters No. 2	70
	c^7	Wavemeters No. 3	58
	c^8	Wavemeters No. 4	8
	c^9	Wavemeters No. 5	56

[1] Prepared by the Chief of the French "Central Establishment for Radio Telegraph Matériel," at the French Ministry of War.

Summary.	Details.	Specification of materials and articles.	Quantities.
	e	Wireless spark-gaps	252
	h	Heterodyne	89
	p	"Sender" No. 2 (key, etc.)	43
	p^{2}	Various portable cells (batteries)	782
	p^{9}	Stations for sustained waves	28
	r^{1}	Various receivers	71
	T^{3}	Vacuum tubes	275,951
	v	Various voltmeters	686
	v^{1}	Variometers	95
90	a^{3}	Spare parts for alternators	3,082
	a^{4}	Spare parts for amplifiers	208
	b	Boxes for detectors—various	26
	b^{6}	Spare parts for test-benches	139
	c^{1}	Spare parts for oscillating circuits of from 0 to 2.5 kw	198
	c^{5}	Liaison cables for wireless stations	647
	c^{6}	"Carquais" (?)	257
	c^{8}	Keys for No. 2 transmitters	40
	c^{15}	Vacuum tube receptacles	16
	d	Spare parts for detectors	42
	e^{1}	Elements (parts) of batteries (cells)	4,718
	e^{4}	Aluminium outlets for antennae receptacles	2,857
	g	Ground mats	1,521
	j	Ebonite rods for antennae reels	1,000
	p^{5}	Fish weight for airplane antennae	26,116
I	f^{2}	Receiving-transmitting land stations for airplane messages	32
	h^{2}	Stations type E–13	6
VII	b^{1}	Equipped chests for sustained wave stations E–3 and E–3 bis, antennae material	177
	e^{1}	Complete standard E–3 bis for sustained wave stations, type E–3 bis	177
	g^{1}	Control box for airplane squadrons	177
	h^{1}	Tool chests for airplane squadrons	77
	j^{1}	Antennae and grounds for artillery groups	18
	m^{1}	Amplifiers 3-ter with accessories	248
	o^{1}	Complete test-benches	45
	p^{1}	Simplified receivers with accessories	738
	q^{1}	Wavemeters with accessories	51
	s^{1}	Paraboloides with accessories	24
	y^{1}	Equipped chests for sustained wave stations E–3, electrical apparatus No. 1	11
	z^{1}	Equipped chests for sustained wave stations E–3, No. 2, antennae material	12
	e^{2}	Lot of antennae material for sustained wave stations	56
	F^{2}	Complete chest E–10 bis, for sustained wave stations	79
XIV	32	Kits for telegraph pioneers, fitted, small model	32
	31	Kits for telegraph pioneers, fitted, large model	21
	o	Completely equipped packs for wireless transmitting station	250
	p	Completely equipped packs for wireless receiving station	150
	q	Completely equipped packs for antennae materiel and grounds for portable stations	526
	r	Completely equipped packs for accessories and spare parts for portable stations	105
	s	Chests for papers (field desks), equipped	3
	x	Accessories for motor control	235
	a^{1}	Boxes for hydrometers	577
1	v	Vehicles for carrying accumulators	3
5	r	Trailers	5
7	g	Electrical generating dynamo of from 0 to 2.5 kw	149
	g^{1}	Spare parts for electrical generating dynamo of from 0 to 2.5 kw	1,321
	g^{12}	Generator sets of from 0 to 5 kw	4
	g^{14}	Generator sets of from 5 to 25 kw	2
	g^{18}	Generator sets with two collectors	337
	h	Various coils	3,971
	m	Electric motor of from 0 to 5 kw	576
	m^{1}	Spare parts for motor (electric) of from 0 to 5 kw	11
	m^{7}	Heat engines of from 0 to 10-hp, inclusive	6
	m^{8}	Spare parts for heat engines of from 0 to 10-hp, inclusive	400
	m^{13}	Various magnetos	5
	m^{14}	Spare parts for magnetos	9
	m^{15}	Coil supports	50
	r	Gasoline tanks	40
	t	Kits for magnetos	2
42	109	Switch-board for electrical installations	1
	b	Batteries of electrical accumulators—various	50,759
51	102	Revolution counters	122
	d^{1}	Hydrometers	967
56	c	Four-conductor cable sheathed in leather, of 9.40 m. length	5
	c^{3}	Two-conductor cable sheathed in leather, of 4.50 m. length	3
	c^{4}	Five-conductor cable sheathed in leather, of 4.50 m. length	8
57	4	Cordage, with or without buckles, toggles, etc., of 9 mm. diameter or less, meters	31,550
71	f	Filament wire, do	9,102
	f^{1}	Wire for ammeters, do	120
74	t	Rubber tubes, do	5,483.20
89	1	Wireless hot-wire ammeters (amperemeters)	656
90	p^{14}	Spare parts for paraboloides	699
	r^{2}	Antennae reels	2,415
	t^{3}	Accessory kits for airplane stations	384
	t^{4}	Ebonite tubes, 1.50 m. in length	2,414
	t^{5}	Ebonite tubes, 0.80 m. in length	214

Summary.	Details.	Specification of materials and articles.	Quantities.
	v	Spare parts for voltmeters	210
91	95	Unreeling apparatus for light cable, model 1907	473
	108	Portable metallic aerial masts—various	86
	p[1]	Iron T-bar Ground stakes	3,655
	111	Ground stakes, model 1906	1,488
	116	Unreeling wheelbarrows, model 1911	500
	r	Spare parts for 50 m. metallic masts	1,732
92	12	Various single-conductor cables, meters	32,491
	15	Light cable, model 1908, do	118,000
	16	Special cable for antennæ—various, do	1,116,783
	17	Field cables, model 1903, modified, do	4,902
7	g[19]	Spare parts for generator sets with two collectors	436

CHAPTER XIX.

SECTION III.

SIGNAL SERVICE (BELGIAN).[1]

EXPLANATORY NOTE.—The Belgian Signal Service, properly speaking, comprised only the operation of military telegraphs and telephones and visual signals.

TELEGRAPHY AND MILITARY SIGNALS IN THE BELGIAN ARMY.

ORGANIZATION.

The telegraph and telephone personnel (troops of the Signal Service of the Belgian Army) was responsible only for the establishment of necessary telegraph, telephone, and visual communications.

This personnel consisted of units of telegraph operators and, later, included crews of telephone operators, which formed part of the troop units (regiment, battalion, group, infantry, cavalry and artillery).

The "Director of Military Telegraphy" (Directeur de la Télégraphie Militaire) was under the orders of the Commander of the Army for matters relating to the army in the field, and under the Ministry of War for matters pertaining to the Service of the Rear (workshops, parks, depots).

I. ORGANIZATION OF MILITARY TELEGRAPHY IN THE FIELD ARMY.

(Charts 3 and 4, Chapter XX, Vol. I.)

The military Telegraph Service consisted of:

1) A "Direction of Military Telegraphy" (Direction de la Télégraphie Militaire) attached to G. H. Q., and composed of three officers.

2) Two companies of G. H. Q. telegraph troops. The first company (2 officers and 136 men) assured communications between G. H. Q. and the army divisions; the second company (3 officers and 26 men) assured communications between G. H. Q. and the rear, as well as those in the interior of the country.

[1] Prepared by the Military Board of Allied Supply from data furnished by the Belgian Ministry of War.

3) A company of telegraph troops with each army division and assigned as follows:

One platoon (1 officer and 66 men) with the army division, for communications between the headquarters of the army division, the headquarters of the infantry divisions (assigned to the army division) and neighboring headquarters.

One platoon (1 officer and 45 men) to each infantry division, for communications at the headquarters of the infantry division.

The total number of army telegraph troops at the date of October 31, 1918, amounted to 27 officers and 1,389 men.[2]

II. ORGANIZATION OF MILITARY TELEGRAPHY IN THE SERVICE OF THE REAR.

The military Telegraph Service of the Rear consisted of: One "Park Company" (Compagnie de parc) and one "Depot Company" (Compagnie de dépôt).

The "Park Company" (5 officers, 213 men) maintained repair shops and supply depots. It was charged with purchasing supplies and with property accounts.

The "Depot Company" (3 officers, 300 men) received the telegraph personnel coming from the front or who were sent back from the hospitals. It functioned as a training center for the officers and men of the Telephone and Telegraph Service. It was also charged with the upkeep and maintenance of the telephone system of the base.

III. ORGANIZATION OF THE "TELEPHONE-SIGNALMEN."

(Téléphonistes Signaleurs—T. S.)

A crew (équipe) of "telephone-signalmen" (7 to 14) was assigned to the staff of each battalion, group, regiment, infantry division and battery. Their duty was to establish and maintain communications by means of telephones, or by visual signals, between their echelon and the next higher echelon.

In the regiments, the signalmen (T. S.) were under the orders of a "Signal" (T. S.) officer. There were 66 Signal officers and 4,400 Signal troops in the Belgian Army.

[2] NOTE.—An "Army Division" (Division d'Armée) in the Belgian Army corresponded to the strength of a division in the American Army, while the Belgian "Infantry Division" (Division d'Infanterie) corresponded to a brigade in the American Army.

Statistics as of October 31, 1918.

The Signal matériel of the Belgian Army, on a front of approximately 30 kilometers, consisted mainly of the following:

80 telephone centrals or exchanges.
4,000 drops.
8,000 telephones.
3,600 wooden poles.
60,000 double bell insulators.
20,000 round insulators.
16,000 kilometers of lines, including buried lines, for which approximately 400 kilometers of trenches had to be dug, at an average depth of 2½ meters.

For the repair and operation of the matériel the base was obliged to furnish, during the four years of war:

800 telephones.
110,000 telephone batteries.
30,000 kilometers of cable.
20,000 kilometers of bronze wire.
10,000 drops.
15,000 poles.
300,000 double bell insulators.
200,000 round insulators.

Below are given the appropriations which were required for the Belgian Signal Corps:

For 1915–1916	francs	1,600,000
For 1917	do	5,268,050
For 1918	do	10,800,000
Estimates for 1919	do	22,500,000

No record was made of the number of messages.

Personnel.

	Officers.	Men.
Officers—telegraphers	33	
Telegraph operators		1,418
Officers—telephonists (Artillery signaling)	20	
Telephone operators (Artillery signaling)		2,909
Officers—telephonists (Infantry signaling)	48	
Telephone operators (Infantry signaling)		1,721
Total officers	101	
Total men		6,048

CHAPTER XIX.

SECTION IV.

SIGNAL SUPPLY SERVICE (ITALIAN).

This service assured the operation of the following means of communication:

Electric signals (telegraph, telephone, wireless, goniometrical);

Visual signals (apparatus for optic signals, wig-wag (flag signals), heliograph (*razzi*), etc.);

Sound and flash ranging (megaphones, bugles, rockets, flash signals), heliograph (*razzi*), etc.);

Courier-messenger services (courier, carrier pigeons, dogs, etc.); Aviation (captive balloons, aeroplanes).

This section will be limited to a consideration of electric signal communications, as these were extensively used and because of the important results obtained therefrom.

TELEGRAPH AND TELEPHONE SERVICES.

(Chart 11, Chapter XX, Vol. I.)

In the advanced zone the telegraph and telephone services were operated by the military engineers, and in the zone of the rear by mobilized personnel belonging to the Ministry of Posts and Telegraphs. The military engineers used existing trunk lines and extended them according to the needs of the service, while the Ministry of Posts and Telegraphs operated the Government telegraph lines which existed in the Zone of the Rear, and modified or extended them according to circumstances.

DIRECTING AGENCIES.

At the beginning, the directing agencies of the military service and of the civilian service were entirely separate.

The military service had:

A Chief Inspector of the Military Service with the Supreme Command. He was under the orders of the General Engineer Command and had charge of all the military telegraph and radiotelegraph services.

An Inspector of the Army Telegraph Services with each army command (army Engineer command), who directed the services in the army to which he was assigned.

The civil telegraph service had:

A General Commissioner of Telegraphs, with the General Commissariat, who had charge of the entire Government telegraph service.

An Army Telegraph Commissioner, with each army Commissariat, who directed the permanent telegraph services in the zone assigned to the army to which he was attached.

Three minor Telegraph Commissioners for the Coast Defence Zone.

To obtain the necessary co-operation between the military and the Government telegraph services, a high official of the Ministry of Posts and Telegraphs was attached to the Supreme Command. He was known as the *Chief Commissioner of Telegraphs*. This official also acted as technical advisor for the entire Telegraph Service of the Army.

Subsequently, war experience brought about the following modifications in the organization of the directing agencies.

a) *The Chief Commissioner of Telegraphs* was abolished, as it was found that the chief inspector of the military service could handle the work satisfactorily by co-operation with the General Commissioner of Telegraphs.

b) *The General Commissioner of Telegraphs and the Army Telegraph Commissioners* were removed from under the control of the General Commissariat and army Commissariats, respectively. The former was placed under the orders of the General Engineer Command while the latter were placed under the Engineer commands of the armies to which they belonged.

The administration of the entire Telegraph Service thus passed to the military inspectors while the Commissariats became the coordinating and directing agencies for the civil services.

c) *Army Corps Telegraph Inspectors* were established in the army corps Engineer commands on account of the great development of the Telegraph Service. The army corps telegraph services were controlled by these inspectors in the zones of their respective army corps.

EXECUTIVE AGENCIES.

The following were the executive agencies of the military Telegraph Service:

Telegraph Companies: These were at first assigned in the proportion of one each to the Supreme Command, army commands and

army corps commands. Later, this number was increased in order to provide better communications throughout, as well as for the artillery, aviation, anti-aircraft defence, etc.

Telegraph Sections for the cavalry divisions.

Telephone Sections for the infantry divisions. These were replaced later by *Telegraph Companies* to provide the necessary means for inter-divisional communications.

Telephone Sections for Alpine groups (mountain troops).

The executive agencies of the permanent Government telegraph services were:

Permanent Telegraph and Telephone Offices, which were in existence before the war and which were located in the territory which became the "Zone of War" or Zone of the Armies.

Offices for the new establishments, such as detached, relay, or special reserve telegraph and telephone stations, as well as mobile (motorized) telephone posts.

All of these stations were operated by mobilized personnel from the Government telegraph services and this personnel was subsequently increased by military personnel under the control of the telegraph Commissariats.

OPERATION OF THE SERVICE

The territory under the jurisdiction of the Supreme Command was served by the following signal lines:

Telephone lines for the general service;
Telegraph and telephone lines for the artillery service;
Telephone lines for the air service;
Telegraph lines for the radiogoniometrical service;
Telegraph and telephone lines for the anti-aircraft service.

In general, the telegraph companies assured communications between the commands to which they were assigned and subordinate commands and services, as well as with the neighboring commands. Either existing permanent lines were utilized, or field lines were established for these purposes.

One of the two companies assigned to the army corps established and operated the communications for the Artillery.

The divisional telegraph companies not only assured general intercommunications, but these companies also established and operated the infantry communications as far down as the battalion commands; artillery communications between regimental commands and commanders of groups of artillery, and the communications between the infantry and cavalry.

The communications between battalions, detachments, and minor units was assured by the signal personnel of these units.

As needs arose, the army telegraph commissioners modified and enlarged the Government lines, established new plants and offices, and increased the operating personnel by requesting same from the military Inspector of Telegraphs. The army telegraph commissioners were in constant communication with the military Inspector to Telegraphs, in order to secure coordination between the field services and the Government telegraph services.

In carrying out the amplification and modification of the Government lines and in establishing new offices, the army telegraph commissioners were assisted by the *Telegraph and Telephone Construction Administrations* and the *Divisional Telephone Administrations.* Both of these agencies were in operation before the war.

The supervision and maintenance of the telegraph and telephone circuits of the first line were exercised by the troops of the telegraph companies and by the telephone personnel of the corps (one kilometer of line, if overhead, and two kilometers, if buried). Behind the first lines, the circuits were supervised by "telegraph wire guards" (the civilian wire guards belonged to the Administration of Posts, Telegraphs and Telephones), each of whom inspected ten kilometers of line daily.

To maintain secrecy concerning the location of the various commands, detachments, and services of the mobilized army, military communications, whether telegraphed by the Government or by private parties, carried the generic indication "Zone of the Armies." Messages thus filed were sent to special *Telegraph centers*, from whence the messages were forwarded to the telegraph offices nearest to the units for whom intended, by means of data supplied daily by the General Commissariat. From the latter, messages passed from the permanent to the field lines and proceeded by wire as far as the field lines extended. If necessary messages were relayed to their destination by other means (courier, etc.). Communications addressed to the interior of the country were forwarded, without delay, to their destinations by the telegraph office which received the message.

SUPPLY OF TELEGRAPH AND TELEPHONE MATERIEL

Difficulties had to be overcome throughout the war to assure the supply of telegraph and telephone matériel, on account of the ever-increasing importance assumed by the Signal services. The initial supplies were provided by:

The Ministry of Posts, Telegraphs and Telephones, for the permanent Government lines;

The Ministry of War and the General Commissariat, for the military lines.

For the permanent Government lines, special supply depots had been established before the war in localities near the frontier. These depots furnished the Commissariats with the matériel required for the initial establishment of lines and new offices. This matériel was distributed through the General Telegraph Administration (forming part of the Ministry of Posts, Telegraphs and Telephones), which purchased it from private manufacturers.

For the field lines, an initial supply was provided by *Telegraph Parks* assigned to the telegraph companies. The latter carried limited quantities of matériel for the establishment and operation of field telegraph and telephone lines.

Theoretically, the supply of telegraph and telephone matériel for these parks was furnished by the *Advanced Engineer Storehouses* under the control of the army Commissariats, and the storehouses, in turn, were supplied by the *Central Depots.*

However, during the first months of the war, on account of the shortage of matériel and the urgency of the work, a system was adopted by which the matérial was sent direct from the producing establishments (military and private factories) to the advanced army storehouses, in accordance with instructions from the General Commissariat.

Subsequently, the above system of supply had to be reorganized, on account of the ever-increasing requirements of the artillery, the need felt by the High Command for more extensive communications, the insufficiency of matériel within the units, and the difficulty of maintaining a full stock (a numero) of supplies for the Government lines in the special depots.

Under the new plan the special depots assumed the supply of telegraph and telephone matériel to the army in the field. This system functioned as follows:

a) *The Engineer Establishment at Padua* was charged with the collection of all telephone and telegraph matériel then avaliable in Italy and, after being tested, this matériel was sent direct to the special depots of the General Commissariat. The *laboratory of the Third Telegraph Regiment* was also used by the above mentioned establishment for the preparation of regulation matériel. For everything else the Padua establishment had recourse to private industries and it directed and regulated the work of the latter.

b) The advanced storehouses and the telegraph Commissariats were supplied from the special depots mentioned in the preceding paragraph. This concentration was necessary in order to quickly supply urgent and unforeseen requirements which, on account of the scarcity of matériel, could not have been satisfied if the normal system of replacement had been followed.

c) *Small repair shops* were established by each telegraph company, and larger repair shops were organized in the armies under the control of the Inspectors of Telegraphs. A factory was also established for the major repairs to equipment and material and operated under the control of the General Commissariat.

As a result of this new organization the central depots were abolished and the following reserve establishments functioned for the Telegraph Service:

The Engineer Establishment at Padua.

The Laboratory of the Third Regiment of Engineers (telegraph troops).

The Territorial Engineer Administration, which was specially charged with the purchase of telegraph and telephone matériel and equipment in the open market.

RADIOTELEGRAPH SERVICE.

Directing Agencies.—The directing agencies of the military Telegraph Service also controlled the Radiotelegraph Service and assigned officers to direct the latter.

The officers assigned to the army commands for this purpose later became commanders of the various army radiotelegraph services, under the control of the Radiotelegraph Inspector of the Army.

The Chief Inspector of Telegraphs continued to act as Director of the Radiotelegraph Service at the Supreme Command.

Executive Agencies.—At the beginning of the war, there was a *Radiotelegraph Section* with the Supreme Command and one with every army command and divisional command of cavalry, as well as a *Radiotelegraph Office* at Treviso. The latter controlled the permanent radiotelegraph establishments of the fortresses in the Zone of the Armies.

Each section was equipped with mobile radiotelegraph stations (on railway cars or motor trucks); while the radiotelegraph office at Treviso controlled twelve permanent radiotelegraph stations.

The above allotment proved at once to be insufficient and additional radiotelegraph units were assigned to the armies. The new units operated radiotelegraph stations, varying in number and power according to particular requirements (intercept and goniometer stations). The radiotelegraph system was extended to include the smaller commands and to assure communications between adjacent units.

The technical direction of the army radiotelegraph services, which included the aviation service, was centralized in a section within each army.

The Chief Inspector of the military Telegraph Service at the Supreme Command maintained supreme control over the radiotelegraph services in the Zone of the Armies, as well as over the permanent stations outside of the Zone of the Armies and all radiotelegraph establishments not assigned to the armies.

Subsequently, through the experiences of war, the need for further coordination of this service was recognized. As a result, the initial allotment of radiotelegraph stations to the army corps and divisions was slowly being extended to brigades, regiments, and battalions when the Armistice intervened.

SUPPLY OF RADIOTELEGRAPH MATÉRIEL.

At the base, radiotelegraph matériel was furnished almost entirely by the Marconi Company, through its Italian office. The latter obtained supplies by importations from England but, during the latter part of the war, this matériel was produced in the Marconi manufacturing establishment at Genoa.

To coordinate and standardize the supply of signal equipment manufactured by private industries, a *Radiotelegraph and Electrical Telegraph Office* was established at Rome; this office formed part of the existing *Military Radiotelegraph Institute.*

An *Advanced Storehouse for Radiotelegraph Matériel* was established in the Zone of the Armies. It was controlled by the Chief Inspector of Telegraphs and restocked by the radiotelegraph and engineer producing establishments.

This storehouse supplied all the equipment and matériel for the radiotelegraph sections. Special matériel was supplied by the advanced engineer storehouses. The radiotelegraph sections maintained small reserves of radiotelegraph matériel and they also had a small laboratory for minor or emergency repairs.

CHAPTER XIX.

SECTION V.

TELEPHONE AND TELEGRAPH SERVICES, SIGNAL CORPS, AMERICAN EXPEDITIONARY FORCES.[1]

GENERAL.

(Chart 5, Chapter XX, Vol. I.)

It has been the function of the Signal Corps to provide adequate facilities for the transmission of communications the nature and importance of which could not be transmitted through the mails or courier system. The means used to the greatest extent in providing this liaison system were the telephone and the telegraph. The operations consisted of two phases, one for the requirements in connection with the creation and the administration of the machinery for supplying the combat units, and second for the liaison between the Command and the adjacent combat units. The provision of telephone and telegraph service for the American Expeditionary Forces presented a problem of considerable magnitude on account of the location of the combat units with respect to the ports of entry from which they were supplied, and the inability of the French Government to furnish but very few of the telephone and telegraph facilities which would be necessary.

Upon the arrival of the American Command in France the immediate problem confronting the Signal Corps was the establishment of adequate means of telephone and telegraph communication between Paris, the temporary headquarters of the American Expeditionary Forces, and Nevers the proposed location of the American supply depot. The Chief Signal Officer, A. E. F. proceeded to establish relations with the French authorities, and arrangements were concluded for the transmitting of messages over the general French systems (pending the establishment of the proposed Signal Corps system of communication).

It developed in the early conferences that the long duration of the war, with its demands on the Allied man-power and raw materials, and the already heavy traffic on French facilities, would preclude the securing from that system of any considerable portion of facilities

[1] Prepared for the M. B. A. S. by the Chief Signal Officer, A. E. F.

required. Accordingly, tentative plans for the basis of ordering materials and apparatus were completed to cover a flexible and extensive all-American system. The American system was designed to supplement and reinforce such facilities as could be secured from the French system. Conferences were held with the French and British military and civilian telephone and telegraph authorities and arrangements were concluded whereby such facilities of their systems as could possibly be made available would be placed at the disposal of the A. E. F., for the use of the Signal Corps.

BEGINNING OF A TELEPHONE AND TELEGRAPH SYSTEM.

The French telephone and telegraph system was used exclusively in the early stages. The first Signal Corps telephone office was opened at Paris on June 15, 1917. From June to August small telephone systems were established at the various base ports in France. The first Signal Corps telegraph line to be put into operation in Europe was leased from the French, between Paris and Nevers, and was equipped with French instruments later remodeled by Signal Corps personnel for the American type of operation. This telegraph line was opened August 9, 1917. The Signal Corps system was expanded until offices for telephone and telegraph services were in operation at the American Headquarters at Paris and Cosne, Vierzon, Dijon, Nantes, and Bordeaux. It was evident that on account of the limited wire facilities in the French system, the Signal Corps of the United States Army would have to build an extensive system of communication and, accordingly, plans were formulated for the construction of a pole and wire line from the first base port, St. Nazaire, to the rear of the zone of combat operations which would eventually be occupied by the United States Army.

It was foreseen at this time that available Signal Corps personnel should be brought to France ahead of the combat units to which they would later be assigned. Accordingly requisitions for personnel were placed and the first telegraph battalions arrived in France on August 20, 1917. They were assigned to duty in the construction of the above mentioned line, the initial portion being between Dijon and Gondrecourt. The arrival of additional Signal Corps personnel and the construction of the necessary facilities over and above those which the Signal Corps were able to obtain from the French system were completed as rapidly as supplies and available personnel would permit.

The first extensive Signal Corps telephone exchange was installed in France at the new General Headquarters of the American Expeditionary Forces, at Chaumont. It was put in operation on September

1, 1917, and provided service to the various offices as rapidly as they were occupied.

Combat divisions of the American Army began to arrive in their divisional training areas in France in the latter part of December, 1917. Telephone and telegraph lines were extended to these areas for the purposes of general command and supply administration. At the same time liaison nets for training purposes were established within the training areas.

During October, 1917, it became evident that the volume of communications between the War Department, at Washington, and the American Expeditionary Forces was increasing to such an extent that the existing facilities across the English Channel were rapidly becoming inadequate. Accordingly, the Chief Signal Officer, American Expeditionary Forces, visited England in November, 1917, and perfected arrangements for the laying of a four conductor cable across the Channel and for the necessary telephone and telegraph lines in England. Pending the carrying out of these projects, immediate arrangements were made for one telegraph line from London to Paris, where it connected with the already established Signal Corps system to Chaumont. The Signal Corps service over this system was inaugurated from Chaumont to London by General Pershing, who sent the first official message to the American Ambassador at London. The special American cable was laid across the Channel and connected to the Signal Corps offices in Paris and London by the leased land lines on February 25, 1918. Arrangements were also made in November, 1917, with the Western Union Company under which that company reserved part of their system from London to New York for official American Expeditionary Forces communications, thereby giving direct service between General Headquarters, American Expeditionary Forces, and Washington, D. C.

THE COMPLETED SYSTEM.

The completed telephone and telegraph system of the Services of Supply at the signing of the Armistice, consisted of a means of liaison between all units of the American Expeditionary Forces. For purposes of description it may be divided into three parts; namely, (1) net for the General Command, Administration, and Services of Supply; (2) special net for the Transportation Service; and (3) net for the United States Navy in France.

(1) *The net for the General Command, Administration and Services of Supply* (Chart 6, Chapter XX, Vol. I).—The meagre wire plant available in the French system for the use of the American Expeditionary Forces necessitated the construction of standard

American pole and wire lines from General Headquarters, at Chaumont, to the headquarters of the Services of Supply at Tours, to the training areas in the vicinity of Chaumont, to the headquarters of the First Army, at Souilly, and to the headquarters of the Second Army at Toul. Also, American built lines were necessary to connect the headquarters of the Services of Supply with the base ports at Brest, St. Nazaire and Bordeaux, and a second line from Tours to Chaumont by way of Paris. The connection between the Headquarters Services of Supply and the headquarters of Base Sections Nos. 3, 4, 5 and 7 consisted of lines leased from the British and French civil systems.

The lines built by the Signal Corps were so engineered and routed as to provide the most direct connection with the Signal Corps system for a large majority of the American Expeditionary units in France and England. Into the Signal Corps system was woven the leased lines obtained from the French and English civil systems, making a most complete and very productive telephone and telegraph system operated and maintained by Signal Corps personnel. To further tie in those areas where only civil service could be furnished, connection was obtained from each Signal Corps office to the nearest civil office of the French and English systems. The entire arrangement provided for a universal and very prompt service so essential to the military operations.

At all centers of activities in the American Expeditionary Forces, except the very smallest, local telephone installations were made and telegraph offices were opened. For the very small units connections were made to the long line system where practicable, otherwise connections were made with the French and British civil and military systems.

The plan covering the Signal Corps system in France continually had as its basis the fundamental principle that whatever facility was put in, it should be of such a character as to provide the greatest amount of service commensurate with the expenditure of material and labor and the tonnage required. To this end the lines constructed were so equipped, operated and maintained as to obtain a maximum efficiency. For example, four single wires between Tours and Chaumont were equipped and operated to provide three telephone circuits and sixteen telegraph circuits. These practices permitted the utilization of a minimum of tonnage from the United States, and the result throughout was a flexible system whereby telephone communications over small copper wires were made possible throughout the American Expeditionary Forces, a result over similar distances not having even been approximated in the French system. For example, the long line system consisted of copper wire ap-

proximately 2½ mm. in diameter, whereas the longer lines in the French civil system consisted of wire approximately twice this diameter. In addition, the latest development in telephone apparatus was introduced at various Signal Corps offices, which made possible satisfactory conversation with every telephone connected to the system, which was a most important arrangement from a military standpoint which otherwise would have been seriously handicapped by limitations in the use of the long distance service.

The latest developments in the art of printing telegraph terminal apparatus were utilized in the telegraph system. There were two primary considerations in the adoption of this highly useful instrument; namely, (1) that another type of special personnel could be utilized and to that extent reduce the requirements for Morse telegraph operators, the total requirements for which otherwise would have been such as to seriously interfere with the means of communication in the United States, which was so necessary to the prosecution of the war; and (2) it also provided another factor of flexibility in that there were two distinct ways of transmitting telegraph communications. This type of operation had been installed between Chaumont and London, Chaumont and Tours, Tours and London, Chaumont and Paris, and Tours and Paris. The telegraph operating forces at the points of origin and destination of the larger volume of telegraph traffic were of the highest type and the most expert operating staffs that have ever been collected. Likewise, in the telephone service women highly trained in switchboard operation were brought from the United States to serve at the larger centers. These women, to a large extent, were able to speak French and this made it possible to secure the maximum efficiency in the combined use of the French and the American systems. Their work was one of the main factors in the success of the telephone service for the American Expeditionary Forces.

(2) *Special net for the use of the Transportation Service.*—Special telephone and telegraph lines were equipped and turned over to the Director General of Transportation, American Expeditionary Forces, for use in connection with the administration and operation of that department in moving A. E. F. personnel and freight over French railroads. These lines extended from the headquarters of the Services of Supply to the principal base ports and up to the railheads in the combat zone. Special Signal Corps personnel was detailed to the operation and maintenance of these lines.

(3) *Net for the use of the United States Navy in France.*—For the use of the United States Navy, a special telephone and telegraph net was provided by the Signal Corps, United States Army, between London and the Navy stations along the coast of France. This net was made possible by the use of existing French lines, where they

could be secured by lease, and throughout the other sections by the construction of standard American lines. Local telephones and telegraph systems were installed where required at the large centers, bases of operation and observation points extending along the coast of France, from Le Havre on the North to Cap Farret, south of Bordeaux. This system provided an adequate and a most satisfactory means of communication for the United States Navy, a fact to which the commanding officers of the Navy have attested many times.

At the time of the conclusion of the Armistice there was in operation Signal Corps pole and wire plant:

Signal Corps Pole and Wire Plant.

	Kilometers.
Pole lines erected:	
(*a*) Long lines	3,200
(*b*) Local	300
	3,500
Wire plant:	
(*a*) Long line system:	
(1) Wire on poles built by Signal Corps	45,000
(2) Wire strung by Signal Corps on French pole lines	5,200
(3) Wire leased from French and operated by Signal Corps	32,800
	83,000
(*b*) Combat lines largely on Signal Corps pole lines and buried system	62,500
(*c*) Local lines and cable system	57,000
Grand total	202,500

The total wire in service was sufficient to encircle the earth five times.

Telephone System.

Telephone central offices:	
(*a*) Semi-permanent Signal Corps system	273
(*b*) Combat Signal Corps system	123
Total	396
Telephone Stations:	
(*a*) Semi-permanent Signal Corps system	9,268
(*b*) Combat Signal Corps system	3,064
(*c*) On systems other than Signal Corps but under supervision of Signal Corps	2,522
Total	14,854

Telegraph System.

Offices:	
(*a*) Semi-permanent Signal Corps system	134
(*b*) Combat Signal Corps system	64
Total	198

Communications.

Telegraph:	Kilometers.
Average telegrams per day during October	47,555
Average length of telegrams (words)	62
Average telegrams per day—on 30-word per message basis	99,280
Telephone: Average long distance telephone calls per day during October	3,825

Female Telephone Operators.

Number of operators on duty in A. E. F. during October	213

METHOD OF SUPPLY.

1. In reviewing the work of the Supply Division of the Signal Corps, or the work of the Supply Division, of the several other Staff Corps and Departments, it is well to remember that, with practically no preparation, the War Department was suddenly called upon to send a large army overseas and sustain it. Aside from the fact that that army had first to be created and trained, there were tremendous difficulties in supply, for no army of the size contemplated had ever before been transported and maintained by any nation 3,000 miles from its base, involving transportation over both ocean and land. It was an untried experiment for which there was no precedent. Not only were experienced personnel and material lacking for such a task, but the very means of using them to best advantage were unknown.

2. It was realized that the problem of supply would be of first importance and would involve tremendous difficulties because of the long distance, scarcity of tonnage, uncertainty of sea transport by reason of the submarine operations of the enemy, and because the supplies in the allied countries were, for the most part, already insufficient to care for their needs. It was natural that the first supply plans should be laid on the time honored lines of the War Department with which officers of the regular establishment at least were familiar. The immediate necessity was action and there was neither time nor competent personnel to study and develop plans better suited to supply operations on an immense scale. As the A. E. F. grew in size and action, radical changes were found necessary in supply methods and in February, 1918, a new institution in the United States Army was formed, i. e., the Services of Supply. The purpose of this institution was to concentrate the supply functions of all departments under a common head who should be responsible to the Commander in Chief. The chief of each Staff Corps and Department remained responsible to the Commander in Chief for the technical functions with which his corps was charged, but thereafter reported to the Commanding General, S. O. S., in all matters of

procurement, supply, transportation and construction. Any history of supply operations in the A. E. F. naturally divides itself into two periods; i. e., before and after creation of the Services of Supply.

3. The Signal Corps had two functions: to provide the telephone and telegraph lines of communication in the Services of Supply, and to provide technical equipment for combatant organizations. The material required for the telephone and telegraph lines of communication was, for the most part, standard American equipment which had been developed and perfected in the States, and the problem was largely one of getting sufficient of that material to supply the needs. Signal Corps equipment for field use prior to the war had been designed for a type of warfare very different from that which was conducted on the western front, and most of it was entirely unsuited for the new work. There was a considerable variation between the type of apparatus used by the British and that used by the French. It was first necessary to determine whether the French or British equipment was most suited to the American needs, or whether it would be desirable to develop an entirely new type of equipment. No quantity production could be sought until these questions were determined.

ESTIMATES OF SIGNAL MATERIAL NEEDED BY A. E. F.

4. Signal Corps material may be divided into two general classes: first, equipment and supplies required by combatant organizations, and, second, material required in the construction and maintenance of the Signal Corps telephone and telegraph lines of communication principally located in the Services of Supply. The first class comprises, in general, field wire, light portable switchboards, field telephones, radio equipment, and visual signaling apparatus. The second class includes equipment for standard telephone and telegraph installations, exchanges, and standard line material for the projects referred to above. Construction tools form a part of both classes, as does the material required for a type of light line construction designed by the Signal Corps in France and known as the "Repp" type.

5. For the first class of material, there were four factors to be considered: the material that various organizations should be equipped with, which should be covered in equipment tables; the rate at which troops would arrive to be equipped; the rate at which their material and equipment would have to be replaced to make up for losses and wastage; and a knowledge of how much of a reserve should be kept on hand to provide for any emergency. The quantity of the second class of material depended on the number and size of installations which were to be made, and the length and number of

lines required for each. These projects were planned by the Engineering Division of this office, and constructed and maintained by the Telephone and Telegraph Division. It was necessary, therefore, to rely on them to furnish the necessary information as to the number and size of the projects and as to the material required for maintenance.

AVAILABLE SOURCES OF SUPPLY.

6. As stated above, Signal Corps material is of two classes—Signal equipment and supplies for combatant organizations, and telephone and telegraph equipment and supplies used in construction of lines in the S. O. S. The second class is primarily standard American equipment, with the exception of poles, cross-arms and wire. The logical source of supply, therefore, was from the United States. A large portion of the first class, however, was equipment which had been developed in Europe resulting from the nature of warfare conducted, and therefore, had to be procured there, at least until the equivalents were under production in the United States. Obtaining material from the United States, however, was accompanied by tonnage difficulties due to the shortage of ships, by undesirable delays due to the difficulty in increasing production of material required to a war time basis.

7. Practicable European sources consisted of France, England, Switzerland, Spain and Italy. In each of these countries, in general, the prices were higher than in the United States and, as far as the commercial material required for the Signal Corps was concerned, the quality inferior. Particularly in France and England, the manufacturing industries were all working at their maximum capacity supplying the Allies when the Americans arrived. In both countries there was an acute shortage of most raw materials. The result was a considerable delay in securing material ordered. Both, however, were close at hand, easier to reach for emergency calls and it was possible to keep in much closer touch with orders placed there than in the United States. Italy is not a manufacturing country of first importance and had practically nothing which the Signal Corps could use. Switzerland and Spain were both neutral, and were also handicapped by lack of most raw materials. The reliability of a great many of the firms in neutral countries was questionable. Except for wrist watches, which were secured in quantity in Switzerland, practically nothing was bought in either of these countries. The United States having adopted in general the French type of field equipment, particularly radio equipment, it was necessary, until production was started in the United States, to procure all such items in that country. Inasmuch as practically none of this type of mate-

rial had been received from the United States up to the time of the Armistice, practically all of it secured was purchased in France. Due to a lack of the proper kinds of field and outpost wire in the United States, and the delay in putting it under production, considerable quantities were secured from England.

8. In general, a better grade of most of the materials used by the Signal Corps could be procured in the United States, cheaper than in Europe. There were exceptions to this, an example of which might be mentioned in cross-arms and poles, which could be procured as cheaply and more expediently in France than from the United States. As mentioned previously, there was, however, certain military equipment not under production in the United States for which the French Government was the only source available during the period of hostilities, as American substitutes had not been received in quantity up to the Armistice.

9. Requisitions were placed in the United States to cover Signal Corps needs of all items which could be procured there. However, because production was so slow in starting, the results were most discouraging at first, particularly with respect to organization equipment and large purchases were necessary wherever they could be made in Europe, disregarding the higher prices which it was necessary to pay. In general, the policy was not to place large orders in Europe, but to purchase at any one time merely enough to cover the immediate need in the hope that the supply from the United States would shortly come up to what was expected. This it did not, and in August, after the sinking of the ship "Tippecanoe," reported to carry a very large quantity of Signal Corps material, it was decided to change this policy and place orders in Europe sufficiently large to take care of such emergency.

PROCUREMENT METHODS AND ROUTINE.

10. Requisitions for material placed on the United States at first had to be approved by the Commander in Chief before being forwarded to Washington. This function was later taken over by the Commanding General, S. O. S. The requisitions were prepared, especial attention being given to nomenclature and description so that the Office of the Chief Signal Officer in Washington would have no difficulty in identifying what was desired. Date and rate of delivery was indicated and a tonnage statement prepared for G–4, General Staff, Headquarters S. O. S., showing both the ship and weight tons involved and indicating the periods in which delivery was expected. These requisitions were submitted to the Chief Signal Officer, A. E. F., by whom they were submitted to the Commanding General, S. O. S., recommending approval. If approved, they

were returned to this office and forwarded by mail to the Chief Signal Officer in Washington for action. In the case of small requisitions forwarded by cablegram, this approval was not required, it being merely necessary to attach a tonnage statement with the cable draft.

11. The larger portion of material ordered in Europe was handled by requisition through the Purchasing and Disbursing Section in Paris, which actually placed the orders with the producer through the prescribed channels. Some, however, particularly after categories were outlined, were requisitioned on the other staff departments, but were handled in essentially the same manner.

SIGNAL CORPS DEPOTS AND ISSUE METHODS.

12. Signal Corps supplies were kept in stock at corps dumps, army parks, advance depots, intermediate depots, base depots, and certain special depots. Supplies were issued from corps dumps and army parks on requisitions approved by the supply section of the staff of the unit to which the dump or park was attached. The advance depot made issues on requisitions approved by the Assistant Chief Signal Officer or G–4 of G. H. Q., the Chief Signal Officer or G–4 of an army, the Chief Signal Officer or G–1 of a detached division. Items that could not be filled from the advance depot were extracted to the Chief Signal Officer, S. O. S., for supply from other depots.

13. Requisitions originating within the S. O. S. were referred to the office of the Chief Signal Officer, S. O. S., and, if approved, issues were directed from the nearest available stocks. Inasmuch as the demands of combat troops would not permit of the establishment of an adequate reserve at intermediate and base depots, it was necessary to centralize the control of issues for S. O. S. activities. By this means, considerable economy was effected in the issues and the stocks in all depots were made available to meet the daily demands.

14. Originally, equipment for combat organizations was shipped from the United States in the same month that the organizations sailed, and consigned to them. As the equipment frequently did not land at the same port as the organization and was often delayed enroute, the plan was adopted of having all such troop property shipped direct to Signal Corps depots and new equipment issued to the organizations immediately upon arrival. In this way, considerable delay was avoided in equipping troops for training.

15. The Signal Corps Advance Supply Depot No. 1, was established at Is-sur-Tille (Côte d'Or) in January, 1918. While this depot was primarily for supply of combat organizations, it served

also as a center for distribution of construction material in the Advance Section.

16. A general supply depot was opened at Nevers (Nièvre) in September, 1917, which became an intermediate depot after the advance depot was opened at Is-sur-Tille. After a year of operation, this depot was evacuated in favor of Intermediate Depot No. 2, established at Gièvres (Loir-et-Cher), which became the main supply center for the S. O. S. During the time that American troops occupied the Paris sector, the supply depot at Gièvres temporarily functioned as an advance depot. At the time of the cessation of hostilities, a new intermediate depot was ready to be opened at Montierchaume (Indre).

17. Base depots were opened at St. Sulpice, near Bordeaux, in August, 1918, and at Montoir, near St. Nazaire, in September, 1918. In addition to storing transient stock, the base depots supplied the territory tributary to these two centers.

18. A special depot was opened for the storage of photographic material at Paris, in August, 1918. In operation, this depot served both as an advance and an intermediate depot. In October, 1918, a special depot was opened at Orly Field, near Paris, for the storage of radio equipment to be issued to the Air Service.

ORGANIZATION OF THE SUPPLY DIVISION, SIGNAL CORPS, A. E. F.

19. This organization was particularly designed for a highly centralized control of supplies. This control was exerted over all supplies other than those under control of the organization in the Zone of the Armies, and was vested in the Director of Supplies, acting for the Chief Signal Officer, S. O. S.

CHAPTER XX.

SECTION I—PART 1.

CONSTRUCTION (WORKS) SERVICES (BRITISH).[1]

HISTORICAL NARRATIVE.

The headquarters of the Works Directorate mobilized on the 5th August 1914, at Kensington Palace Hotel, London. It consisted of three officers. It left London August 9th for Southampton.

Previous to this date, much work had been done by the directorate at the War Office in collecting information as to the types of building likely to be required on the lines of communication in France. The Director of Works (D. W.) was instructed by the Quartermaster General (Q. M. G.) to act directly under the orders of the Inspector General of Communications (I. G. C.), Major General Robb, upon mobilization.

Havre, Boulogne and Rouen were made ready for the reception of troops of the British Armies in France and Flanders. Selections of camp sites and arrangements for water supply were preliminary steps taken. Also hospitals, field bakeries, remount depots, veterinary hospitals, post offices and offices and billets generally were planned. Amiens was selected as an advance base.

To install the works above noted, but two companies of the Royal Engineers (R. E.) were placed at the disposal of the D. W. In the early part of August, approximately 35 officers of the R. E. were under the D. W., but this number was heavily drawn on owing to casualties at the front.

On the 26th of August, Amiens was ordered evacuated, followed by the evacuation of Boulogne, Havre and Rouen.

Le Mans was designated as the new advanced base, August 30, 1914, replacing Amiens. St. Nazaire was the new base port for cargo ships, while Nantes became the secondary port. The principal base establishments were formed at Nantes. Angers was developed as a hospital centre only.

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[1] Prepared for the M. B. A. S. by Director of Works, British Armies in France and Flanders.

The German retreat to the Aisne in September made possible the reoccupancy of the original bases, and the military establishments first planned were re-opened as follows:

Havre Base.—Principal base of British Armies in France and Flanders for supplies and ordnance. Remount depot and veterinary hospital. A field bakery, eight camps for disembarkation of British troops.

Rouen Base.—Accommodation for supplies was provided on the quays and in hangars. A field bakery was established. Also general hospital, and four camps for disembarkation of British troops.

Boulogne.—Base for supplies and ordnance, also hospital centre, and principal base for evacuation of sick and wounded.

Abbeville.—Advanced base headquarters, P. G. C.

Marseille.—Base for Indian divisions.

Other bases were as follows:

St. Omer.—General Headquarters.

Orléans.—Indian concentration camp.

Nantes.—Base.

St. Nazaire.—Base.

WINTER ACCOMMODATIONS.

Boulogne.—Winter hutting, including hospital extensions. Construction of a convalescent camp. Veterinary hospital.

Marseille.—Estimated cost of 20,000 pounds.

Rouen.—Four hutted hospitals. Each 520 beds. Four reinforcement camps, each for 1,200 men. Remount depot, 2,500 horses. Veterinary hospital, 10,000 horses. Indian veterinary hospital. In addition, such accommodations as were necessary for supplies, ordnance, etc.

Havre.—Six reinforcement camps. Remount depot, 2,500 horses. Veterinary hospital, 1,000 horses. In addition, hospital accommodations in buildings adapted from hangars. New construction for supplies, ordnance, etc.

Orders were that the sleeping accommodations for men should be in hut tents (light framed huts covered with canvas, portable, and readily erected without skilled labor). Horses to be in stables.

The losses in R. E. personnel by combat units caused the removal of those originally alloted to the Works Directorate. To replace these civil and mechanical engineers, architects and surveyors of experience were selected by the War Office and commissioned as temporary Inspectors of Works.

During December, 1914, Dieppe was prepared as a British military station, and the Loire bases closed.

During January, 1915, Etaples was selected as a hospital site as follows:

Hospitals for 200 officers and 5,000 other ranks.
Convalescent camp for 1,500 men.
Reinforcement camp for 40,000 men.

The duties connected with hiring of lands finally made it necessary to establish a Lands Section in the D. W. office.

The question of road upkeep came up at this time. The main roads were dealt with at G. H. Q., those classed as municipal roads on the L. of C. by the D. W. The general principle adopted was where a town did not levy *octroi* on the Army, military assistance was given; in cases where *octroi* was charged, the town maintained the roads.

The change from open fighting to trench warfare had caused a demand for engineer stores of various kinds. At first a considerable amount was obtained locally by chief engineers and C. R. Es. of divisions, but it was found necessary to supplement these by local purchase in France, by manufacture in base engineer workshops, and by importation.

The D. W. was charged with engineer supply and he established base parks and workshops at Havre and Boulogne.

CONSTRUCTION.

1. In the early part of 1916, the Works Directorate[2] was principally engaged in winter accommodation. During the remainder of the year, the principal work consisted in the construction of large depots, store depots, jetties, in the improvement of port facilities, construction of a great number of new camps and in the extension of forestry, quarrying and engineer store operations.

2. At headquarters of bases established in towns such as Havre, Rouen, Boulogne, Calais and Abbeville, etc., many houses were leased for offices as well as billets, which required improvements to bring them up to British standard of sanitation, etc.

3. The appended table gives some idea of the magnitude of building operations, but does not represent fully all work done, as for instance the evacuation due to the German advance in 1918. (See tables, Annex "A").

By February 1917, a revised establishment in two main groups was organized to deal with engineer stores, consisting of:

D. D. Works----------
A. D. Works----------
} at D. W.'s headquarters.
Chief R. E. Stores Officer (North) at Les Attaques (Calais).
Chief R. E. Stores Officer (South) at Abancourt.

[2] Chart 1, Chapter XXI, Vol. I.

Prisoners of war, formed into companies were employed in addition to base park and artizan companies. The former worked under their own non commissioned officers and proved very satisfactory, the average daily task being 5½ tons per man.

DISCHARGE OF SHIPPING AT PORTS.

The rapid discharge of shipping had in 1916, constituted one of the principal troubles of R. E. stores officers. The requisite available labor constantly did not synchronize with the necessary trucks and barges available. The lack of coordination was greatly felt.

In December 1916, the newly formed Directorate General of Transportation (D. G. T.) organization took over the whole responsibility of receiving stores discharged from ships and of transportation into R. E. depots.

CHECKING AND ACCOUNTING.

Under the conditions that came in force to ensure rapid discharge, it became evident that any attempt to check cargoes out of ships did not justify by its results the employment of the large personnel essential to obtain even approximately accurate results.

The system adopted therefore was checking in and out of depots only. Experience proved that a skilled central staff at the depot was able to reconcile receipts with the manifests of ships with a surprisingly small percentage of error.

In the depots, a system was adopted of tally cards for each store. Stores were maintained in groups under group storekeepers, who were responsible to the chief storekeeper of the depot.

Stocktaking officers were attached to chief store accountants, to whom were assigned the duty of taking stock continuously choosing, so far as possible, items of which the stock was for the moment low. The stock so counted was checked by them with the stocks as recorded on the chief storekeeper's tally cards, and with the ledger remains, any discrepancies found being adjusted as laid down in "Regulations for Engineer Services".

STONE SUPPLY FOR ROADS.

By 1915, the upkeep of the roads behind the armies had become a matter of serious concern. As many quarries in the north of France were in the enemy's hands, the Director of Works had to assist by importing road-metal and soling from Cornwall and Guernsey. This stone was distributed to the French "Ponts et Chaussées", who kept up the *routes nationales*, and to the British armies and L. of C. for their road repair.

In 1916, D. G. T. took over road work and the supply of road metal.

TIMBER.

By 1915, the demands for timber by armies had greatly increased; in February 1915, the D. W. began to purchase timber from stocks held by timber merchants in France. Timber was chiefly obtained from Rouen itself, from Nantes and also Havre.

In August 1915, the Director of Works arranged for a supply of timber to be imported from England through the War Office, at a rate of 350,000 feet cube per month.

In October 1915, the Director of Works commenced forestry operations (described separately under "Forestry") and 18,000 tons per month were produced, the depot being Abancourt.

In March, 1917, a Directorate of Forestry was formed, which took over control of the provision of timber required by the British Armies in France and Flanders.

In 1917, the consumption of timber by armies and L. of C. had risen so greatly, that the issues of timber from R. E. depots averaged 51,000 tons monthly.

SUPPLY OF MATERIAL AND STORES TO L. OF C.

In 1914, most of the constructional work on the L. of C. was carried out by French and British contractors, who supplied their own plant and materials. A few other engineer stores and machinery were obtained by the D. Works from the War Office, England, or purchased locally.

As demands for stores and materials rapidly increased, restrictions on local purchase were instituted to regulate supply and prevent competition. In 1915, individual Works Officers were stopped buying imported timber or using French timber unless included in French contracts under 25,000 Frs.; they demanded on D. W., who arranged supply from the British Army stocks.

In 1916, purchase in France of materials equally procurable from British manufacture was limited to purchases of 10,000 Francs, except bricks and articles not suitable for transport.

MEMORANDUM ON PORT CONSTRUCTION DEPARTMENT.

The Ports Construction Department was authorized in March 1917, to carry out all general construction work at, and additions to, ports in France required for the British Armies in France and Flanders, including the French terminal berths for the channel ferry, and also for the purpose of undertaking the reconstruction

of the Belgian ports of Bruges, Zeebruge, and Ostend, etc., which at that time was anticipated might be in the hands of the Allies during the course of the year.

The authorized strength of the department was about 1,800 skilled British personnel and 4,500 unskilled non-British; the actual average strength was 1,800 British and 1,400 non-British.

Belgian Ports.—Information as to the condition of the ports was collected and kept up-to-date, and schemes for reconstruction prepared. Plant and material valued over £500,000 was stored ready at a depot at Les Forts, near Dunkirk.

Early in 1918, the military situation necessitated the evacuation of this plant from the depot to Richborough (England) and Zeneghem.

Later in the year the War Cabinet decided that the reconstruction should be carried out by the Civil Engineer-in-Chief of the Admiralty, to whom the plant and certain personnel were therefore handed over.

Channel Ferry.—The proposal to run a Cross Channel Train Ferry Service was first put forward in December 1916, and the entire design and construction of the terminal berths on the French side were entrusted to the Chief Engineer, Ports Construction.

After detailed investigation of all the ports in northern France, Dunkirk, Calais and Dieppe, were finally selected for this purpose, Dunkirk and Calais to be served from Richborough, and Dieppe from Southampton.

A complete description of the ferry service, with drawings of the terminus at Richborough, the steamers, adjusting bridges, hoisting gear, etc., will be found in the "Engineer" of the 17th January 1919.

On the French side the steamer berths were all of different design, to suit local conditions, at the selected ports; but were in general outline similar to the Richborough berth. At Dunkirk the steamer berths alongside floating timber pontoons instead of a fixed structure; at Calais along side concrete piers with timber fenders and at Dieppe alongside an existing viaduct to which suitable timber fendering was fixed. No particular engineering difficulties were encountered. The work was put in hand April–June 1917, and was completed early in 1918. The inaugural service to Calais commenced on the 10th February 1918, and that to Dieppe on 22nd February 1918. Owing to naval and military reasons the terminus at Dunkirk was little used. The ferry steamers proved themselves good sea boats, able to cross in all but the severest weather.

The Ferry Service proved of great value for the importation of motor lorries, locomotives, railway wagons, tanks and railway wagons and heavy artillery on railway mountings, including two

14-inch guns on railway mountings each weighing 296 tons and measuring 87 feet in length.

Channel Train Ferry, Cherbourg: A berth at Cherbourg was made for the train ferry steamer "Leonard", a vessel of different type to the others, previously employed on the St. Lawrence River, at Quebec.

D. G. T. depot, Dissel: In 1918, an important depot for the Stores and Chief Mechanical Engineer's Department was formed. The total area of buildings constructed aggregated 168,000 square feet, and the work included the provision of complete water supply, extensive dug-outs, platforms and semi-permanent camps for personnel.

Locomotive shops, Rang-Du-Fliers: During the same period a large depot for locomotives was completed at Rang-Du-Fliers including a locomotive erecting shop, built of "Winget" blocks, length 304 feet, width 40 feet and height to eaves 35 feet. It was equipped with two 45-ton overhead traveling cranes electrically driven. The total area of the buildings constructed was 105,000 square feet and complete water supply and semi-permanent camps were also provided.

The outstanding feature of 1917, was, so far as the Works Directorate was concerned:

The German retirement and subsequent British advance on the Somme, which caused a considerable addition to the area of the L. of C.

The principal works carried out by the Works Directorate during 1917, were in connection with:

The extension of store depots in the north.

The large increase of labor (Chinese and Indian) and in P. of W., for whom camps had to be constructed.

The arrival in France of the W. A. A. C., for whom accommodation had to be provided.

Development of aircraft depots.

A heavy program of winter hutting.

Forestry operations transferred to a new directorate.

Large increase in hospital constructions in France, as, owing to submarine campaign with the loss of hospital ships, it was decided to keep the wounded in France wherever possible.

PRINCIPAL WORK CARRIED OUT IN 1917.

Hospitals at St. Omer and Etaples.

Hospitals and convalescent camps at Boulogne.

Extensions to labor camps at Henriville and Boulogne.

Establishments for Portuguese at Ambleteuse, near Boulogne, consisting of four infantry base depots, fully hutted, one general hospital of 1,500 beds and convalescent camp for 1,000 men.

Veterinary hospital near Calais.

Vendroux depot for ordnance and supplies, near Calais, and extension to R. E. Stores depot.

At this time, owing to reverses in Italy and the subsequent despatch of British forces there, the Works Directorate was called on to extend its operations to this point.

The Mediterranean L. of C. was formed as a separate organization on the establishment of the Cherbourg-Taranto route. It ceased to exist from 22nd November 1917, that portion in France going over to the control of G. O. C., British Armies in France, and that which lay in Italy to the G. O. C. in C., Italian Expeditionary Force.

The outstanding features of the year 1918, from the Works point of view, were the continuation of the large winter program for the winter 1917–1918; the necessity of finding new sites for a number of important military establishments consequent on the German advance in the spring; the transfer of the Lands Branch of the Works Directorate to the Director of Hirings and Requisitions, and of the Stores Branch to the Director of Engineering Stores; the transfer of the work on the southern aerodromes to the Independent Air Force; the provision of protection for personnel at stations on the L. of C. in consequence of the intensity of the air attacks made by the Germans on those stations during the spring and summer of 1918; the alterations and modifications of work in hand or proposed, on account of the advance of the British Army; and the further modifications and extensive arrangements for demobilization due to the Armistice.

It was anticipated that the consumption of petrol at the aerodromes used by night bombing squadrons would be very considerable and that in order to deal with it satisfactorily, bulk storage would be necessary.

Arrangements were accordingly made by the Asiatic Petroleum Company, under instructions from the War Office, to construct the installations required and to make the necessary additions to the petrol installations at Rouen.

GERMAN ADVANCE.

On March 21st, the Germans attacked the Third and Fifth Armies under cover of a morning fog, and succeeded in forcing back the Fifth Army, until our line had fallen back nearly to Amiens. The situation was so serious, that the construction of new defence lines in rear of those previously existing became urgently necessary. All available labor, British or Chinese, was collected from the L. of C. and sent up to dig trenches. In order that these labor companies might go forward equipped as far as possible, C. R. Es. were ordered

to issue out to them 75 per cent of all the picks and shovels that they had on charge for the execution of Works service. Arrangements were also made to supply engineer stores for the construction of the new defence lines ordered by G. H. Q., and for this purpose two temporary advanced depots were opened, one at Mautort, near Abbeville, and one at Teneur in the area occupied by the Tank Corps. These depots were supplied by rail with stocks of entrenching tools, pickets, screwposts, barbed wire, etc., from the existing engineer store depots at Les Attaques and at Blargies, and supplies were drawn from the advance depots by road, as the railway arrangements did not permit of despatch of stores further to the front by rail.

Four C. R. Es. were withdrawn from the L. of C. and were placed under the D. W. for defence work. The D. W., himself, proceeded to Auxi-le-Château on March 26th to lay out a defence line from the Somme River to Fosseuse, near Arras.

This line was partially dug, but was then stopped as it was considered better to concentrate all the labor on lines more advanced.

In addition to the preparation of defence lines as above mentioned, orders were issued by G. H. Q. that preparations should immediately be made for the demolition of bridges and for the obstruction of roads in rear of a line from Dunkirk, through St. Omer and Doullens, to the Somme. Officers were detailed by the D. W. to prepare the necessary reconnaissance reports, and the estimates of explosives and other demolition material required.

Units belonging to the Works Directorate were detailed to carry out the duty on receipt of orders, and in the meantime were practised in making up and placing firing charges.

Under orders from H. Q., L. of C., arrangements were made at the end of March for the defence of the line of the Bresle, and the C. R. E., Rouen, acted as Chief Engineer to the Commandant at Rouen who had been appointed the defence commander of this line.

The importance of strengthening the left flank of the armies by means of inundations has been foreseen by G. H. Q., and in February 1918, arrangements were considered for the construction of a pumping station at Dunkerque to deliver seawater into the Dunkerque-Furnes canal for use on the Belgian front. The construction was put in hand and six powerful petrol driven centrifugal pumps, each capable of delivering 600,000 gallons per hour, were installed, and enclosed in a bombproof engine-house. This pumping installation was entirely completed before the end of May, but could have been put in action early in April.

It was similarly contemplated by G. H. Q., to create inundations between St. Omer and Bergues, and these were prepared for by raising the level of the water in the Basse-Colme canal. This neces-

sitated the erection of pumping plant to drain artificially the area occupied by No. 14 ammunition depot at Zeneghem, as owing to the rise in the canal, the normal natural drainage into it from this area was no longer possible.

AIR RAIDS

The increase of activity in enemy bombing operations, necessitated the protection of camps and hospitals by means of trenches, dug-outs, and traverses.

A number of bombs were dropped in the Outreau steel works on the Laine, above Boulogne, in which was the central electric power station, and the risk of having all the electric lighting and power suspended led to the order of a 1,000 K. W. turbo-alternator, the site for which was selected near the mouth of the River Slack, just south of Ambleteuse.

Owing to the Armistice, this set was not erected. Similarly at Calais, owing to the exposed situation of the 1,000 K. W. turbo-alternator installed by the British near the Ordnance workshops at Valdelièvre, and to the partial failure of electrical supply by the French, a 1,500 K. W. turbo-alternator was ordered, and a site chosen for it near Ardres. The work was put in hand at once and this generator was erected, but was not completely ready to function until the end of March, 1919.

The risk of fire due to air raids had caused considerable attention to be given to fire protection arrangements, and complete systems of fire mains were introduced in the Mautort Outreau and Vendroux supply depots, in the railway depot at Audruicq, as well as in some of the aircraft supply depots such as those at Marquise, Bahot, Vron, and Courban. For ammunition depots, however, it had been agreed that only first aid fire fighting arrangements were of use, as if a fire took hold it would be impossible to extinguish it.

C. R. ES. WORKSHOPS ON L. OF C.

At an early period of the war, workshops were established by Senior Works Officers at the stations where important work was being carried out and especially at their headquarters. These workshops increased in importance as maintenance work became more serious, and as more and more work was carried out by direct labor.

Machine tools were installed, driven by steam or by electricity according to circumstances.

The shops were divided into three classes:

1. For first class districts.
2. For second class districts.
3. For outstations, or small C. R. E's. districts.

SECTION I—PART 2.

LABOR ORGANIZATION.

Prior to August 1914, the only kind of labor contemplated for war service was civilian, supplemented by fatigue parties from the troops.

At the outbreak of war, however, it was realized that organized military labor would be required in addition, and A. S. C. labor companies were formed for work on the lines of communication. These companies, which were added to in accordance with the constantly increasing demands for labor at the ports and depots, were employed mainly by the Directorate of Supplies, and partly by the Directorates of Works, Railways, and Ordnance.

In army areas during the early months of the war labor was provided from the fighting formations, but in the spring of 1915, the demands were so great that special steps had to be taken, and in August, R. E. labor battalions were sent out for work on defences. These were followed quickly by infantry labor battalions, to replace the French territorials and Belgian civilians who had been employed on the maintenance of the roads, and whose services were then required by their own armies.

The Somme offensive of 1916, created a fresh and enormous demand for labor. The increasing tactical importance of communications had led to the organization of the Transportation Directorates, and a vast amount of construction work had to be undertaken. The later months of the year saw the arrival of battalions of the South African Native Labor Corps and the British West India Regiment, a battalion of Cape Boys, and detachment of the Bermuda Royal Garrison Artillery. During 1917, contingents of the Egyptian Labor Corps, the Indian Labor Corps, and the Chinese Labor Corps, began to pour into France, and a company of Fijians, who had volunteered for transport work, also helped to fill the gap in labor requirements.

Eventually there were no less than twelve different classes of labor employed in France and Flanders.

South African Native Labor Corps.
Cape Boys Corps.
Egyptian Labor Corps.
Indian Labor Corps.
Chinese Labor Corps.
Fijian Labor Company.
Canadian Labor units.
Non-combatant corps.

Middlesex (alien) Infantry Labor companies.
Russian labor companies.
Italian labor.
Prisoners of war.

FORMATION OF THE LABOR DIRECTORATE.

The close connection between the demand for labor and the tactical situation created by the Somme offensive of 1916, increased the necessity, which had already made itself felt, for ensuring elasticity in the distribution of labor, and focused attention upon the important part labor must play in the modern offensive.

Originally all labor had been allotted to services and departments, and none had been "pooled." No machinery existed for taking labor from one department and giving it to another as it became more urgently needed. Some attempt had been made to effect this at the ports by distribution being placed under the control of the base commandants, and by the appointment of labor superintendents, but a special organization was necessary to meet the new situation, and in December, 1916, the Directorate of Labor was formed to deal with non-technical and non-specialized labor; that is to say, the labor used to supplement the technical and specialized units when these units were not sufficient in themselves to do all the work required.

The first task of the directorate was to standardize the organization of the labor under its control, by forming labor units into companies of 500 of all ranks. Larger units had to be split up into detachments, sometimes scattered over a wide area, to the detriment of the discipline and organization of the unit. A further arrangement was the transference of all British labor battalions and companies to a labor corps. This involved dealing with twenty-two infantry regiments, and later the R. E. and A. S. C. The appointment of advisers on native labor enabled the Director of Labor to study the peculiarities of, and the best way to handle different classes of native labor, and to forward information thus obtained to representatives of the labor organization and employers.

LABOR CONTROL.

The work of the Labor Directorate, so far as distribution was concerned, called for little criticism, but the discipline and administration of labor units in army areas lacked much from the fact that the labor representatives with the armies were advisory, not executive officers. Their duties were to advise the commanders of formations, dealing on their behalf with the allotment and distribution of labor with a view to its proper employment and economical

working. For discipline the labor groups came under the camp commandant or the O. C. corps or army troops. Their movements, rationing, etc., were the concern of the "Q" Branch of the corps or army staff. Such a separation of distribution and administration could not be continued and efficiency obtained. The difficulty was realized by some army commanders, who made the labor representative responsible for the successful working of all the labor in the army. Wherever this was done the results were highly satisfactory, and suggested a reorganization of the Labor Directorate. Consideration of the question culminated in the appointment of a Controller of Labor with army and corps labor commandants.

The new organization, by uniting under one authority the administration and distribution of labor, raised the standard of discipline to a high level. During the intensive fighting of 1918, the Labor Corps, which had been formed mainly to meet the conditions of stationary warfare, surmounted the new problems with conspicuous success.

COLORED LABOR.

The use of colored labor with the British Armies in France and Flanders grew to very large proportions. Eventually there were 96,000 Chinese coolies, 22,000 South Africans, more than 10,000 Egyptians, and large number of Indians, besides the small Fijian unit, engaged on labor duties. The work of all these, when well officered and supervised, was thoroughly good.

LABOR ON L. OF C.

At the bases, depots, and on the L. of C. generally, the same story of good work holds good. At first the efficiency left much to be desired, but, with the selection of the right officers and N. C. Os., and the better chain of control, a stiffening up of discipline enabled fine results to be achieved.

EFFICIENCY OF LABOR.

It is scarcely possible to overestimate the sterling value of labor with the British Armies in France and Flanders. Steadily and unobtrusively, and with an evergrowing efficiency whose effect upon military operations called for warm praise from army and corps commanders, the Labor Corps in the army areas performed "feats of arms" which won the unstinted admiration of their fighting comrades. Waterpoints were opened, mine craters and shell holes filled, and splendid roads made and maintained, often under shell-fire. Ammunition, supplies, and communication with the fighting line

were ensured by these labor companies. The endurance and pluck of the older men, many of whom were over fifty years of age, were beyond praise.

The great part played by labor during the war may be gathered from the following figures:

"Effectives" at work daily.

	On L. of C.	In army areas.
December 1916	42,000	[1] 45,000
December 1917	91,000	118,000
November 1918	124,000	125,000

It will be seen that at the date of the Armistice the Labor Control was dealing with numbers more than twice as great as those of the original Expeditionary Force.

Issues of principal stores to armies.

Store.	1916	1917	January 1918 to June.	July to December, 1918.
Cement ..... brls.	172,900	302,400	122,529	76,283
Corr. screening ..... rolls.	.....	7,210	1,570	2,203
Corr. iron ..... bdls.	392,030	709,800	172,225	119,839
Roofing felt ..... rolls.	195,000	439,500	109,202	102,826
Joists ..... No.	181,700	137,200	53,021	50,300
Rails ..... No.	192,900	82,900	29,826	13,804
Screwposts ..... No.	2,153,800	3,698,900	3,365,980	1,749,335
Shelters, large ..... No.	9,919	24,170	10,448	7,160
Shelters, small ..... No.	9,541	21,000	9,640	9,460
Willesden canvas ..... rolls.	.....	1,810	505	887
Wire entanglement ..... bdls.	.....	44,310	11,244	23,162
Wire netting ..... rolls.	169,600	183,100	55,279	82,678
Wire weaving ..... rolls.	.....	17,210	19,315	5,917
Revetting hurdles ..... No.	.....	166,500	99,573	95,385
Trench boards ..... No.	.....	2,200,100	924,321	510,500
Trench frames ..... No.	.....	193,200	110,962	97,850
Trench scoops ..... No.	.....	38,700	4,650	7,050
Piping, 6-inch ..... miles.	.....	47	4½	1¾
Piping, 4-inch ..... do.	291	703	58¼	117¾
Piping, 2-inch ..... do.	162½	407	47½	56¾
Piping, 1½-inch ..... do.	95½	220	26¼	15¾
Piping, 1-inch ..... do.	85	193	19¾	16¾
Tanks, 1,600-gallon ..... No.	508	974	76	82
Tanks, 400-gallon ..... No.	1,587	3,645	738	788
Tanks, 200-gallon ..... No.	1,758	5,045	821	896
Tanks, 100-gallon ..... No.	2,321	6,660	1,657	1,284
Tanks, 50-gallon ..... No.	2,999	7,175	1,781	1,337
Pumps, superior ..... No.	.....	9,870	1,405	2,324
Pumps, inferior ..... No.	.....	5,340	2,700	850
Picks ..... No.	537,425	751,200	489,200	198,892
Shovels ..... No.	1,019,887	1,560,600	978,000	460,078
Sandbags ..... No.	288,932,492	308,76 ,900	88,820,200	43,041,850
X. P. M. ..... sheets.	1,122,503	1,254,400	1,080,300	388,738
Barbed wire ..... tons.	1,223,640	1,373,600	34,800	14,098
Plain wire ..... coils.	75,201	56,250	110,700	16,757¼
Posts W. E ..... No.	1,411,379	2,255,300	2,542,800	1,237,510
Nails ..... lbs.	9,574,840	17,087,700	.....	.....

[1] Exclusive of fighting troops.

List of Machine Tools for C. R. E.'s Workshops.

1ST CLASS WORKSHOPS.

Woodworking Shops (Carpenter and pattern maker):	
Lathe woodworking	1
General joinery or woodworker	1
Morticing machine	1
Circular saw, 36-inch (a second saw may be added)	1
Band saw	1
Metal Working Shops (fitters):	
Lathe, 8-inch gap lathe	1
Lathe, 6-inch (screw cutting)	1
Lathe, instrument repairer, 3-inch	1
Punching and shearing machine up to ½-inch holes in ½-inch plates	1
Drilling machine up to 1¼-inch hole	1
Up to ¾-inch hole	1
Metal Working Shops—Continued.	
Planing and shaping machine	1
Screwing machine (Bolts to 1 inch, pipes to 4 inches.)	1
Emery wheel	1
Smiths:	
Forges as required; power blowers may be used.	
Power hammer, 2 cwt	1
Foundry: Cupola (1 ton)	1
Tinsmiths:	
Hand shears	1
Hand punch	1
Bench vices and hand tools, as required.	

2ND CLASS WORKSHOPS.

Woodworking Shops (carpenters):	
General joiner or (or planing machine) woodworker	1
Morticing machine	1
Circular saw, 36-inch	1
Band saw	1
Metal Working Shops (fitters):	
Lathe, 6-inch (not screw cutting)	1
Drilling machine up to ¾-inch hole (hand machine)	1
Metal Working Shops—Continued.	
Screwing machine up to 4 inches, for pipes only (hand machine)	1
Emery wheel, 7-inch	1
Smiths: Forges as required, hand blown.	
Foundry: None required.	
Tinsmiths: Hand tools only.	
Bench vices and hand tools, as required.	

3RD CLASS WORKSHOPS.

Out-stations or small C. R. E's District:	
Morticing machine (hand machine)	1
Circular saw, 36-inch	1
Band saw or circular saw, 30-inch, for cross-cutting	1
Out-stations or small C. R. E's District—Continued.	
Drill, up to ¾-inch (hand machine)	1
Forge	1
Bench vices and hand tools, as required.	

ANNEX "A."

Area on L. of C.	Area employment companies.	Area employment artizan companies.	A. E. garrison guard companies.	Army ordnance companies.	Base ordnance depots.	Ordnance depots.	Ammunition depots.	Command paymaster and office staff.	Field printing and stationery depots.	Supply depots.	Bakeries.	L. of C. supply companies.	Transport auxiliary H. T. coy.	Transport auxiliary petrol coy.	Transport auxiliary steam coy.	M. T. heavy repair shops.	M. T. depots.	Veterinary hospitals.	Convalescent horse depots.	Veterinary store depots.	Infantry base depots.	Ellis fat-extracting plant.[1]
Abancourt	3	2	3	3		1	1		1	1		2	Det.	8	Det.			2				
Abbeville	5	1	4	5		2	1		1	2		2	Det.	1				2				
Boulogne	8		1	4		1		[2]1		2	1	3	1	1	1			1			4	1
Calais	9	2	9	22	1	1	2			1	1	3	Det.		1		3	3		1	6	1
Cherbourg			1			1				1				Det.								
Dieppe	3	1	3	3		1	1			1	1	1	2	1	1			1				
Dunkirk	2		1									Det.	1		Det.							
Etaples	5	3	4	3			1				1		Det.	1				3	3		25	1
Havre	10	1	3	14	1	1				1		4	1	1	1	1		2		1	12	2
Marseille	1		2			1						Det.	1	Det.				Det.			[3]1	
Paris (Cent)	1		1	2								Det.		1		1						
Rouen	9	3	5	5	1					1	1	4	2	4	Det.	3	1	3	1	1	8	1
Trouville	1		1												Det.							1
Total	57	13	38	61	3	9	6	1	2	10	5	19	8	13	4	5	4	17	4	8	56	7
St. Omer																[4]1		[4]1				

[1] Portuguese at Boulogne. [2] Formerly at Rouen. [3] Indian General B. D. [4] Evacuated 1918.

Area on L. of C.	Remount depots.[1]	Rest camps.	Aircraft supply depot.	Aircraft depots.	Reception park R. A. F.	R. A. F. base M. T. repair depot.	Engine repair shops.	R. A. sections anti-aircraft.	A. A. searchlight sections.	Artizan works companies.	Base park companies.	E. & M. companies.[2]	Reinforcement parties.	R. E. stores depots.	Works companies.	Camouflage parks and factories.	Army schools.	Machine gun school.	Lewis gun and light mortar school.	Schools of cookery.	Anti gas school.	Tank corps.	Quarrying companies.
Abancourt	1	1						2	2	1	1			1	1		3					1	
Abbeville	2		7[1]	1				5	5	1		1		1			1				1		
Boulogne	2	6						5	2	3											1		1
Calais	2	1	2	1	1			15	11	4	1			2	1	1				1	1		11
Cherbourg	1																						
Dieppe	1							1	1											1			
Dunkirk								1				1		1									
Etaples		1						1	4	1	1	1					1	1	1		1	1	
Havre	1	2	1					7		1	1												
Marseille		2								2	1												
Paris (Cent)		1						2	2	2	1									1			
Rouen	1	1				1	[2]1	1		1	1		1	1	2					1	1		
Trouville										1													
Total	10	16	4	2	1	1	1	39	27	15	3	3	1	6	2	4	4	1	1	5	6	2	12
St. Omer			1			1																	

[1] Of these, two A. R. depots and two for Portuguese. [2] Headquarters of companies. [1] Salvage. [2] At Pont-de-l'Arche, Rouen.

ANNEX "A."—Continued.

Area on L. of C.	Infantry battalions	Training cadres infantry brigades.	Companies G. B. Royal Fusiliers.	Anti-aircraft platoons.	Labor groups.	Labor companies.	R. M. labor company.	Chinese labor companies.	Laundries.	General hospitals.[9]	Stationary hospitals.[9]	Native hospitals.	Detention hospitals.	Native detention hospitals.	P. of W. detention hospitals.	Convalescent depots.[10]	Sisters and Q. M. A. A. C. convalescent homes.	Sisters hospital.	Military prisons.	P. of W. cages.	P. of W. companies.	Q. M. A. A. C. detachments.	Third echelon, G. H. Q. officers and staff.
Abancourt	------	1	3	2	2	2	------	13	------	------	1	------	1	1	------	------	------	------	------	------	9	------	------
Abbeville	1	------	4	4	4	------	------	15	2	2	2	1	1	1	------	1	------	------	1	1	20	2	------
Boulogne	1	------	------	2	3	2	1	13	2	10	5	1	4	------	------	[11] 4	2	------	------	------	10	6	------
Calais	------	1	9	7	5	2	1	33	------	2	1	------	7	2	2	------	------	1	2	2	43	6	------
Cherbourg	1	------	------	------	------	------	1	------	------	------	1	------	1	1	------	------	------	------	------	------	1	------	------
Dieppe	[12] 3	------	3	2	2	------	1	7	------	4	1	1	------	------	------	1	------	------	1	------	13	4	------
Dunkirk	------	------	1	1	1	2	1	5	------	------	------	------	------	1	------	------	------	------	1	------	------	------	------
Etaples	------	1	4	3	2	------	------	7	1	9	3	------	------	------	------	1	1	------	------	------	18	4	------
Havre	------	1	3	2	2	2	1	14	------	3	2	------	7	1	------	3	2	------	1	1	13	2	------
Marseille	------	------	2	------	------	------	1	------	------	2	1	1	------	1	------	2	------	1	1	------	2	------	------
Paris (Cent.)	------	------	Det.	------	1	1	------	------	------	2	1	------	9	------	------	------	------	------	------	------	15	------	------
Rouen	------	1	5	3	5	1	1	12	------	9	4	2	3	------	------	3	------	------	3	------	36	2	1
Trouville	------	------	1	------	------	1	------	------	------	4	------	------	------	------	------	[11] 4	------	1	------	------	5	1	------
Total	6	5	35	26	27	13	8	119	5	47	22	6	33	8	2	19	5	3	10	4	185	27	1
St. Omer	1	------	------	------	------	------	------	1	1	3	4	------	------	------	------	------	------	------	------	------	5	1	------

[9] One for Portuguese at Boulogne.

[10] One convalescent home for Portuguese at Boulogne.

[11] One for officers.

[12] One battery.

CHAPTER XX.

SECTION II.

CONSTRUCTION SERVICES (FRENCH).

IN THE ZONE OF THE INTERIOR.

Military constructions were executed, as in time of peace, by the Engineer Service (Service du Génie). For this purpose the territory was subdivided into "Engineer Sections" (Chefferies du Génie), and these were grouped into "Engineer Directions" (Directions du Génie). The engineer directions were, from a technical standpoint, under the direct orders of the Minister of War (4th Direction—2nd Bureau).

Engineer officers prepared the plans for construction projects in conjunction with the authorities concerned (Headquarters, Medical Service, etc.). The work was then carried out by civilian contractors. The necessary raw materials (iron, steel, etc.) for construction purposes were requisitioned and furnished to the contractors by the Minister.

Military buildings, both in the interior and in the Zone of the Armies, had to be erected rapidly and this necessitated the use of already prepared, demountable, building material (Aviation hangars, Adrian barracks, E. C. M. B. barracks, etc.). Studies concerning these materials and relations with the civilian contractors were centralized in the "Direction for barrack, cantonment and camouflage materials" (Direction du matériel des baraquements, cantonnements et camouflage), under whose orders was the "Central Engineer Establishment for barrack material" (Etablissement central du matériel des baraquements du Génie—E. C. M. B.).

Docks at the base ports were constructed by civilian contractors under the control of the Ministry of Public Works. The cost of construction was met, partly by the Allied nation using the port, partly by the French Government, and partly by the Chamber of Commerce of the town or city concerned.

IN THE ZONE OF THE ARMIES.

The same principles were followed, and constructions were carried out by the engineers, both, in the advanced zone (zône de l'avant) and in the zone of the lines of communication (zône des étapes).

In the Advanced Zone, the "Commanding General of the Engineers" directed the construction services. For this purpose he had under his orders:

1. For the quartering of the troops: a number of officers, who were in charge of barrack construction, and a varying number of "barrack construction companies" (Compagnies de baraqueurs).

Types of constructions: Adrian barracks, E. C. M. B. barracks, etc.

2. For the construction of hospital installations: a special service in which the Medical Service (Service de Santé) was represented.

Types of constructions: Adrian barracks and so-called "Medical Service" barracks (closely resembling the Bessoneau type barracks).

Whenever the number of barrack construction companies was insufficient for the execution of the work, additional personnel was obtained by requesting same from other engineer units.

To the army engineers were also attached the water supply services, the roads services, the "Massard-Dessolier" (M. D.) companies for the construction of underground shelters (dugouts), etc.

For the construction of camps and cantonments, an engineer officer of field rank was assigned as assistant to the officer in charge (Major Supérieur) of the camps and cantonments of the army. He had crews of "construction laborers" at his disposal for each of the cantonment zones.

IN THE ZONE OF THE LINES OF COMMUNICATION. (Zône des Etapes).

The organization in this zone was similar to that in the advanced zone. The "Director of the lines of communications Engineers" (Directeur du Génie des Etapes) filled the same functions in this zone, as did the commanding general of the army engineers in the advanced zone. In 1918, lines of communication engineer sections, similar to those which existed in the zone of the interior, were organized and placed under the orders of the Director of the lines of communication Engineers.

The commanding general of the army engineers and the director of the lines of communication engineers submitted their demands for materials to G. H. Q. (Direction of the Rear), and the latter filled these requests by drawing upon its depots or by transmitting the requisitions to the Ministry of War (4th Direction—2nd Bureau).

In the Zone of the Armies, the construction, upkeep and repair of the railroads were carried out by the railway engineer units which were, normally, at the disposal of the Commander in Chief (Direction of Military Transportation of the Armies.)

The 60 cm. gauge railways were laid and their upkeep was assured by special artillery troops, under the orders of the Commander in Chief. (D. A.)

CHAPTER XX.

SECTION III.

MILITARY CONSTRUCTION SERVICES (BELGIAN).

At the War Department, a "General Direction of Military Buildings" (Direction Générale des Bâtiments Militaires—D. G. B. M.) centralized and coordinated the "Service of Military Buildings" (Service des Bâtiments Militaires—S. B. M.)

The Director General was under the direct orders of the Minister for the military constructions and buildings in the rear, and he operated through the Chief of the General Staff for the military constructions and buildings at the front.

At the front.—The Chief of the General Staff caused the "Service of Military Buildings" to be carried out by the Engineer Commandants of the army divisions in the combat sectors. Two permanent "Directions of Military Buildings" (Directions des Bâtiments Militaires—D. B. M.) were established in the rest cantonments. (Chart 2, Chapter XXI, Volume I.)

The Commandant of the Auxiliary Engineer troops (C. T. A. G.), under the orders of the Chief of the General Staff, exercised the functions of chief of the "Service of Military Buildings" for the army in the field.

In the rear.—The "Service of Military Buildings" was carried out by "Directions of Military Buildings" (D. B. M.), under whose orders were "Commandants of Military Buildings" (Commandants des Bâtiments Militaires—C. B. M.). The echelon "C. B. M." only existed in important centers in the rear, located at a distance from the seat of a "Direction." (D. B. M.)

The Minister determined, according to circumstances, the number of "directions" and "commandants"; he also determined the extent of their jurisdiction, the organization of stores, the shops and depots which were to supply these organizations with equipment and materials, as well as the composition of the military and civil personnel for the technical administration and execution of the service.

FUNCTIONS OF THE "SERVICE OF MILITARY BUILDINGS" (S. B. M.)

This service was responsible for:

1. Construction, upkeep, preservation and administration of military buildings (bâtiments militaires—B. M.).

2. Obtaining assistance from the Army in the construction and equipment of non-military buildings, whenever this assistance was requested.

3. The acquisition, appropriation and rental of grounds, buildings, furnishings and materials. However, the Minister authorized certain services to make their own rental contracts, but these agreements had to be submitted for the approval of the "General Direction of Military Buildings."

4. Damages to property belonging to the D. G. B. M., or to property which had been rented in its name, or which had been placed at its disposal.

5. Allocations, in money or in kind, for the lighting of military buildings; contracts for water supply, garbage collecting and supply of fuel, chargeable to the State.

6. The establishment of connections with the civil telephone system in rear of the zone of the field army (permits, verification of contracts and expenditures pertaining to these contracts).

7. The control and supervision of electrical installations other than those belonging to the field army or to the D. G. A. S. T. A.

STOREHOUSES FOR ARTILLERY AND ENGINEER MATERIALS (M. A. G.)

The "Storehouses for Artillery and Engineer materials" (Magasins de l'Artillerie et du Génie—M. A. G.) were attached to the "Artillery Establishments" (Etablissements de l'Artillerie—E. A.) at Le Havre and at Graville.

The purpose of these establishments was to assure the supply of materials of all kinds in current use by all of the services of the Army. They also furnished portable tools to the various units and to the pioneers.

Theoretically, the "M. A. G." maintained a sufficient stock of reserves for a period of six months. The director of these establishments furnished the purchasing commissions with the necessary data concerning requirements.

The artillery and engineer storehouses included:

(1) A section for oils, paints and materials.

(2) A section for tools and equipment.

(3) A section for kitchen materials and hardware (nails, screws, rivets, etc.).

(4) A section for lighting materials.

(5) A section for small arms (reserve of rifles).

(6) A section for coal.

(7) A workshop, which was particularly charged with the repair of portable tools and equipment salvaged at the front.

CHAPTER XX.

SECTION IV.

CONSTRUCTION SERVICES (ITALIAN).

There was no special construction service in the Italian Army. In the Zone of the Armies, construction work (with the exception of that pertaining to the railways) was entrusted to the commands of the army corps engineers and, in the Zone of the Rear (retrovia), to the Administrations of the Military Engineers and of the Civil Engineers, at the "Intendenza Generale."

During the war these organizations were assigned new and varied fields of activity, far in excess of anything which had previously been foreseen, and this necessitated great modifications in the organization and functions of the above mentioned bodies.

Commands of the Army Corps Engineers.—To enable the commands of the army corps engineers to effectively carry out the construction work in the zone of the first line, it was provided that all requests for constructions interesting the army corps, but which did not concern the front line proper, should be addressed to the commands of the army corps engineers. This resulted in the formation of special technical organizations which provided for, coordinated, and regulated the various construction projects. Consequently, special offices for bridge construction, roads, electrical power and water supply installations, etc., were organized at the commands of the army corps engineers. Each of these "offices" was composed of an administrative staff, an office staff, and operating personnel, with workshops, factories, and laboratories in connection therewith.

At the time of the mobilization, the "Intendenza Generale" charged these organizations with the supply, repair, and removal of engineer plants and, as a result of this reorganization, they hastily took over the administration of construction projects in the rear, that is to say, of work which in time of peace developed upon the "Territorial Engineer Administration."

Administrations of Army Corps Military Engineers.—These organizations were responsible for:

a) The erection of permanent hospital buildings of the second line (hospitals, lazarettos, convalescent camps, etc.);

b) the erection of buildings and sheds for the use of the Commissariat Service (storehouses for supplies, brick bakeries, sheds for cattle, warehouses for materials and stores of all kinds, etc.);

c) The erection of buildings in the advanced zone (storehouses for artillery material and explosives, sheds for animals, veterinary infirmaries, depots for benzine and motor transport material, etc.);

d) the erection of buildings suitable for hangars and for the various services of the Aviation;

e) the construction of huts for use as winter quarters;

f) various constructions, such as water supply lines, wireless stations, depots for building materials, concentration camps for prisoners, etc.

These administrations expanded their organizations and subdivided the territory which had been assigned them in the various zones. In each of these subdivisions there was an administrative section, with a military and a civilian chief at its head. At the main office of the administration, a special section was charged with the study of proposed construction plans and with the coordination of the various construction projects.

Administrations of Army Corps Civil Engineers.—Established at the beginning of the war, solely for the construction and maintenance of the roads in the Zone of the Rear (retrovia).[1] Subsequently, the civil engineers were responsible, within certain limits, for the execution of various works such as the construction of buildings, hospital huts, schools, disinfecting stations, quarters for workmen, the laying out of cemeteries, aqueducts, drains, electrical plants, serial railways, motor transport and ammunition depots, etc.

WINTER QUARTERS.

The problem of providing suitable winter quarters (huts) for the Italian Army was most difficult. This is readily apparent if one considers the large number of men and animals that had to be provided with winter quarters, as compared with the available cantonments in the mountainous zones of the Italian theater of operations.

It was therefore planned to make extensive use of huts in certain portions of the mountain zones. Huts of various types and sizes (wood and brick) were adopted, while the roofs were constructed with whatever material was most readily obtainable. For roofing purposes, cemented cardboard (cartone cetremato), and a material known as "eternit," were largely used and proved very serviceable.

Portable huts were adopted on account of the ease with which they could be erected, dismantled or moved and, as a result, various

[1] See Chapter XXIV on the "Roads Services."

types of huts, with single or double walls, were constructed. The double walled type was particularly adapted for use in the high mountainous regions, as it furnished greater protection against the cold, etc.

To reduce the number of buildings as much as possible, the huts were constructed with double and triple rows of bunks; wells were dug near each group of sleeping huts, reservoirs (vasche), kitchens, and sanitary equipment were also provided. All of these installations were provided with lighting facilities and, wherever possible, electricity was used in order to reduce fire hazards. Centers which did not possess an electric light plant received the current in transformers (gabine) which were fed by high tension line from other points.

CHAPTER XX.

SECTION V.

CONSTRUCTION SERVICES (AMERICAN).[1]

I. PRELIMIARY HISTORICAL OUTGROWTH OF THE CONSTRUCTION SERVICE, AMERICAN E. F.

The following is a brief history of the various steps leading up to the final organization of the Division of Construction and Forestry, which was developed to meet the necessities of the situation:

In July and August 1917, the organization of the American E. F. was established and three base, intermediate and advance sections were formed.

The office of the Chief Engineer, Line of Communication, was organized about the middle of August 1917.

The actual work of construction was commenced by the 15th Engineers (Ry.), Colonel Edgar Jadwin, C. E., commanding, which arrived at Vierzon July 28, 1917, and which brought from America a trainload of tools and plant. A number of surveys were made and detachments were immediately distributed to Issoudun, Bordeaux, Gondrecourt, and other places from the ports to the Advance Section for construction work.

In February 1918, a new organization was prescribed for the Line of Communications, namely the S. O. S. The Service of Utilities was also created, which included the Departments of Construction and Forestry, Light Railways and Roads, Transportation, and Motor Transport.

On July 12, 1918, the Service of Utilities was abolished and the Department of Construction and Forestry became a division of the office of the Chief of Engineer, American E. F.

II. ORGANIZATION.

(Chart 3, Chapter XXI, Vol. I.)

The Department of Construction and Forestry was organized as follows: Deputy Director, General Construction, Railroads and Docks, Forestry, Administration.

[1] Prepared for the M. B. A. S., by the Director of Construction and Forestry, American E. F., and reduced to the compass of this work by the American Section M. B. A. S.

Base Section No. 1	Hdqrs. St. Nazaire.
Base Section No. 2	Hdqrs. Bordeaux.
Base Section No. 3	Hdqrs. London.
Base Section No. 4	Hdqrs. Le Havre.
Base Section No. 5	Hdqrs. Brest.
Base Section No. 6	Hdqrs. Marseille.
Base Section No. 7	Hdqrs. La Rochelle.
Intermediate Section—East	Hdqrs. Nevers.
Intermediate Section—West	Hdqrs. Gièvres.
Advance Section	Hdqrs. Neufchâteau.

The forestry work was carried on in the field through District Commanders, each of whom also commanded a battalion, with attached service companies, which operated from two to eight sawmills, most of which were in the Advance Section and Base Section No. 2.

The districts in the Advance Section and Base Section No. 2 were combined under Section Forestry Officers. These officers were directly under a central office for production and shipments outside their own section, but filled local requisitions on the orders of the Section Engineer in whose section they were located.

The headquarters of the 20th Engineers was in Tours. This regiment consisted of one regimental headquarters, 14 battalion headquarters, 49 companies and 28 service companies.

The rapidly increasing force at the time of the Armistice, 150,823 men, 127,000 of whom were available for work, called for an elastic organization.

This was obtained by the use of type plans and by the use of a decentralized organization. The work was handled by the Director of Construction and Forestry at Tours, operating through a Section Engineer Officer in each of the sections. Section Engineer Officers were given general instructions and were supported consistently so long as they observed the general policies. The director was thereby enabled to spend considerable time in inspections and consultations with the officers in the field.

The results confirm this as a satisfactory type of organization for handling a large construction force under such varying conditions.

III. TROOPS AND LABOR.

Throughout the period of construction, the labor forces were inadequate. There was a special shortage of technical troops. Such technical troops as were available were used for the purpose of supervision.

IV. CLASSES OF WORK.

The various classes of construction work carried on may be subdivided into:

(1) *Shelter for troops*, including camps of various types such as rest and depot divisional areas, embarkation camps, camps for stevedores, women's camps, enclosures for American prisoners and prisoners of war, instruction centers and schools for army corps, Artillery, Aviation, Tank, Motor Transport, Ordnance, Chemical Warfare Service, etc.

(2) *Hospitalization*, consisting of base, camp, evacuation and Red Cross hospitals and convalescent camps.

(3) *Ports*, comprising the construction of docks and warehouses thereon, railroad connections and lighters.

(4) *Railroads.*—This included engine terminals, regulating stations, double-tracking at various congested points, cut-offs, receiving, classification and departure yards and tracks in storage depots and their connection with the ports.

(5) *Storage Depots*, including large storage depots required at the ports and in the Intermediate and Advance Sections; also special ammunition and aviation depots, coal storage yards, gasoline and oil stations, motor transport centers, remount depots, veterinary hospitals, refrigerating plants and salvage plants.

All of the above work was in charge of the D. C. & F. from its beginning, except the following:

(a) *Railroad construction*, which was in charge of the Chief Engineer, L. of C., up to September 14, 1917, when it was turned over to the Transportation Department. It was again placed under this division on March 12, 1918. Of the 950 miles of railroad constructed, 62 miles, or 7 per cent, were constructed while the work was in charge of the Transportation Department.

(b) *Air Service Construction.* Taken over by this division on December 31, 1917, when approximately 7 per cent of the total work had been completed.

(c) *Ordnance Construction.* Assumed by this division on January 17, 1918. About 1 per cent of this work had been completed before that date.

V. DESCRIPTION OF VARIOUS CLASSES OF WORK.

The problem of sheltering troops was much the same as that of the hospitals. A total of approximately 23,000 barracks were contracted for, of which 15,000 including 4,500 hospital barracks, were delivered.

Owing to the slow deliveries of the "Adrian" and "Bryant" types, it became necessary to construct barracks, two types of which were developed, to accommodate 100 men each.

A total of approximately 16,000 barracks were erected representing over 300 miles of barracks.

The largest camp involving the construction of barracks and other facilities was Pontanezen Camp at Brest, for 80,000 men, 55,000 of whom were in barracks, requiring 500 barracks for officers and men. In addition, 15 mess halls and kitchens, a complete bathing, delousing and laundry plant and numerous administration, storage and welfare buildings, were erected. There were several types of kitchens developed for embarkation and concentration camps of a capacity of 4,500 men per hour.

VI. HOSPITALIZATION.

In August 1917, instructions were issued to provide for hospitalization on the Line of Communication for 300,000 men. In September 1917, nine French hospitals were taken over, each of which formed a nucleus for a hospital center, the original capacity being about 6,000 beds, which developed into 34,800 beds. Preparations were made to construct a large number barrack hospitals. Plans of the standard type barrack hospital were developed. A type "A" standard hospital provided for 1,000 normal beds and 1,000 beds by crisis expansion in tentage, and a type "B" camp hospital providing 300 beds. French and English experiences were consulted and hospitals were grouped as far as local conditions permitted. Most hospitals were constructed of lumber, but in some cases light masonry walls and concrete floors were used.

On June 1st., 1918, the Commander in Chief directed that there be maintained a bed status of 15 per cent of the American E. F. strength in Europe. This increased rate was more than met.

On November 14, 1918, hospitalization was reduced to 7½ per cent; the bed space thus provided was 280,000 beds, or 14.2 per cent of the strength of the American E. F.

On Armistice Day, slightly over one half of the total hospitalization was provided by construction. This amounted to 7,700 hospital barracks, representing 127 miles of wards.

The maximum number of beds occupied by sick, wounded and convalescent, never exceeded 10 per cent, although the *available* bed space since the first week in July had always been at least 50,000 beds in excess of the number of beds occupied, although tentage for crisis expansion and operating personnel were not provided in sufficient number to match the bed space provided by construction.

The large scale of hospital construction is typified by the 20,000 bed type "A" base hospital centers at Mars and Mesves, in the Intermediate Section, each with 4,000 bed convalescent camps, together with the construction of road, water, sewerage and lighting facilities, and various other features demanded in order that the projects might function as full grown municipalities. Each of the twenty 1,000 bed units forming these centers consisted of 20 ward buildings for patients, in addition to kitchens, dining-rooms, store-rooms, operating buildings, laboratory, morgue, bath house and personnel quarters, a total of 58 buildings per 1,000 bed unit.

This necessitated the construction of a water supply system of 10-inch pipe line, 5 miles long, approximately the same amount of sewerage pipe and a 100,000 gallon reinforced concrete reservoir on towers 30 feet high, in connection with which there were two pumping stations, each of 500,000 gallon daily capacity, and a filter plant of the same size. Six miles of standard gauge railroad and a 15,000 volt transmission line 11 miles long were built.

A force of 4,152 men of different nationalities was engaged on this work. The Mesves hospital project was practically a duplication of the 20,000 bed center at Mars.

VII. PORTS.

At all French ports, it was necessary to alter the railway facilities to conform to American standard, which is explained under the heading of "Railroads."

Up to November 16th, 1918, 67 ship berths had been obtained from the French Government, 12 had been constructed, and work had been projected for the construction of 40 more.

Owing to considerable discussion of the port program for 1917, the only construction authorized was the 10-berth dock at American Bassens.

Construction was begun on a 10-berth dock at American Bassens in October 1917, and it was ready for berthing ships by the following March. This dock was 4,100 feet long and 82 feet wide and was built of piles and timber mainly obtained from the United States. It had ample switching facilities, including classification and departure yards, and was connected by rail with the 10 berths used by the American Army at French Bassens, the 20 berths being connected by a third track in order that a shuttle service could be operated to the St. Sulpice storage project. In August, the dock was reinforced for the installation of American Gantry cranes, and 3,200 additional 80-foot piling were driven. This dock, as finally constructed, contained 11,000 piles and timber amounting to 4,500,000 feet B. M. It was equipped with 40 American Gantry cranes.

The port program at Brest included the construction of two berths on the Jetée de l'Est and four berths on the Jetée du Sud. The two berths on the Jetée de l'Est were the only ones completed.

Because of the necessity for obtaining accurate soundings and other data, construction on the Montoir dock was not started until July 1918. The original plan called for double-track trestle approach, 4,000 feet in length, and a dock 3,250 feet long. At the time of the Armistice, the double-track approach had been completed and 40 per cent of the dock proper. Because of the Armistice, it was decided to construct only three berths, and these were completed and in use January, 1919. The outstanding feature of the construction of this dock was that all timber and most of the piles were obtained in France. Piles 80 to 100 feet in length were found and cut in the Vosges, handled to the nearest railroad point, and shipped by rail to Montoir.

Preliminary work for the 10-berth dock and storage depot at Talmont was well advanced, equipment and material assembled, and railroad built into the dock site when all work was stopped by the signing of the Armistice. This dock would have been completed by June 1, 1919. A labor force of 2,500 men was engaged on this work during October, 1918.

Of the lighterage docks recommended and authorized by the dock program, only one, St. Loubes on the Dordogne River near Bordeaux, for eight berths, was completed and in operation at the time of the Armistice.

Other docks of a similar design were under construction at St. Pardon, on the same river, and at Donges, near Montoir, and material had been delivered and other dock construction was ready to start on the Jetée du Sud at Brest and at two points on the Seine River near Rouen. Fifty-eight 300-ton lighters were constructed from French timber and twenty-six 500-ton lighters from American timber, besides seven derrick-barges of from 30 to 100 tons lifting capacity and others in course of construction.

In addition to the above construction, detailed plans had been provided, equipment assembled and construction started for adapting many French berths to American standards, notably Marseille, Toulon, Cette, Brest, and Le Havre, in accordance with the program mapped out in the Jadwin-Wilgus report dated August 19, 1918.

VIII. RAILROADS.

The main lines of communication for the American E. F., utilized during existing French double-track railroads, extending from the ports of Brest, Saint Nazaire, La Pallice and Bordeaux eastward

and converging in the center of France within the quadrangle formed by the cities of Tours, Châteauroux, Bourges and Orléans, thence radiating easterly to Is-sur-Tille, Chaumont, Neufchâteau and Saint Dizier, which points were in close proximity to the rear of the American armies. These railroads were the "Paris-Orléans Railway", the "Paris-Lyon-Méditerranée Railway" and the "Etat" and the "Est" Railways. These railways comprised both the first and the second lines of communication, and were the line of railway along which the main American facilities were constructed and upon which American trains with American train crews were operated. The "P. L. M." Railway, from Marseille and Toulon was also used, but with the exception of a few track changes at the ports, it contained no American facilities and was operated by the French.

Starting at the ports and extending the entire length of the line of communications, all construction work was done in a very densely populated foreign country, with all the consequent difficulties to be met and overcome. The program of railway construction may be divided into six categories.

(a) The track layouts at the docks and port facilities were entirely the French standard, where tracks were parallel and all connection was by means of turntables operated by hand, making a very slow and cumbersome operation. In order to get the maximum capacity and use American railway equipment, it was necessary to change from the French standard to the American standard of switching. At Saint Nazaire, the first port used by the American E. F., changes entailed a rearranging and construction to the American standard of switching of a total of 23 miles of track, and at other French ports and docks in like proportion.

(b) There was urgent necessity for getting the supplies away from the ships side as fast as possible, and in order to do this it was necessary to build direct track connection under American control between the docks and the storage and classification yards. At St. Nazaire, a double-track connection was built, approximately 4 miles in length, involving considerable grading and one double-track bridge across the Etang de Mean. At Bordeaux a third track was built parallel to the "P. O." road, a distance of 8 miles, to the storage yard to St. Sulpice.

(c) In order to properly classify and store supplies pending shipment, it was necessary to build extensive yards and storehouses as near to the ports as there was available ground. These were built at Montoir for St. Nazaire, at St. Luce for Nantes, at St. Sulpice for Bordeaux, and similar construction was started at Aigrefeuille for La Pallice, and at Miramas for Marseille. St. Luce was the port storage for Nantes. Fifteen miles of track were completed with

125,000 square feet of covered and 556,000 square feet of open storage.

The storage depot at Montoir was originally designed for a total trackage of 240 miles. At the time of the Armistice, 128 miles of track had been built and was in operation, including complete operating facilities, comprising 25 miles of track in receiving and departure yards, 5 miles in classification yards, 5 miles in engine terminal, 6 miles in Ordnance storage yard, and the balance of track to serve general storage warehouses and the many connections necessary to serve minor facilities. Construction of the project at Montoir started on September 30, 1917, and was completed December 31, 1918. The maximum number of men engaged in the construction work was 3,083. The project at St. Sulpice was practically identical with that at Montoir.

(d) The two large intermediate storage projects were located at Gièvres and Montierchaume, near the city of Châteauroux. These projects were intended to hold the reserve supplies for the operation of the American Army.

At the storage project at Gièvres, supplies were received from all ports and held in storage until needed in the advanced depots or elsewhere. At the time of the Armistice, there was laid and in operation 143 miles of track, which comprised the 36 miles in the receiving and departure yard, 9 miles in the sixteen classification yards, 7 miles in engine terminal, 13 miles in Engineer depot for open storage, and the balance, 69 miles, to serve the 165 warehouses, refrigerating plant and other lesser facilities. Gièvres was the largest of the storage facilities. It covered an area 6 miles in length and 2 in depth. There were 30,000 men stationed in camps within the project, 20,000 for construction and 10,000 for operation purposes. Construction work was started at Gièvres in September 1917, and the project started functioning in November of the same year. The maximum number of men employed on construction was 5,877.

The intermediate storage yards at Montierchaume was designed on approximately the same plan and size as Gièvres. At the time of the Armistice, a total amount of 50 miles of track had been laid, including receiving, classification and departure yards, engine terminal and storage tracks.

Ammunition storage depots were constructed at Jonchéry, Mehun, Issoudun and St. Loubes.

(e) Advanced storage and regulating stations were built at Is-sur-Tille and Liffol-le-Grand, and the French regulating station at St. Dizier was used. At Is-sur-Tille, 10 miles north of Dijon, the largest advance storage and regulating station was built, comprising a total of 95 miles of track. This was divided into receiving, classifi-

cation and departure yards, storage and miscellaneous tracks, and contained engine terminal facilities. Construction on this project commenced October, 1917, by the 16th Engineers, and began functioning in December of the same year, and was practically completed in June, 1918. The construction of this yard involved heavy grading, a large part of which was in solid rock. The maximum number of men engaged in this work was 3,984.

Liffol-le-Grand, near Neufchâteau, was in reality a regulating station, with comparatively small amount of storage. It consisted of 26 miles of track in receiving, departure and classification yards, 7 miles of track in engine terminal facilities, 12 miles for storage purposes. Construction was started in April, 1918, but for military reasons the work was not rushed until the following July. The maximum number of men engaged on work was 2,576. The work was practically complete in October, 1918.

(f) It was found that the engine terminal facilities along the French railways would not be of sufficient capacity to handle the heavy traffic necessary to adequately supply the American E. F., and as these engine terminals were in congested centers, it was decided to build new ones solely for American operations. Under this program engine terminals were built at Montoir, Saumur, Gièvres, Cercy-la-Tour, Is-sur-Tille, Liffol-le-Grand, and along the line out of Bordeaux, at Nexon, Périguex, and Montierchaume. All of these engine terminals were constructed and in operation.

The engine terminals were practically of the same design, including receiving and departure yards, engine house and repair shop and other necessary facilities. The trackage involved varied between 8 to 14 miles. The water supply along the French railroads used by the American E. F. was strengthened and increased in numerous places.

In addition to the railroad work as set forth above, it was necessary to construct sidings and spur lines at the various hospitals, aviation centers, camps, Ordnance storage projects, oil and gasoline stations, and to the many forestry operations. A total of 950 miles of railroad was constructed. If this were laid in a continuous line, it would reach from the Atlantic Ocean at Saint Nazaire, across France and Germany and to the Russian border. The progress of American railroad operations is shown in Chart 5, Chapter XV, Vol. I.

For further reference, see report prepared by a board appointed by the Commanding General, S. O. S., showing description and maps of standard gauge railway facilities inaugurated by the Director General of Transportation and built by the D. C. & F. Comprehensive plans were prepared by the Transportation Service

for all track facilities, but shortage of materials and labor together with the rapid increase of the troops' arrivals called for wise discrimination as to what was needed. It became necessary to make a decision almost from day to day and, from the observation of the tracks that were used most and those that were not largely used, the experience seemed to be that it was best to prepare for a maximum trackage but to put down a minimum to avoid loss of manpower and materials and leaving room to add others as necessity developed.

IX. STORAGE DEPOTS.

The covered storage as originally estimated was 21 square feet per man in the American E. F., but it was found by experience that for a 90-day reserve, 10 square feet per man were sufficient. This was later reduced to 5 square feet when a 45-day reserve was determined. These requirements were met as follows:

		Square feet.
Depot storage		15,529,000
Gièvres	square feet	3,839,000
St. Sulpice	do	2,627,000
Montoir	do	3,447,000
Montierchaume	do	1,214,000
Is-sur-Tille	do	1,355,000
Other depots	do	3,047,000
Dock storage		3,028,000
Miscellaneous storage		3,858,000
Total		22,415,000

Originally, warehouses were constructed of lumber with rubberoid roofing. Owing to shortage of lumber, a type was developed with wood frame and corrugated iron roofing and sides, using round poles for posts. This warehouse was 50 feet by 490 feet, and 12 feet high at the eaves and required only 20,800 feet B. M of lumber and 44,000 square feet of corrugated iron and could be hastily and quickly erected.

At Gièvres, on one occasion, a warehouse of 50 feet by 294 feet was erected by 60 men in eight and a half hours, only the roof and ends being covered with corrugated iron.

Floors were not built except in buildings where supplies would suffer from moisture.

The principal Motor Transport project was the main base plant and repair shop at Verneuil, near Nevers. It was designed to serve as the base repair center for the Motor Transport Corps.

The project consisted of the main base plant, which was started April 12, 1918, and completed on February 1, 1919, and included 361,000 square feet of shops.

The camp for personnel, which was started about August 1, 1918, was completed in January, 1919. The construction consisted almost entirely of standard demountable type troop barracks for quarters, mess halls, etc., amounting to a total floor space of 302,430 feet.

The principal Air Service project was the Air Service Production Center No. 2, at Romorantin.

A camp was constructed for 10,000 men.

The original project was authorized December 27, 1917. The maximum number of men employed at one time was 2,684. When construction was stopped on November 15, 1918, 85 per cent of the entire authorized work had been completed. The construction consisted of 1,297,200 square feet of shops; 765,200 square feet of storehouses and hangars; 616,000 square feet of barracks and 126,000 square feet of hospital space.

X. REMOUNT DEPOTS AND VETERINARY HOSPITALS.

Remount depots with veterinary hospitals were established at the principal base ports. Large depots with veterinary hospitals adjoining were established at Gièvres, Selles-sur-Cher, and Sougy, in the Intermediate Section. In the Advance Section a large depot and veterinary hospital was built at Lux, near Is-sur-Tille, and many smaller remount depots and hospitals between that point and the front lines.

The total facilities authorized by the Staff comprised remount depots for 61,200 animals and veterinary hospitals for 39,100 animals. Of these, there was actually available on February 1, 1919, the following space for animals:

In remount depots constructed by the D. C. & F.	27,700	
In remount depots obtained from the French	12,000	
		39,700
In veterinary hospitals constructed by the D. C. & F.	16,500	
In veterinary hospitals obtained from the French	11,100	
		27,600
Total space in remount depots and veterinary hospitals		67,300

In general, remount depots were built for 2,000 to 5,000 animals, with a veterinary hospital near at hand to accommodate from 1,000 to 2,000 animals. The project at Sougy had a capacity for 5,000 animals in the remount depot and 2,000 in the veterinary hospital. It had quarters for 100 officers and for 2,500 enlisted men, with necessary mess halls, bath houses, and included a recreation building.

XI. WATER SUPPLY AND SEWERAGE.

In connection with all work, there was a large amount of water supply required.

A system of water analysis laboratories was erected in the S. O. S. The water supply for the city of Saint Nazaire was the largest single problem. The ordinary French requirements at St. Nazaire amounted to about one million gallons per day. The combined French and American requirements were estimated at about 3,000,000 gallons per day. It was decided to provide additional storage reservoirs with a capacity of 400 million gallons. It was necessary to construct one rapid sand filter of 3 million gallons daily capacity and another of 1,000,000 gallons daily capacity in order to provide satisfactory water. To fill the reservoirs in the rainy season and to elevate the water, 15 pumps with a total capacity of 30 million gallons per day had to be installed; 48,000 feet of 24-inch to 12-inch pipe; 60,000 of 8-inch to 4-inch pipe, and elevated tanks of 200,000 gallons capacity were used in the supply and main distribution systems alone, not to mention miles of smaller pipe used for distribution.

The water supply of the docks and camps at Brest offered another large problem. The original French systems were inadequate and provision for an additional 900,000 gallons per day was made. A pumping station on the Penfield river was installed with a daily capacity of 1,300,000 gallons and 28,000 feet of pipe line laid. Pressure pumps of a capacity of 2,000,000 gallons per day were installed. At the Pontanazen camp, it was estimated that 3,000,000 gallons a day would be necessary. The Penfield river was the source. Two reservoirs, one of 23,000,000 gallons capacity and another of 2,000,000 gallons capacity were constructed. Two pumping stations containing six pumps of a capacity of 4,700,000 gallons daily were constructed; 41,000 feet of 14-inch to 10-inch pipe and 10,000 feet of 6-inch and 4-inch pipe were used on the main supply and distribution system. Other projects of interest were:

The Savenay Hospital water supply, for which a concrete arch dam 40 feet high and containing over 6,000 cubic yards of concrete to provide a reservoir storage capacity of 100,000,000 gallons was constructed in addition to two filter plants, each of 330,000 gallons daily capacity, with a concrete standpipe of 50,000 gallons capacity.

At Allerey and Beaune Hospitals, 57,000 feet of sewer pipe and 40,000 feet of water mains were laid. At Romorantin Air Service Plant, two filters of 200,000 gallons daily capacity were placed. A slow sand filter was installed at Langres and Châteauroux hospitals. At Montierchaume, there was constructed a storage depot involving the laying of some 30,000 feet of 4, 6 and 8 inch pipe, the installation of pumping stations of a capacity of 100 horsepower, the drilling of wells of a total depth of 1,700 feet, and the construction of elevated tanks of a total capacity of 150,000 gallons. The depot at Gièvres was of even larger capacity than Montierchaume. At

Bassens, 1,500,000 gallons of water per day were provided by drilling two artesian wells to a depth of 700 feet. A well of 1,520 feet depth was drilled at Beau Désert Hospital, and one of 1,020 feet depth at St. Sulpice. For the Mars and Mesves water supply systems, see under "Hospitalization."

XII. REFRIGERATION.

A total refrigerating space for the storage of 14,900 tons was built, with ice-making facilities for 500 tons per day.

The plants at Gièvres and Bassens were the largest constructed, having a capacity for 7,500 and 6,000 tons of frozen beef respectively. At the signing of the Armistice, plans had been completed for a duplication of the Gièvres plant and Bassens plant in the Advance Section, as well as a 400-ton plant at Marseille. These three projects were cancelled.

The beef storage building at Bassens was cork insulated throughout, using 100,000 cubic feet of cork. The floor was of reinforced concrete over cork-board. The cold storage rooms contained 134,800 lineal feet of 2 inch standard pipe. The refrigerating machines were driven by cross-compound condensing Corliss engines. The boiler capacity was 900 horsepower. The reinforced concrete reservoir had a capacity of 130,000 gallons of water; 931,000 feet B. M. of lumber were used. This plant was constructed and in operation in four and one-half months after commencement of the work.

XIII. BAKERIES.

The Is-sur-Tille bakery had a capacity of 800,000 pounds daily and an emergency production of 1,000,000 pounds daily. Bakeries at Brest and Bordeaux had a capacity of 150,000 pounds daily; at St. Nazaire of 120,000 pounds daily. Plans were completed for a mechanical bakery at Liffol-le-Grand with a capacity of 400,000 pounds daily, but construction was cancelled at the time of the Armistice. Plans for the construction of field bakeries totalling in capacity approximately 600,000 pounds daily were made, of which a capacity of 500,000 pounds daily were completed.

All machinery was electric driven, power being furnished from a modern steam turbo generating plant of 900 kilowatt capacity, the power house being in a separate building, 55 by 125 feet. Ovens were built in groups of seven, so as to lessen chance of plant being totally disabled.

XIV. ELECTRICAL INSTALLATIONS

Steam generating stations involving approximately 3,000 kilowatts of power were in process of construction at the time of the

Armistice. The larger of these were the 900 kilowatt plant at the bakery at Is-sur-Tille; a 1,000 kilowatt standby plant at the Bassens project; a 750 kilowatt plant for the Air Service at Romorantin.

The construction of a 3,500 kilowatt plant at Aytre was to supply power for the car works at La Rochelle and docks at La Pallice.

Three thousand kilowatts in rotary convertor substations, were designed and under construction. These were at Neuvy-Pailloux, to serve the tank factory; at Marseille, La Pallice, and St. Nazaire, to serve the Gantry cranes. At Mehun, a 2,500 kilowatt substation was constructed.

One hundred and twenty-five miles of transmission line was constructed or under construction. Low tension distributing systems and general interior wiring were installed in the S. O. S.

XV. OIL AND GASOLINE STORAGE.

The following seacoast gasoline storage stations were constructed and operated:

La Pallice: Four 25,000-barrel tanks;

St. Loubes: One 25,000-barrel tank;

Blaye: Two 25,000-barrel storage tanks were erected but were never placed in operation.

Gièvres: Four 10,000-barrel tanks constructed and placed in operation.

XVI. ROADS.

This division in the year 1918, had charge of all road work in the S. O. S. except that in the Advance Section. During this period, ninety miles of new roads were constructed. The maintenance and repair work was limited to approximately 300 miles, which repair work was performed mainly in the immediate vicinity of Bordeaux and the docks at Bassens, and the streets of Saint Nazaire. On January 2, 1919, all road work in the S. O. S. and Luxemburg was placed under the direction of the division.

The " cantonnier " system was adopted for the maintenance of the highways. This system is one of constant patrol and of carefully placing well tamped patches and resurfacing.

XVII. FORESTRY.

The Forestry Section cut and logged 15,000 piles from 65 to 100 feet in length, under great difficulties, assuring the completion of the major dock projects at the American E. F. base ports. In addition, 15,000,000 feet of long heavy timbers, specially selected, were furnished for dock, barge and bridge construction. By an active field

organization, it was possible to keep the current rail and cargo deliveries of lumber, ties and piling up to 70 per cent of current production in spite of the shortage of transportation facilities in France.

XVIII. EFFECT OF THE ARMISTICE.

Shortly after the Armistice, the total number of projects authorized was 795; of these 298 were canceled, 401 were completed, and 96 were still under construction.

XIX. SALVAGE.

The D. C. & F. was charged with the dismantling of all camps, depots and other construction projects that were the property of the United States and which the Commanding General, S. O. S., had decided were no longer required by the American E. F. This was carried out as quickly as the return of the troops to the United States permitted.

XX. GENERAL REMARKS.

As an illustration of the work done by this Department, if all the railroads were laid in a continuous straight line, it would reach from the Atlantic Ocean at St. Nazaire, across France and Germany to the Russian frontier. Similarly, if all the building construction were consolidated into one building having the width of our standard barrack and hospitals, it would reach from St. Nazaire, across France and to the Elbe River. The forestry troops produced 75 per cent of the lumber and ties used on this construction, and in addition 375 miles of corded fuelwood, and 144 miles of piling.

A board of officers appointed by the Commanding General S. O. S., estimated, in a report under date of March 13, 1919, the total cost on December 31, 1918, of all projects and facilities built, as $165,661,455.00, not including cost of land occupied and not including certain work for which the figures had not been received.

Further details of the work accomplished by the D. C. & F., may be found in the reports of the Forestry Section and the Section Engineer Officers, copies of which have been filed in the Office of the Chief Engineer, American E. F., and the Office of the Chief of Engineers, War Department, Washington, D. C.

CHAPTER XXI.

SECTION I.

FORESTRY SERVICE (BRITISH).[1]

CAUSES OF FORMATION OF DIRECTORATE.

The loss of shipping in 1916 made it impossible to continue the import into France of the large quantities of timber required by the armies which had hitherto been obtained from Sweden, Russia and Canada. It was known that France possessed valuable and extensive resources in standing timber which were being exploited on a small scale by the British Army.

CONVENTION OF 1916.

A convention was accordingly made with the French Government by which, in return for shipping facilities and assistance, "coupes" (felling grants) were granted to the British Army sufficient to maintain two battalions (2,200 strength) of Canadian foresters, and, in the event of Canadian personnel being available in excess of two battalions, the French Government undertook to supply "coupes" either on payment in cash or in kind, as might be deemed desirable by the War Timber Committee which was created to carry out the provisions of the convention. This committee was required to examine in detail the requirements of the Allied Armies upon a basis of not less than three months' indent, and preferably on a six months' indent, and, with this information, and with knowledge of the resources and production of the forestry operations in France, to arrange with the Admiralty for the shipping required to bring to France what timber was required to meet the timber needs. The convention laid down that except with the consent of the French authorities, the purchasing power of the British Army should be limited to the acquisition of small quantities of local timber in the Zone of the Armies by chief engineers of armies and corps of Officers Commanding Royal Engineers (C. R. E.) of divisions.

FORESTRY IN FRANCE IN 1916.

At the date when the convention came into force (15th November 1916) forestry operations were being carried out on a small scale

[1] Prepared for the Military Board of Allied Supply by the Director of Forestry Service, British Expeditionary Forces in France and Flanders.

in army areas and on the lines of communications. The personnel employed consisted in the army areas of working parties drawn from the infantry under the orders of chief engineers of armies and corps, and in the lines of communication area of two Royal Engineers labor battalions, two and a half army troops companies Royal Engineers and attached details, working under the supervision of the Forests Branch of the Directorate of Works.

The British Forestry Mission had made arrangements for two Canadian forestry companies to work in Central France, where they commenced work on the 27th of November, 1916. Advantage was taken of the opportunity afforded by the conclusion of the convention to take steps for the formation of an independent directorate to deal with the many problems ancillary to extensive development of forestry operations for the armies in France.

All British skilled personnel was accordingly formed into recognized Royal Engineer units under the control of the Directorate of Forestry, which came into active operation on the 10th of March, 1917.

RELATIONS WITH CANADIAN FORESTRY CORPS (C. F. C.).

As regards the Canadian Forestry Corps, the directorate was required to indicate to the Canadian Forestry Corps (C. F. C.) the location of forestry operations and the requirements of the British Army as to the sizes and types of the products therefrom, while the actual operations were left to the Canadian Forestry Corps to be conducted by them entirely under the direction of their own staff.

MARCH, 1917.

Forestry operations were in active progress in the following areas by the end of March, 1917:

1. *Army Areas*	Forest of Nieppe (State Forest) and minor operations.
2. *Lines of Communication*	Eawy (State Forest).
	Brotonne (State Forest).
	Haute d'Eu (State Forest).
	Basse d'Eu (State Forest).
	Crécy (State Forest).
	St. Evroult (Private Forest).
	Rouvray (State Forest).
3. *Central Area*	Blancheland (Private Forest).
	Parc de Conches (Private Forest).
	Forêt de Conches (Private Forest).
	Bois Normand (Private Forest).
4. *Jura Area*	La Joux (State Forest).
	Boujaille (Communal Forest).

CONVENTION OF 1917.

Early in 1917 it was perceived that the needs of the armies were greater than could be provided for under the convention of 1916, and that there was foundation for the French claim that the advantages which they were to secure under the convention had not in fact accrued to them and could not accrue to them. The convention of 1916 was replaced after negotiations by a convention which came into effect on the 1st October, 1917. The British Government had to maintain fifty-six companies of the Canadian Forestry Corps. Ten of these companies were to work exclusively for the British Army in forests provided by the French at the expense of the British Government. The products of the labors of the forty-six remaining companies, who worked in forests provided by the French Government free, was to be divided between the two governments under conditions of exploitation which the experience of previous months had shown to be necessary on economic grounds. The question of tonnage was excluded from this convention and remitted for solution to the Ministers of the two Allied Governments, who were primarily responsible for shipping matters.

The provisions of this convention rendered possible the development of the operations of the Forestry Directorate and from that date to the conclusion of hostilities the association of the British Forestry Service with the French became more intimate and easy.

INTERALLIED WOOD COMMITTEE (C. I. B. G.)

The "Interallied Wood Committee" (Comité Interallié des Bois de Guerre) was formed and controlled the acquisition of standing timber in France for the Allies. It was most successful in this and was able to check the inflation of prices due to profiteering. This body was distinct in origin, function and composition from the "Interallied Wood Purchasing Committee" (Comité Interallié d'Achat de Bois—C. I. A. B.), whose operations extended to the acquisition of timber from Scandinavia, Canada, Switzerland, for the purposes of the Allies.

RELATIONS WITH THE FRENCH FORESTRY SERVICE.

As is well known, the importance of forests as a national asset is vividly recognized in France, where since the days of Napoleon, admirable efforts have been made to conserve the State forests on sound scientific lines.

Forest exploitation in times of war has to go faster and more intensively than is allowed in the leisurely times of peace. But rich and extensive as are the forests of the State, it would be im-

possible in the interests of the future to have allowed reckless felling uncontrolled by regard for sylvicultural conditions. Clear felling had only been permitted in artificial (pine) forests and then sometimes only on the condition of resowing. In natural forests, private as well as public, the trees to be felled are marked. Reserves are kept and the interests of the future zealously safeguarded by the Technical Forestry Commission (Commission Forestière d'Expertise). Within these limits operations were concluded, and though in early days there was criticism well founded, the relations of those engaged in forestry work with the French forestry officers were marked by great cordiality and reciprocal esteem.

CONSOLIDATED INDENTS.

The policy of forecasting the requirements of the Army on the basis of six months was followed throughout. An indent over a long period is necessarily on generous lines. All possible combinations of circumstances, all possible permutations of policy were reckoned on, so that whatever might have happened provision would have been made by the prevision of the services against every eventuality that war might have forced upon the armies.

The indents were always scrutinized closely, discussed with the directors of the services, and approved by the Quartermaster General, after the fullest consideration of the possibilities of production in estimating which it was essential to bear in mind that the organization of forestry exploitation is by no means simple. Apart from the many factors which have to be considered in planning the working scheme for a big forest, such as problems of mill and camp sites, railway facilities, water supply, methods of extraction, it is not an easy thing when once exploitation has actively started to modify specifications without seriously diminishing production. Trees when felled in the forest have to be cross-cut to proper lengths before being hauled to the mill. The lengths are fixed after expert consideration of the commodities which have to be produced. Any change of policy and of specification retards production until all the new adjustments have been made. Production has to be kept up at full rates. It was therefore impossible to undertake fancy work, and the value of standardization as the essential condition of production on a large scale is admirably illustrated in the case of timber from the forests.

DIRECTOR—PERSONNEL.

Brigadier General Lord Lovat, K. T., K. C. M. G., K. C. V. O., C. B., D. S. O., A. D. C., assumed duty as Director on March 10th, 1917, and remained in charge throughout.

The headquarters staff consisted of fourteen British and four Canadian officers.

FORMATION OF DIRECTORATES.

The directorate was formed of two main divisions (1) General Administration, and (2) Technical Equipment and Organization. (Chart 1, Chapter XXII, Volume I.)

Under the heading General Administration were comprised departments dealing with production, statistics, contracts and purchases, personnel and liaison with the War Office, Controller of Timber Supplies, French Military Mission (Forestry Section), "Interallied Wood Committee" (C. I. B. G.) and "Interallied Wood Purchasing Committee" (C. I. A. B.), and the co-ordination of the work of these departments with the technical departments.

Under the heading Technical Equipment and Organization were departments dealing with the purchase of machinery and equipment, installations of mills and technical engineering, and forestry exploitations. Special officers were appointed as liaison officers with the Canadian Forestry Corps and the Directorates of Transportation and Transport.

With this organization, at every stage effective control was exercised by expert officers over the work in the forests and to secure closer cooperation and the exchange of ideas, weekly meetings of heads of departments were held with the director at which problems were discussed in common, the progress of operations surveyed and policy shaped according to the requirements of the military situation.

The organization of the various groups followed on similar lines.

BRITISH ORGANIZATION.

(1) British organization was divided into three groups:

(a) *Armies Area Group*, consisting of a Forest Control attached to each army headquarters and five skilled R. E. forestry companies. The group headquarters controlled all forestry operations in armies area, and supervised through the controls and skilled companies a large force of unskilled labor (prisoners of war, Chinese and Indian) which ultimately numbered 9,000 strong. Seven Canadian companies also worked in this group.

(b) *Lines of Communication Group*, consisting of six Forest Districts situated for the most part in large State forests in the Seine Inférieure and six Royal Engineers forestry companies with the group headquarters at Rouen. The forest of Castets in Les Landes was taken over by the lines of communication on its evacuation by the American Expeditionary Forces in 1918. The maximum

strength of the unskilled labor employed in this group was 13,000 (mostly prisoners of war and Chinese coolies).

(c) *Paris Staff*, under an Assistant Director, who acted as British representative on the "Interallied Wood Committee" (C. I. B. G.) and the "Interallied Wood Purchasing Committee" (C. I. A. B.), with subordinate staffs (i) for estimation and purchasing duties in Central France and at a later date in the Landes and Gironde, and (ii) for despatching work at Bordeaux and Bayonne. This organization was responsible for the entire purchase, estimation and valuation of timber bought outside the British zone, and for the despatch of forest produce from the Landes forests by sea to northern ports.

CANADIAN ORGANIZATION.

(2) Canadian organization, consisted of a headquarters controlling three main groups:

Central Group: Two districts, 14 companies; operating in a large area south west of the Seine.

Jura Group: Three districts, 19 companies; operating in the Vosges and Jura Mountains and in the Department of Haute-Marne.

Bordeaux Group: Two districts, 18 companies; operating in the Departments of the Landes and Gironde, together with seven companies working in the armies areas.

The total personnel numbered 425 officers and 11,225 other ranks, and supervised up to 6,500 laborers (prisoners of war).

Each of these divisions formed a separate entity with peculiarities and characteristics due both to their previous history and to the natural features of the area in which they worked. Each division had to deal with special problems and each therefore deserves separate note.

ARMIES AREA.

In the armies area the organization had grown out of, was part of and always remained in close contact with the armies. This intimate association was of peculiar advantage to the directorate, as it enabled its operation to be appreciated and understood by those for whose benefit and assistance they were carried on. The armies area was poor in State forest resources and it was necessary to supplement the grants made by the French authorities, through the French Mission, in their State forests: Nieppe, Clairmarais, Tournehem and Crécy, by extensive purchases from private owners. A staff of expert timber buyers was maintained to this end, and while from time to time serious difficulties were encountered, in the main the supplies of standing timber were well secured. It was

laid down that recourse was not to be had to requisition unless it could be conclusively shown that a fair and reasonable price had been offered, that it had been unreasonably refused, and that the standing timber was in fact required. Various devices, maximum and minimum scales of prices, etc., were proposed and tried from time to time to meet the difficulty of fixing a fair price, but the industry, patience, ingenuity and tact of the expert purchasers obtained the trees which were needed to keep the mills going at a cost which, regard being had to the special difficulties of this area, must be regarded as eminently moderate.

Brushwood supplies: In the armies area the following quantities of hurdles and fascines were made for the northern armies for the maintenance of their trenches and forward roads, during the period May 1917 to November 1918: Fascines, 85,098 tons; hurdles, 24,145 tons; pickets, 92,570 tons.

LINES OF COMMUNICATION AREA.

In the lines of communication area where operations had been commenced by the Director of Works, conditions were more stable. The French forest authorities conceded "coupes" in the rich State forests and the supply of forest produce to the depots was steadily maintained by an efficient and economical administration. Unskilled labor was employed in this area in large numbers with marked success.

CANADIAN FORESTRY CORPS AREAS.

The areas exploited by the Canadian Forestry Corps were rich in standing timber and suitable for the vigourous methods the skill and the mechanical genius of the professional lumbermen who tackled with characteristic ingenuity and with complete success the difficulties of work in the rolling uplands of the Central Plain, in the rich pine forests of the Landes and the fir-clad slopes of the mountains of France's eastern frontier.

DEVELOPMENT OF CANADIAN FORESTRY CORPS (C. F. C.), CENTRAL AREA.

The first operation entered by the Canadian Forestry Corps was Bois Normand in the Department of the Eure. At the end of 1916, two operations were in progress in the Central Area south of the Seine. At the end of 1917 fourteen operations were in progress. The total number of operations in this area was twenty-eight, of which nine were State forests (Perseigne, Andaine, Bellême, Evouves, Bourse, Senonches, Rouvray, Bord and La Trappe).

Jura and Vosges.—The first operation in the Jura was entered by the C. F. C. in March, 1917, at La Joux, a State forest. At the end

of 1917, ten operations were in progress. The total number of operations in this area was seventeen, of which six were in State forests (La Joux, La Fresse, Levier, La Vologne, Noiregoutte and Géhant) while the remainder were owned by the communes.

Les Landes.—The Canadian Forestry Corps operations commenced in this area in July, 1917, at La Saussouze. By the end of 1917, six operations were in progress and in all sixteen operations were carried on in this richly-timbered area, none of which were in State forests.

Forests.	1917, March.	1917, December.	Total number of forests exploited.
Armies area [1]	2	4	4
Lines of communication	7	7	7
Canadian Forestry Corps:			
Central area	5	14	28
Jura and Vosges	2	10	17
Les Landes	----------	6	16
	16	41	72

[1] In the armies area there were over twenty minor operations not counted as forests.

Personnel.	1917, March.	1917, December.	1918, November.
Number of companies at work:			
Royal Engineers	----------	4	11
Canadian Forestry Corps	3	56	58

CANADIAN FORESTRY CROPS STATISTICS.

It is estimated by the Canadian Forestry Corps statisticians that, excluding operations in army areas (British and French), they felled 1,898,267 metre cube of standing timber: Central Group, 714,075; Jura Group, 463,600; Bordeaux Group, 720,592, which yielded the following quantities of produce:

	Sawn.	Round.	Fuel.
Central Group	385, 580	145, 616	169, 463
Jura Group	276, 624	2, 956	110, 577
Bordeaux Group	397, 077	10, 657	162, 970

Their operations in all comprised the conversion of 2,199,067 metre cube of standing timber into 1,246,947 tons of sawn timber, 225,508 tons of round timber and 616,396 tons of fuel.

RESULTS.

The extent to which the Forestry Directorate succeeded in reducing imports of timber and releasing shipping for other purposes is shown by the following table.

Period.	Indent (tons).	Total (tons).	Deliveries.			
			From French forests.		Imported by sea.	
			Tons.	Percentage.	Tons.	Percentage.
April, 1917–September, 1917	752, 231	774, 822	426, 208	55	348, 614	45
October, 1917–March, 1918	753, 928	748, 126	669, 735	89½	78, 391	10½
April, 1918–September, 1918	782, 027	815, 855	752, 038	92	63, 847	8
October and November, 1918	294, 278	231, 869	217, 093	94	14, 776	6
	2, 582, 464	2, 570, 672	2, 065, 074	----------	505, 628	----------

These figures include indents of a special nature which could not be met from France.

The production from the French forests rose steadily from 51,330 tons in April, 1917, to a maximum of 278,077 tons in July, 1918 (Table P. 2); 2,570,672 tons were supplied to the British Army; 399,147 tons to the French Army; 19,932 tons to the American Army. Reserves which at the end of September 1917 amounted to 172,465 tons, little more than five weeks' supply, had by the end of November 1918, been built up to 692,457 tons, nearly six months' supply and were adequate to meet all contingencies and fluctuations of the military situation.

In twenty months, over one million tons of sawn timber were supplied to the Director of Works and Director of Engineerng Stores; 5,780,000 slabs were provided for road making; 24,000 tons of telegraph poles were delivered for the Signal Service. The supply of sleepers was 4,171,000 standards, 1,315,000 metre, 3,050,000 60-cm. for light railways and 356,000 tons of fuel wood were delivered to the armies.

NOTE [1].—Concerning Chart No. 2, Chapter XXII, Vol. I, it must be explained that the British forestry services drew Ordnance stores from the Ordnance depots, supplies from supply depots and railway material from railway depots as required. Technical equipment was obtained sometimes by local purchase, sometimes by direct purchase from England, sometimes through the Director of Engineering Stores or the Director of Works. The Canadian Forestry Corps made an important quantity of technical equipment at their workshops in England from designs prepared by officers serving in France. In this way considerable power of adaptability was secured which proved of great value in meeting very varied requirements rapidly and satisfactorily.

[1] Note prepared by Colonel T. C. Hodson, Director of Forestry, British Army.

TABLE 2.—*Production summary.*

[April, 1917–November, 1918]

	Sawn	Round	Fuel	Total
1917				
April	16,191	20,028	15,111	51,330
May	24,259	25,085	19,201	68,545
June	40,735	25,401	28,559	94,695
July	39,654	15,383	19,583	74,620
August	52,093	10,881	24,264	87,238
September	85,574	18,939	45,227	149,740
October	76,609	16,758	44,353	137,720
November	90,095	21,650	62,188	173,933
December	65,684	18,988	50,160	134,832
1918				
January	75,200	28,949	50,088	154,237
February	102,885	41,629	69,068	213,582
March	86,334	52,850	55,931	193,115
April	81,785	43,890	51,872	177,547
May	119,710	32,507	74,166	226,383
June	111,915	36,725	59,307	207,947
July	148,944	41,187	87,946	278,077
August	129,737	36,226	69,011	234,974
September	120,527	37,173	70,383	228,083
October	132,063	39,312	84,513	255,888
November	74,612	8,427	60,688	143,727
Total	1,674,606	571,988	1,039,619	3,286,213

CHAPTER XXI.

SECTION II.

SUPPLY OF WOOD—FORESTRY SERVICE (FRENCH).

The service for the supply of wood was created during the war because of conditions arising from the war. As a matter of fact, the enormous demand for wood, required in the construction of exterior shelters (barracks, camps, etc.) and defensive works (posts, supports), resulted from the stabilization of the front and the prolonged maintenance of the armies in a stationary zone. Later, these requirements increased progressively, on account of the efforts which were being made to better the living conditions of the troops and because of the construction of various works employed in the preparation of offensive operations (zones d'attaque), such as battery positions, parks, shops, hospitals, etc.

It was only after the middle of 1915 that these requirements became important but their subsequent development was very rapid.

Existing resources of cut timber were exhausted almost immediately and it became readily apparent that the quantity of wood which could be obtained through purchase from civil contractors would be insignificant in comparison with actual requirements. It was therefore necessary to provide for military forestry operations, moreover, the stabilization of the front enabled the armies to partly supply themselves by exploiting the resources in their respective zones. These direct exploitations were advantageous from a double point of view in that they furnished an important supplement to the amount of wood which could be obtained from the interior (whose wood production was slow to develop owing to shortage of labor) and because they economized transportation. Finally, for reasons which will be stated later, the Commander in Chief (Direction of the Rear) was called upon to organize wood production.

The organization of this service will be examined successively:

A. In the Zone of the Armies.
B. In the Allied Armies.
C. In the Direction of the Rear.
D. In the interior.

At the end of this statement will be found statistics on the consumption of various kinds of wood at different periods.

ORGANIZATION OF THE SERVICE.

A. In the Armies.

Purchases in the open market.—At the beginning of the war and throughout the campaign the armies made purchases. It was necessary to avoid the disadvantages which would certainly have arisen had the armies competed against each other or against the central services, and this was accomplished by:

1. Prescribing price limits.

2. Forbidding the armies to make purchases outside of their own zones and to purchase within their zones only after presentation, by the furnishers, of certificates stating that the wood supplied came from the zone of the army concerned. The Direction of the Rear (D. A.) was naturally obliged to establish a supervision to insure compliance with these regulations.

Exploitations by the armies.—The armies exploited the forests within their zones and, until June 1915, these operations were relatively unimportant. They were undertaken after agreement with the local forestry guards and "communes" (townships) and the issue of general regulations was deemed unnecessary.

On June 29, 1915, the Minister of Agriculture, warned from various sources that these operations were becoming important and that certain difficulties had arisen, requested that a "Direction" be organized and that forestry operations be supervised by mobilized water and forestry guards. On July 1st, in compliance with this request, the Direction of the Rear asked the Minister to furnish the names of the water and forestry guards serving in the Zone of the Armies and information as to whether or not these men were mobilized; it also requested forestry maps so that available resources might be listed.

At the same time, the Commander in Chief requested the Minister (Letter 4505 D. A. July 10, 1915) to extend the authority of the "Forestry Commission" (Commission des forêts), which had been created in the Zone of the Interior by a decree of December 14, 1914, to the Zone of the Armies, through the designation of a General Staff officer as Military Forestry Commissioner of this zone. The Technical Commissioner would be the same for both the Zone of the Armies and the Zone of the Interior. This proposition was adopted.

On July 25, 1915, the Commander in Chief issued general instructions (7565 D. A.) which regulated the organization of forestry operations in the armies, determined the relations to be established between the armies and the officials of the water and forestry services in the army zones, and prescribed that requests for the assignment of forests for exploitation purposes (coupes) should be submitted to

him for approval after receiving the remarks of the forestry agent (conservateur) concerned. This enabled the Commander in Chief to readily and rapidly supervise forestry operations, moreover, this procedure was found to be most satisfactory. The armies were also directed to employ the mobilized water and forestry guards who happened to be included in their units for the technical supervision of forestry operations. Finally, the Direction of the Rear assigned companies of "Forestry troops" (Chasseurs forestiers) among the armies and these were employed as foremen of lumber camps or to strengthen groups of unskilled laborers.

Until the end of the war, these measures served as the basis of all forestry operations undertaken by the armies. It may be said that due to the application of these rules, the armies caused as little damage to the timber resources as was compatible with the extent of their operations, notwithstanding their prolonged exploitation of the same territorial areas.

However, something was still lacking. Although the bulletin of July 25, 1915, provided for the creation of army services to direct forestry operations, to be composed of mobilized water and forestry guards, and although all of the armies actually had such organizations, as a matter of fact these forestry services really had no official status. It was therefore necessary to officially create a "Forestry service" in each army, with a chief of service at its head ("conservateur" or "inspecteur") and a number of assistants. These regulations were modified by an order (note D. A. 6526) dated September 16, 1916. To secure coordination in the methods of exploitation and to better preserve national timber resources, it was prescribed that: A number of "forestry sectors" (secteurs forestiers) be organized in each army zone; that an officer be placed at the head of each forestry sector and that these "chiefs of sectors," in case the army moved, would remain on the spot and would serve the new army entering the zone.

B. In the Allied Armies.

Purchases.—The Allied Armies were subject to the same regulations as the French armies.

Forestry exploitations.—(Chart 5, Chapter XXII, Volume I.)

Same general dispositions as for the French armies. On July 31, 1915, the British and Belgian Armies were notified that they were amenable to the instructions of July 25th, and that whenever they made requests for wood cutting privileges (coupes) they were to furnish a detailed estimate as to the lumber which they desired to obtain. On September 14th, forestry officers (chasseurs forestiers) were attached to the French missions with these armies. Under the

conditions stated above, various forestry areas were successively assigned to the British and Belgians.

The requirements of the Belgians were small and this enabled them to find the necessary resources within their own zone or in its immediate vicinity. For the British Army, whose needs were increasing constantly, it was necessary to establish a wood program covering future estimated requirements for a long period of time. For this purpose a meeting was held at the 4th Section (4e Bureau) of G. H. Q., on February 21, 1916 and, transportation facilities being considered, a list was drawn up of forests which were to be reserved wholly or in part for the use of the British Army. These included the forests in the British zone (which was poor), most of the forests in the Seine-Inférieure and certain resources in the Eure. A similar service was organized in the American Army in 1917.

C. Exploitations by the Direction of the Rear.

In addition to the army exploitations, the Direction of the Rear soon organized forestry operations of its own. It was necessary to procure reserves to be used for the supply of armies whose zones were poor in timber resources; to utilize resources in the zone of the rear but which, on account of their distance, could not readily be exploited by the armies; to provide the armies, as soon as their requirements increased, with means of obtaining supplies which the Minister of War might be unable to furnish in due time (from his exploitations in the zone of the interior) on account of the shortage of labor, especially in view of the fact that the Commander in Chief could readily assign a few of his available lines of communication units (unités d'étapes) to this work; moreover, since these units were under his direct orders, the Commander in Chief could withdraw them and assign them elsewhere should more urgent requirements arise. This organization gave the maximum production and flexibility.

The first exploitation operated by the Direction of the Rear, (forest of Halate) was organized in May 1915, for the purpose of increasing the supply of spars (rondins) which were to be used in preparation for the Champagne offensive. Located in the immediate vicinity of G. H. Q., it was enabled to employ the company of "forestry troops" (chasseurs) which had been assigned to guard headquarters, and to thus obtain information as to the best methods for the operation of such activities (tools required, means of transportation, etc., proportionate to the number of laborers employed.)

A little later, at the beginning of August, the Railroad Direction (Direction des chemins de fer) advised that it was experiencing a

shortage of railway ties, not only for its own use but also for that of the heavy railway artillery; the latter was just being organized and its requirements were gradually increasing. New forestry exploitations were opened to supply the necessary timber, which was then sent to sawmills organized, requisitioned or rented by the "Railroad School" (Ecole des chemins de fer)—(Forests of Rumilly, Temple de-Jouy, Sourdum and Roumare).

To conserve the resources in the Zone of the Armies additional units were placed at the disposal of the Director of Railroads for the production of railroad ties from forestry exploitations in the Zone of the Interior. These units worked for and under the direction of the Railroad School. These forestry operations were located principally in the Departments of Allier, Cher, Nièvre, Loiret and Sarthe. At the end of 1916, there had been assigned thereto eight companies of infantry and three companies of lines of communication Engineers (Génie d'Etapes), with proportionate means of transportation, (two auxiliary transport sections (CVAX) and four motorized forestry sections).

By the same date, the other forestry operations of the Direction of the Rear, proper, had also expanded and employed 22 companies of troops, 4 CVAX sections and the equivalent of 7 motor transport sections. These troops were distributed in the Seine-Inférieure (forests of Lyon and Roumare), the Aube (forests of Rumilly and Temple), in the forest of Villers-Cotterêts and in the Vosges. For the production of the large number of spars (rondins) required in the preparation of the Somme offensive a large exploitation was also organized in the forest of Orléans in May, 1916.

At the beginning of 1916, the Direction of the Rear's forestry exploitations were gradually provided with sawmills to enable them to cut the wood on the spot.

The reasons for the organization of forestry operations by the Direction of the Rear, operating under the orders of the Commander in Chief, have been stated above. A specific example will demonstrate the flexibility of this system. During the early part of July, 1916, the 6th French Army sent an urgent request for large shipments of fascines for the organization of conquered positions and for clearing the trenches. It was the first request ever received for this type of supplies. Orders were immediately given to the forestry organizations of the Direction of the Rear and, at the same time, a request was sent to the Minister of War. Eight days later, the Direction of the Rear's forestry units were forwarding from 3,000 to 4,000 fascines weekly, while, after a delay of four weeks, the Ministry could only furnish a few hundred per week.

SAWMILLS AND DEPOTS.

The large Engineer establishment (chefferie du Génie) of the Direction of the Rear, located first at Villers-Cotterêts and later at Chatres, also furnished large quantities of cut timber.

In addition, at the beginning of 1916, arrangements were made between the Ministry of War and the Direction of the Rear for the direct shipment to the armies of cargoes of imported wood arriving on steamers from abroad. The Direction of the Rear thereupon constructed a large depot at La Petite-Synthe, near Dunkerque, connected with the railroad and by canal. This establishment started operating at the beginning of June and rendered valuable services until the end of the war.

D. Organization of the wood (forestry) services of the Ministry in the interior.

1. Organization of the service.—On December 13, 1914, for the purpose of assembling lumber for the construction of booms (estacades) to replace bridges which had been destroyed, a "supply center" (centre d'approvisionnement) was established at Lons-le-Saulnier.

This was the beginning of the organization of the Wood Service (Service des Bois). As the requirements of the armies increased other supply centers were progressively established, from the end of 1914 until the end of 1915, and attached to the Engineer directions (Directions du Génie). These centers were located at Paris, Rouen, Orléans, Besançon, Nantes, Grenoble, Montpellier and Bordeaux; there was one at Marseille also to supply the needs of the Army of the Orient.

Meanwhile, to overcome the rise in prices occasioned by competition between the various Ministries, it was decided (November 21, 1915) that the 4th Direction of the Ministry of War would centralize all wood requirements and that thereafter this direction would be solely responsible for the purchase of construction lumber. Other services, attached to other ministries, handled hard woods, wood for heating purposes and imported lumber.

This organization was unsatisfactory and the formation of a central wood service which would combine these independent agencies became imperative. The new organization was only accomplished in July 1917 and consisted of:

a. *The General Wood Committee* (*Comité Général des Bois*), presided by the Minister of Agriculture, and composed of representatives from the various ministries and experts on forestry and lum-

ber matters. This committee was charged with the study of all questions concerning the production, manufacture and importation of wood and the supply of same to the armies and various public services.

The public services were forbidden to purchase wood except through this committee. Moreover, after agreement with the producers, a rule was established which was known as the "¾ rule," under the terms of which all lumber operators and sawmill operators were required to place three-fourths of their entire production at the disposal of the General Wood Committee; the remaining fourth was available for commercial purposes.

b. *The "Permanent Section" of the above committee*, which was charged with the operation of the service and the preparation of the work of the main committee.

c. *The General Inspection of the Wood Service* (Inspection Générale du Service des bois), which included all the services which had previously handled wood supplies. Through the "wood centers" (centres de bois) and through the organizations described below, the General Inspection secured national maximum production and regulated the distribution of available resources.

2. Operation of the service.—The Inspector General of the Wood Service (Inspecteur Général du Service des bois) was in fact the main executive. He was, at the same time, vice president of the General Wood Committee, president of the permanent section and president of the Interallied Committee on wood for war purposes. (See further).

The wood centers (centres de bois)—C. B.) were executive agencies. There were nine of these centers and they obtained their supplies by:

Contracts with producers and sawmill operators (¾ rule).

Direct forestry operations by means of labor troops organized into "C. B." companies.

Importations.

Forestry exploitations by the Canadian Forestry Corps, units of which worked half for England and half for France. (See further).

3. Interallied organizations.

1. *The "International Wood Purchasing Commission"* (Commission Internationale d'achats de bois—C. I. A. B.).

This commission was created through an agreement between the French and British Governments in February 1916, and which was subsequently entered into by the Italian and American Governments. Its purpose was to prevent competition in the acquisition of lumber from abroad.

The Allied representatives on the C. I. A. B. centralized the requisitions, distributed the purchases to be made among the various countries, proceded to purchase in common accord and divided available supplies according to the needs of each Government and tonnage available. This agency did away with all competition between the various Allied Governments. Its headquarters were in London, because that city was the main lumber market and because England was the greatest consumer of imported wood.

As war requirements increased, branches (délégations) of the C. I. A. B. were established in various producing countries, Sweden, Portugal, Switzerland and America.

2. *Interallied Committee on Wood for war purposes* (Comité Interallié des Bois de Guerre—C. I. B. G.)

Difficulties arose in 1916, chiefly on account of the lack of bottoms for the transport of imported wood purchased by the C. I. A. B. An agreement was then entered into, on November 15, 1916, by the French and British Governments under the terms of which a "War Timber Committee" (W. T. C.) was created and charged with coordinating the requisitions and supplies of wood for the armies. At the same time, it provided for the free grant of French timber land, to be exploited by troops of the Canadian Forestry Corps (two battalions), in exchange for tonnage to be turned over by the British Admiralty to France for the importation of wood.

However, on account of the submarine warfare, imports decreased and at the beginning of 1917, the British Government decided to increase the number of Canadian forestry companies to 56. The "War Timber Committee" became the "Franco-British Committee on wood for war purposes" (Comité Franco-Britannique des Bois de Guerre—C. F. B. B. G.) on May 3, 1917 and held its first meeting on the 25th of that month.

The Belgian and American Governments in turn joined the committee which then assumed the name of "Interallied Committee on wood for war purposes" (Comité Interallié des Bois de Guerre—C. I. B. G.), on September 28, 1917.

Subsequently, following negotiations in England, a new agreement was entered into on January 15, 1918 (with retroactive effect from October 1, 1917,) to determine the assignment of forestry exploitations to the 56 Canadian forestry companies, and the distribution between the British and French authorities of the results of their production.

The C. I. B. G. operated as follows:

British Armies: Timber cuts for 46 of the Canadian forestry companies were placed, free of charge, at the disposal of the British

Government by the French. The cost of exploiting and sawing was borne by the British and the production was divided equally between the French and British authorities.

Timber cuts for the remaining 10 Canadian forestry companies were ceded to the British Government at cost price and the British retained the entire production.

Belgian and American Armies: The timber cuts required for the Belgian and American Armies by the French services were ceded to them at cost price and they kept all the products of their exploitation. However, in exchange for the saving which this manner of purchase netted it, the American Government placed three companies of forestry troops at the disposal of the French Army free of charge.

The permanent executive staff of the C. I. B. G. consisted of seven members, i. e.: representatives from the Ministry of Industrial Reconstitution, the Ministry of Agriculture, the French, British, Belgian and American Armies and the Canadian Forestry Corps. It was charged with locating forests suitable for exploitation by Allied forestry companies; requesting their purchase by the General Wood Inspection; requesting the Ministry of Agriculture to assign forests and distribute among the Allies forests which had been acquired or timber cuts which had been ceded. It was also responsible for the enforcement of the clauses pertaining to the purchasing contracts and the operation of forestry activities in accordance with the regulations prescribed by the French Forestry Service. It centralized requisitions and maintained the necessary records concerning purchases of forests, shipments, divisions, exchanges, etc.

At the date of the Armistice, the C. I. B. G. had been able to acquire at normal prices, requisition, or lease, about 5,200,000 cubic meters of wood, of which 3,000,000 cubic meters were to be exploited by the Canadian forestry troops and the remainder by the Americans.

STATISTICAL DATA.

A. Quantities of wood required for the preparation of an important offensive (Somme 1916).

At the beginning of April, the headquarters (General Foch) of the "Northern Army Group" (G. A. N.) requested the shipment, to extend from the 15th of April to the 30th of June, of the following quantities of spars (rondins) and supporting timbers (bois de mine).

a) *1,500,000 three and four meter spars*, of which 600,000 for the Army Corps; 450,000 for the heavy artillery (A. L.); 115,000 for the "Dessolier" type shelters; 330,000 for the heavy howitzers (A. L. G. P.). A total of about 150,000 cubic meters, corresponding to 11,000 railway cars.

b) *Stakes for barbed wire and revetting:* 1,200,000, or a total of about 18,000 cubic meters or 1,500 railway cars.

c) *Supporting timbers:* 5,000 frames, superior gallery; 9,000 frames, main gallery; 1,500 frames, half gallery; 5,000 large branches; 100,000 lining planks; 50,000 roofing planks; 30,000 ml. of battens. The whole corresponding to 300 railway cars.

These materials were furnished practically as requested. At that time, on account of special provisions which had been made, the Direction of the Rear could supply 220,000 spars and the Ministry of War 200,000 spars per month.

With reference to the spars alone, there were shipped to the two regulating stations of Creil and Le Bourget:

Second fortnight in April, 113,000 spars or about 800 carloads.
First fortnight in May, 150,000 spars or about 1,100 carloads.
Second fortnight in May, 200,000 spars or about 1,400 carloads.
First fortnight in June, 250,000 spars or about 1,800 carloads.
Second fortnight in June, 250,000 spars or about 1,800 carloads.

B. Data on the consumption of wood by the armies in 1917.

Kind of wood.	Average monthly requirements (cubic meters—mc).	Quantities furnished.			Carloads.
		By the Minister.	By the Direction of the Rear.	Total.	
Construction wood	100,000	46,000	4,000	50,000	4,000
Uprights (bois de mine)	30,000	21,000	4,000	25,000	2,250
Spars (rondins)	[1] 100,000	50,000	30,000	80,000	5,700
Stakes (piquets)	[2] 20,000	7,000	3,000	10,000	825
Total				[3] 165,000	

[1] Or 1,000,000 spars.
[2] Or 1,330,000 stakes.
[3] The armies were able to procure 45,000 cubic meters of construction wood from their own zone each month, which gives an average monthly total consumption of 165,000 plus 45,000, or 210,000 cubic meters (mc).

In 1917 the operating companies of the Direction of the Rear also furnished 3,000 cubic meters (mc.) of sawed lumber monthly.

C. Statistics on the resources assembled by the "Wood centers" (Centres de bois) of the interior during 1917–1918.

Month, 1917	Construction timber and piling (cubic meters—mc.)	Various kinds of wood (cubic meters[1]	Hard wood[2]	Totals. (cubic meters—mc.)
January	108,400	57,100	----------	165,500
February	84,000	58,000	----------	142,000
March	133,600	74,400	----------	208,000
April	113,800	75,700	----------	189,500
May	137,700	66,300	----------	204,000
June	114,300	78,300	----------	192,600
July	124,100	71,900	----------	196,000
August	120,000	69,500	----------	189,500
September	130,900	62,600	----------	193,500
October	156,900	60,800	----------	217,700
November	152,900	65,100	----------	218,000
December	266,000	81,100	----------	347,100
Total for 1917[3]	1,642,600	820,800	----------	2,463,400
In 1918 the "Wood centers" centralized[4]	2,108,250	868,300	313,650	3,290,200

[1] The various kinds of wood included round logs, pegs, gratings, revetting wood, railway ties, telegraph poles, etc.

[2] No statistics were kept for hard wood consumed during 1917.

[3] Of these totals: 540,133 cubic meters (mc.) of construction wood and 706,800 cubic meters (mc.) of various woods were furnished to the armies.

[4] In 1918 the General Wood Inspection only supplied the armies with 633,217 cubic meters (mc.) of wood out of total amounts given above. As a matter of fact, on account of the almost complete equipment of the front and due to the changing methods of operations, the wood requirements of 1918 were much inferior to those of 1917.

CHAPTER XXI.

SECTION III.

WOOD SERVICE—FORESTRY EXPLOITATIONS (BELGIAN).

(Chart 3, Chapter XXII, Volume I.)

Until March 1917, the Belgian War Department obtained its supplies of wood by importation, by purchases in France, and by the exploitation of two forests, one at Guines and the other at Vernon, both equipped with mechanical sawmills. The various Artillery and Engineer establishments each had a mechanical sawmill for their own requirements.

About this time it became necessary to create a "Wood Service" (Service des bois) for the Belgian Army, and this service was placed under the control of the "General Direction of the Armament and of the Technical Services of the Army" (D. G. A. S. T. A.), as the latter was charged with furnishing all the requirements of the field army, either by direct purchases or through its various establishments.

On account of the size of the Belgian Army, the Wood Service was small, nevertheless, the total daily requirements amounted to about 1,000 tons of wood of all kinds.

SOURCES OF SUPPLY.

1. Exploitation of forests by military labor.
2. Contracts with civilians, whereby these were to turn over their entire production to the military authorities, while the latter were to place military or prisoner of war labor at the disposal of the contractors.
3. Purchases in the open market.
4. In case of necessity, requests for cessions from the Allied armies.

ORGANIZATION OF THE SERVICE.

Personnel.—An officer (Capitaine-Commandant) was placed at the head of the service. He was chief of the service and had the following personnel at his disposal:

1. A staff (service central) composed of: one officer, assistant; one officer, who received the lumber; and one officer, accountant, who

kept the records pertaining to the service, established cost prices and prepared statements.

2. A forestry company, recruited from the oldest military classes, and operating in the forest of Guines (Pas-de-Calais).

3. A forestry company at Neuilly-le-Vendin (Mayenne).

4. A forestry platoon at l'Huisserie (Mayenne).

5. A special platoon at La Coulonche (Orne).

6. Personnel, composed of specialists, for the operation of the sawmill at La Petite-Synthe, near Dunkerque.

7. Prisoners of war, assigned as follows: The first group to the forestry company at Neuilly-le-Vendin and the second group to the sawmill at La Petite-Synthe.

8. Groups composed of specialists and prisoners of war, varying in size, and placed at the disposal of contractors working exclusively for the Belgian Army.

The total forestry personnel amounted to: (a) Military forestry operations: 22 officers, 1,242 men and 220 prisoners of war; (b) with civilian contractors: 170 men and 650 prisoners of war.

Groups 4 and 5, which were composed of special elements, never attained expected production. Group 3, although its composition did not prepare it for forestry work, gave relatively good results.

ACCOUNTS.

A thorough cost survey of the Wood Service was prepared as soon as practicable, based on industrial principles, which made it possible to determine the exact cost of the lumber. Regularly, every two weeks, each unit prepared a statement showing all expenditures, including cost of operation, equipment and supplies, depreciation and subsistence of men and animals.

From these statements it was ascertained that the cost of the lumber produced by the forestry company at Neuilly-le-Vendin almost equalled commercial cost price, while that produced by the troops operating in the forest of Guines was 30 per cent less than the commercial price. This in itself was a remarkable result.

With each delivery, the accounting service furnished a statement to the receiving unit showing the cost price of the lumber delivered.

FORESTRY OPERATIONS OF THE ARMY.

a) Exploitation in the region of Guines, which forwarded its output direct by rail or by water.

b) Exploitations in the Orne and Mayenne, with headquarters at Neuilly-le-Vendin, forwarding by way of Honfleur.

c) Exploitation at La Coulonche (Orne), forwarding by way of Honfleur.

d) Exploitation at l'Huisserie, near Laval, (Mayenne), forwarding by way of Honfleur.

e) Mechanical sawmill at Dunkerque. This plant was put into operation about October 15, 1918 and ceased shortly after the Armistice.

f) Establishments at Le Havre, Calais, Gravelines and depots near the front. Each of these had sawmills of varying capacity for their own requirements.

FORESTRY OPERATIONS BY CIVILIAN CONTRACTORS.

Contractors employing military or prisoner of war labor and whose entire production was supplied to the Belgian Army, operated at the following places:

Chambly, Chars, Jumièges, Rouen, Orbec, Beaumont-le-Roger, Pontorson, Villechauve and Onzain.

DIRECT PURCHASES.

No purchases were made in foreign countries other than in France. Various kinds of wood were purchased from dealers throughout France.

CESSIONS.

The French and British services had authorized the cession of wood to the Belgian Army.

CONCLUSION.

At the date of the Armistice, all of the above mentioned forestry services had been functioning regularly for quite a while.

The chief of the Belgian "Wood Service" (Service des bois) was also the Belgian representative on the "Interallied Committee on Wood for war purposes" (C. I. B. G.)

France was subdivided into districts or "régions" which were assigned either to the French, British or American forestry services. Belgium was therefore obliged to request, from one or the other of these services, authorization to operate in their particular areas. This direct contact enabled Belgium, in time of need, to obtain the assistance of her Allies by the cession of prepared lumber and, in turn, Belgium was enabled at times to place some of the lumber which had been prepared by her forestry troops at the disposal of her Allies.

The representative (délégué) of the D. G. A. S. T. A. at London represented Belgium on the "Interallied Committee for the purchase of wood for war purposes" (C. I. A. B.), which was located in that city.

STATISTICAL DATA—BELGIAN ARMY.

Total production, Wood Service, Forestry Operations.

From March, 1917, to November 11, 1918, the total production was as follows:

Material.	Army forestry operations.	From contractors.	Direct purchases.	Cessions from Allies.	Total.
Stakes or posts (small)	3,417,069	114,406	1,089,965	279,215	4,900,655
Poles (light)	749,723	101,141	515,747	5,000	1,371,611
Joints	24,087		1,585	4,735	30,407
Poles (large)	14,850		425		15,275
Undressed lumber	24,750	8,661	1,080	3,101	37,592
Cross pieces (pieces)	37,126	3,272		29,800	70,198
Wicker work gabions	565,400	30,187	57,500		653,087
Fuel wood (cubic meters—m³)	101,540				101,540

NOTE.—On account of the lack of means of transportation, with the exception of the establishment at Guines, the entire production remained stocked at its source at the date of the Armistice.

CHAPTER XXI.

SECTION IV.

FORESTRY (WOOD) SERVICES (ITALIAN).

In the Italian Army, wood for construction purposes or for fuel was furnished by two different agencies (enti). In the Zone of the Armies wood was generally supplied by the General Commissariat, while in the interior of the country it was furnished by the Ministry of Arms and Munitions, through the General Administration of the Engineers.

SUPPLY IN THE ZONE OF THE ARMIES.

(Chart 6, Chapter XXII, Volume I.)

During the early part of the war the supply of wood for construction purposes was separate from that for fuel. The first was provided by the army Engineer commands and the administrations of army Engineers, through purchases from private concerns; fuel wood was obtained by the exploitation of local resources by the troop units. Later, to safeguard the national timber resources, a special organization was created and this service supplied all of the wood requirements.

ORGANIZATION OF THE FORESTRY SERVICE.

The Forestry Service acquired forests and provided means for exploiting them, including operating personnel. It was responsible for the procurement, preparation and distribution of wood to the armies.

The administration of this service devolved upon the Engineer section of the General Commissariat. "Timber committees" were organized to act as executive technical organizations. Insofar as administration and supply were concerned, these committees were under the army Commissariats and their work was coordinated by the General Commissariat.

The timber committees were constituted as follows:

A field officer (or captain), acting as president.

An officer of the Royal Forestry Corps, as consulting member.

Technically qualified army officers and forestry agents, as members and to direct the forestry operations.

Previous to November 1917, there were eight timber committees; these were subsequently increased to eleven.

Forestry operations were carried out by special forestry companies composed of professional personnel. These troops were assigned to

the timber committees in varying numbers, according to the nature of the work and amount of labor involved.

The maximum number of personnel assigned to the timber committees amounted to 34 forestry officials, 210 forestry agents, and 35 forestry companies, or a total of about 15,000 men. In addition to personnel, Government and private sawmills, as well as means of transportation (motor and animal transport, aerial railways, etc.), were placed at the disposal of the committees.

OPERATION OF THE SERVICE.

Forests were surveyed and those which answered the requirements were either purchased or requisitioned. The purchase price proposed by the forestry inspectors was determined by the Ministry of Arms and Munitions.

The timber was transported under the supervision of the timber committees. It was sent from the forestry areas and sawmills to the railroads, where it was inspected by timber experts and then despatched to the armies by complete carloads. Construction lumber was forwarded to the advanced Engineer storehouses and fuel wood was shipped to the advanced storehouses for food supplies; surpluses were forwarded to the depots of the General Commissariat.

The General Commissariat prepared wood production programs and these were allocated among the various timber committees for fulfillment. Wherever possible private sawmills, existing on the spot or in nearby localities, were employed. The mills were operated by the owners and the timber committees endeavored to increase their production in every way. The committees furnished additional operating personnel for this purpose, they also supplied saws, motors, etc., and, in case of necessity, constructed new sawmills.

SUPPLIES FROM THE HOME COUNTRY AND FROM ABROAD.

The system of supply passed through three distinct phases:

1) The requisition of all available lumber in the country.

2) The purchase of wood in America.

3) Purchases in Switzerland, when the submarine warfare caused a shortage of tonnage.

Wood concentration depots were organized and placed under the control of the nearest administration of territorial Engineers for the storage of surplus wood resources. Although these depots served as reserve establishments, they forwarded supplies direct to the advanced storehouses of the Army.

In Italy, the production of wood, both in the Zone of the Armies and in the interior, was generally inadequate for the needs of the Army.

CHAPTER XXI.

SECTION V.

FORESTRY (AMERICAN).[1]

The Forestry Section of the Division of Construction and Forestry was organized to supply the American Expeditionary Forces, and to a small degree the French and British Armies, with forest products cut in accordance with the principles of French forestry from the carefully managed forests of France. Although the forestry section, even at the crest of its activities, contributed only in a small way to the timber needs of the French and British forces, the request of the Allies for this assistance upon our entry into the war represents the birth of a forestry branch in the American military organization. The conservation of tonnage, which quickly became a grave problem, made necessary the elimination, in so far as possible, of the transportation of war material across the water and its procurement in France, and as a result the French and British had already developed their lumber-producing services to a large degree when the United States entered upon the scene.

ALLIES REQUEST AMERICAN FORESTERS.

The request of the British mission to the War Department in Washington for the loan of one regiment of forestry troops was quickly granted, and likewise the similar request from the French, without much realization of the needs of the American Army in this respect. These needs did not become apparent until a few weeks later, early in May, 1917, when the preliminary investigations of General Pershing's staff and the information contributed by the French mission indicated the immensity of the task before the American Army in preparing for its activity in France. They showed that vast quantities of lumber and forest products would be required in developing port facilities, lines of communication, and in the general housing and supply of the American forces.

The harbors, railroads, warehouses, barracks and hospitals serving the French and British were being used to the limit of their capacity,

[1] Extract from the Historical Report of the Chief Engineer, A. E. F. (1917–1919) (Forestry).

thereby making necessary completely new developments of this character for the American forces. The ports of Bordeaux, St. Nazaire, and Brest were placed at the disposal of the United States by the French, who, at the same time, pointed out that the meager peace-time facilities at these points of entry were entirely inadequate and barely served as beginning for the tremendous load that would be placed upon them by military activity.

Consequently the Chief of Engineers, United States Army, to whom had been delegated the organization of the forestry regiments for the British and French, realized the urgent and immediate need of the American Army for a large number of forestry troops to serve itself, a need so urgent that these troops must be set to work in France in advance of all other troops, to produce piling and timbers for the immense wharves to be immediately constructed, ties for railroad yards and sidings, lumber for warehouses, barracks and hospitals, and cordwood for fuel. In view of the needs of the American Army assistance was not given to the French and British as soon as had been originally intended, but nevertheless the 6th Battalion served the British from April 1 to September 30, 1918, and the 7th Battalion worked for the French from March 1, 1918, to February 1, 1919.

FIRST FORESTRY REGIMENT ORGANIZED.

During the months of May and June, 1917, the War Department formally authorized the organization of the 10th Engineers, and solicited the Forest Service of the Department of Agriculture to bring together the personnel and designate the required equipment. Major (later Col.) James A. Woodruff, Deputy Director of Construction and Forestry, was made the regimental commander, and under his direction this regiment, the first of its kind in American history, came into being as rapidly as the obstacles attending the formation of such a new unit and service would permit.

Upon his arrival in France, August 20, 1917, Lieut. Col. Greeley was assigned to the examination of forests which had been tentatively offered for American exploitation by the French Ministry of Armament.

After lengthy discussions and conferences with the French the American Expeditionary Forces was admitted to membership on the "Comité Interallié des Bois de Guerre," which had acted up to that time as a Franco-British committee solely for the approval of timber purchases and their allocation to the respective armies. With the inclusion of the Americans the committee became a much broader organization, filling requisitions from the different Allies and adjusting rival claims for the exploitation of the same areas.

The complete absence of information as to the conditions under which these troops must operate, such as the character and size of timber, the topography, transportation facilities, location of timber with respect to the point of use, led to the sending to France of two men to secure and report information on these points of uncertainty. These men were Henry S. Graves, Chief Forester, Forest Service, commissioned as a major in the Engineer Officers' Reserve Corps, and Barrington Moore, private forester, familiar with France, the French language, and the French Forest Service. They discovered immediately upon their arrival, early in June, that suitable tracts of timber must first be located and acquired, either from private owners or from the State. Consequently, Major Greeley and 12 men, expert in estimating, examination and mapping of timber lands, reached France during July, 1917, and immediately set to work to secure timber for the coming forestry troops. This force then became the Forestry Section with headquarters at Paris, with Lieut. Col. Graves in charge, under the Engineer purchasing officer.

ORGANIZATION DEVELOPED.

The program at that time consisted of the production of 12,000,000 feet per month of sawed lumber and ties, 15,000 telephone and telegraph poles, 16,000 small poles and pickets and 35,000 steres of fuel wood. For the fulfillment of this program a much larger operating force was required in France, and additional troops were authorized under the designation of the 20th Engineers (forestry). This unusual regiment was organized by Colonel W. A. Mitchell, and consisted of 10 battalions of forestry troops and 3 highway battalions, while 36 service companies were ordered for forestry work. By July 1, 1918, the forest Engineers in France comprised the following:

10th Engineers (2 battalions) 6 companies.
20th Engineers (10 battalions) 30 companies.
41st Engineers (1 battalion) 4 companies (highway).
42d Engineers (1 battalion) 4 companies (highway).
43d Engineers (1 battalion) 4 companies (highway).
503d Engineers (1 battalion) 4 companies (service).
507th Engineers (1 battalion) 4 companies (service).
517th Engineers (1 battalion) 4 companies (service).
519th Engineers (1 battalion) 4 companies (service).
523d Engineers (1 battalion) 4 companies (service).
531st Engineers (1 battalion) 4 companies (service).
533d Engineers (1 battalion) 4 companies (service).

The first troops to arrive, the 10th Engineers, struggled against the handicap of having at the outset, almost no equipment. By July, 1918, the equipment for the entire two regiments was sufficient for the performance of their program, with a few minor exceptions. In the meantime the original program had been expanded in keeping with the increased troop movements to France, to the amount of 40,000,000 feet of sawn lumber monthly and a proportional increase in the amount of piling, poles, fuel wood, and other forest products.

In February, 1918, the Forestry Section was moved to Tours with the headquarters of the Chief Engineer, Line of Communications, became a part of the reorganized Services of Supply, and found its place as the Forestry Section of the Department of Construction and Forestry, under the Chief Engineer, American Expeditionary Forces. The organization of the Forestry Section itself consisted of central headquarters at Tours, comprising the following officers:

Adjutant: To care for the military administration of the forestry troops.

Acquisition: To handle the purchasing of timber, in direct charge of Lieut. Col. Greeley.

Technical equipment and operation: To provide technical equipment for the forestry operations, and to supervise the methods of operation under the immediate direction of Lieut. Col. George H. Kelly.

Shipments and products: To distribute among the various operations the requisitions for forest products received from all branches of the American Expeditionary Forces and provide transportation, under the immediate direction of Lieut. Col. R. A. Johnson.

In the beginning the purchase of timber was made with little regard for location, so that the troops might be placed immediately at work upon their arrival. Later, however, as the acquisition of timber gradually gained headway on the needs, more attention was given to the location of timber tracts with respect to the products required by the various services of the American Expeditionary Forces and to the point of ultimate use.

Eventually all such questions as size and kind of timber, logging conditions, proximity of the timber to projects upon which the output would be used, and the shipment of the products by railroads and highways in such a way as to prevent congestion, were given careful consideration in the acquisition of timber tracts. This naturally led to the distribution of forestry troops over a wide area, extending in a belt from the western coast of France to its eastern frontier, with a large group south of Bordeaux, in the Department of the Landes, and a smaller group in the plateau region of south central France, in the Department of Cantal.

One hundred and seven Mills Operating.—The largest number of active operations was in October, 1918, when there were 107 mills of varying capacity.

In the beginning, 8 stationary French sawmills and 12 portable French mills were acquired. This equipment aided greatly in meeting the acute shortage of lumber. However, their capacity was so limited that they were discarded as rapidly as American mills could be obtained.

Three types of American sawmills were employed:

1. A heavy-powered, permanent steam plant, rated to cut 20,000 feet b. m. in 10 hours.

2. A moderately powered, permanent steam plant, rated to cut 10,000 feet, b. m. in 10 hours.

3. A very light, portable Bolter mill, run either by steam or by gas tractor, rated to cut 5,000 board feet in 10 hours and especially suited to light products like railroad ties.

Practically, all sawmills were operated day and night shifts and some of them three 8-hour shifts. More than double the rated capacity of the plants was obtained currently by most of the forestry operations. Upwards of 150,000 feet of lumber were cut in 20 hours at several of the large mills whose rated capacity for the same period was 40,000 feet. Cuts as high as 66,000 feet of railroad ties were made in 20 hours on the little bolter mills. All of the large and many of the small mills were steamed successfully by means of dutch ovens for burning sawdust, designed and installed on the ground by forestry millwrights, saving thereby a great quantity of fuel wood.

This scattering of the forestry operations over such a wide territory made imperative the grouping of operations into districts, each in charge of a district commander, of which there were 14 at the height of activity. Each district had a district office organization, copying in miniature the central office organization, and to him the operation commanders within his district were responsible. The district commander, in turn, was directly responsible to central headquarters.

To this plan there were two exceptions, namely, the operations in the Landes and those in the advance section, which were made responsible to two section forestry officers attached respectively to the office of the section engineer, base section No. 2, and of the section engineer of the advance section. The purpose of this arrangement was to facilitate and expedite the action upon requisitions received in those sections. Lieut. Col. Chapman became the section forestry officer for the advance section, with headquarters at Neufchâteau, and Lieut. Col. Benedict for the operations in the Landes, with

headquarters at Bordeaux, base section No. 2. The responsibilities of the section forestry officers at Bordeaux were greatly increased by the difficulties and intricacies of the transportation problem in the Pontenx, Mimizan, Dax and Labrit districts. Major La Londe was stationed at Bordeaux, even prior to the designation of the section forestry officer, to work out the transportation problems of the Landes operations, thereby supplementing the work of the individual districts in the Landes territory.

HOW FIELD WORK WAS ORGANIZED.

The organization of each individual operation resembled very closely the general scheme of any representative American commercial logging job, with a camp superintendent in the person of the operation or company commander, a mill foreman, usually a lieutenant, and woods foreman or logging boss, a lieutenant. The military administration and operation were either combined under one lieutenant or divided between two or more. This general arrangement varied with the requirements of each job, with a less or greater number of officers and men, depending upon the work to be done; as in the case of the Pontenx district, an officer was placed in charge of railroad operations with a separate corps of locomotive engineers, brakemen, conductors, and repair men; or, as at Subligny-Villeroy, in the Gien district, an officer was placed in charge of road repair with troops assigned to that special task.

Although the report upon which the purchase of a tract was based provided a plan of operation indicating the position of the mill, sidings, roads to be used, the methods to be followed in logging, etc., nevertheless, the actual exploitation of a body of timber and the ultimate success of the operation rested almost entirely upon the operation commander. Some assistance could be obtained from his district commander and, in turn, from central headquarters. It is these operations, frequently secluded and isolated in dense forests, ranging in size from small detachments to a tiny Bolter mill driven by a gasoline engine and a small complement of woods tools, to a camp of 3,000 men operating tandem 20-M mills driven by 200-horsepower engines, which presented the task and achievement of the forestry troops.

SPEEDY WORK IN PRODUCING TIES.

Examples of the resourcefulness and high sense of duty demanded in order to obtain maximum results may be picked from any of the individual companies or their detachments, but exemplifying the whole may be quoted the instance of the 4th Battalion, at Mimizan, which had produced 10,000 ties in France 38

days after the organization of the battalion was authorized and 11 days after it had landed in France. Lacking harness for their draft animals, the men of this battalion set to making harness out of the materials at hand. Gunnysacks were transformed into breaststraps, tugs and reins were made of rope, and 60-penny nails did service as bits for the makeshift bridles.

In other operations, where horse transportation was lacking, the products were carried from the woods to the railroad on the backs of men, particularly in the case of such lighter products as ties, poles, and cordwood; for weeks logs were dragged on the ground by hand and piling was brought out of the woods on logging wheels improvised from dump carts and the running gears of transport wagons and pulled by teams of 20 men. Much of this work was done in continuous cold rain, for which the men were not properly dressed, and which was the harder to bear from the fact that they had no stoves in their tents during the worst of that time.

HOW RUSH ORDERS WERE FILLED.

To one district came an order for entanglement stakes. The order was marked "Rush"; the stakes were needed in a hurry. The operation lacked horses, wagons, and motor vehicles, but there was no stopping on that account. A standing order was issued that no man should return from the woods without all the entanglement stakes he could pack. At once, from every quarter, stakes were moving out of the woods on the backs of men in an endless stream. That the order was promptly filled is evidenced by the wire which was soon received: "Stop sending stakes; can't use any more."

Another operation received a dispatch calling for poles—as many as could be furnished and as quickly as possible. This, too, was before the forestry Engineers had been put to the test. After about two days of production of poles, just when the work was well organized to win the war with poles, another dispatch flashed in to the commanding major: "Flooded with poles; cancel further shipments."

Nearly coincident with this there was an order for 10,000 ties with which to construct a railroad spur at a hospital that was being put up in a hurry. In six days those ties were hewed, and that without a broad adz in the outfit, ordinary chopping and falling axes having been used to do the work.

RATED MILL OUTPUT TRIPLED.

Taken altogether, the early labors of the forestry Engineers in France stand as a paradox of pioneering in an old and densely settled

region, using such haphazard equipment as our ships were able to bring, accepting gratefully the generous assistance of the French and supplying the lacks with characteristic resourcefulness. As the equipment arrived and was supplied to the troops, the energy and enthusiasm of the men served to push the use of that equipment to unheard-of limits. Sawmills that were purchased with the manufacturer's commercial rating of 10,000 feet b. m. in 10 hours were made to give three times that amount. Small Bolter mills, rated at 5,000 feet b. m. per 10 hours, with such slight home-made and rough modifications as could be applied, frequently recorded 30,000 feet b. m. of sawn timber in 20 hours. A 20,000 daily 10-hour capacity mill recorded an output of 80,000 feet b. m. in 20 hours. The performance of the troops was so remarkable that all predictions were surpassed in October with a total production in that month of 30,000,000 feet b. m.

But the mere production of this material did not end the activity of the Forestry Section, which took upon itself the job of seeing that its products were shipped to the projects upon which they would be used. In spite of the shortage of railroad cars and deficiencies in motor transport, which became more stringent each month from the increased number of troops landing in France, the record of shipments increased and kept pace with the forest products made available by the troops in the woods. The total productions of the forestry troops up to May 1, 1919, is represented by the following:

Lumber	feet, b. m.	218,211,000
Standard-gauge ties	pieces	3,051,137
Small ties	do	954,667
Miscellaneous round products	do	1,926,603
Piling	do	39,095
Fagots and facenes	do	4,669
Fuel wood	cords	340,000

The production of fuel wood became a particularly important part of the work of the Forestry Section. During the winter of 1917 to 1918, the needs of the Army were largely supplied from French sources. Early in the summer of 1918, it became apparent that the output of fuel wood from the forest troops as a by-product would not be sufficient and that the French supply could not be depended upon to care for our Army. Consequently, the Quartermaster furnished 10,000 service troops under the direction of 20 officers from the Forestry Section, in charge of Lieut. Col. Allen S. Peck, for the cutting of fuel wood in the advance section. The organization of this special force was started in July, 1918. Their work was carried on with vigor until January, 1919, when the production of fuel wood from all sources gained sufficiently upon the requirements to permit a slackening of effort. The extent of this task is best expressed by

the total production of forestry and quartermaster troops under forestry direction to the amount of 534,000 cords up to May 1, 1919.

FORESTRY SECTION REORGANIZED.

The increased program presented on July 1, 1918, on the basis of the arrival of 250,000 troops in France per month, demanding a monthly production of 70,000,000 board feet of lumber, or a total of 700,000,000 feet in 10 months. In order to meet this schedule and at the same time furnish assistance urgently requested by the French, 24,000 additional forestry troops were cabled for, together with 108 additional 10–M sawmills and other equipment. In October, 1918, in order to properly absorb and take care of this tremendous expansion in the organization, the Forestry Section was reorganized into one huge regiment, known as the 20th Engineers, providing for the 49 Engineer companies, 28 Engineer service companies, and 14 battalion headquarters already in France, with 96 additional companies and 15 additional battalion headquarters to be recruited in the States and sent to France as soon as possible. The schedule provided for the arrival of the entire new complement in France by March, 1919.

After the Armistice, however, the activities of the Forestry Section decreased until, on December 31, 1918, nearly all of the mills had shut down, many had been dismantled and sent for salvage to Engineer depots. Only the mill at Eclaron (Haute-Marne) was held intact to meet any possible emergency, while other operations continued running their sawmills only long enough to cut up such logs as had been felled.

There were two exceptions deserving of mention. At Pontenx-les-Forges, in the Landes, there were concentrated a number of companies from other districts for the purpose of cutting 140,000 fire-killed trees which had been contracted for prior to the Armistice and whose products were needed, to supply enough material for completing the embarkation facilities of the Army and furnishing packing lumber for homeward-bound freight. Six 20–M mills were erected and began operation on February 3, 1919, at which time there were over 3,000 troops concentrated in the burned area. At Capitieux (Gironde) a similar burned-timber project containing 55,000 trees was exploited by the 6th Battalion, with the 48th Company attached, involving five sawmills and 10 miles of logging railroad.

The shipment of forest products for any one month never equalled the production for that month, and at the cessation of hostilities there was almost enough of a surplus to complete projected facilities.

For location of forestry activities see Chart 4, Chapter XXII, Vol. I.

APPENDIX A.

CHAPTER XXI—SECTION V.

29th July, 1918.

American Delegate C. I. B. G., 14 Place des Etats Unis, Paris.

Program of Timber needed by A. E. F., July 1, 1918, to May 31, 1919.

1. There is attached a statement of the forest products required by the A. E. F. from July 1, 1918, to May 31, 1919. These products are essential to supply an army of 3,500,000 men which, according to the present schedule of troop movements, will be in France not later than June 30, 1919.

2. To supply the materials called for by this program, 1,437,500 cubic meters of standing timber, au reel, must be obtained from the French in addition to that acquired but not cut on August 1, 1918. This is shown by the following calculation.

	Cubic meters.	
Total amount of timber needed		4,059,054
Available from Switzerland and other European sources	500,000	
Cut prior to August 1 and available toward filling this program	285,000	
Total cut products available		785,000
Timber to be cut from French forests, August 1 to May 31		3,274,054
Amount of timber acquired but not cut August 1		1,826,554
Amount of timber still to be acquired		1,447,500

3. The situation as to fuel wood is as follows:

	Steres.
Total quantity of fuel wood required July 1 to May 31	2,700,000
Fuel wood available from stocks previously cut and from French sources	820,000
Fuel wood still to be cut	1,880,000
Amount of fuel wood still to be acquired	981,588

4. Please transmit a copy of this letter and program to the French Delegate, on the Executive Committee of the C. I. B. G., calling his attention to the fact that this program supercedes that previously transmitted extending from June 1, 1918, to January 1, 1919. It is necessary that the acquisition of timber for the A. E. F. proceed as rapidly as possible until the full amount required by this program is secured. As I advised the French Delegate on the C. I. B. G., in my letter of July 25, 1918, steps have been taken by the A. E. F. to procure the additional personnel and saw mills necessary to cut the full quantity of timber herein requested by May 31, 1919.

By direction of Brigadier General Jadwin.

J. A. WOODRUFF,
Colonel, Engineers, N. A.

INFORMATION ON WOOD.

A. *Resources.*

Numbers 1 and 4 are given in the attached table.

2. Standing timber acquired, and in process of acquisition is 2,516,000 cubic meters (au reel). Timber cut is 456,000 cubic meters. Possible resources in standing timber is 2,060,000 cubic meters.

3. There are no American stocks aside from the forests.

B. *Needs.*

Given in attached table.

C. *General Information.*

5. All the forestry troops, except 4,000 unskilled laborers who can be used only on fuel wood production, have already arrived in France.

6. The question of sending for additional forestry troops is being studied by the Commander in Chief. Additional unskilled labor would not increase the production of sawn material (see end of tabulation of production).

7. The material which we hope to obtain from Switzerland, Portugal and Spain, from July 1, to December 31, 1918, is as follows: Switzerland, 60,170 tons or 120,000 cubic meters; Portugal, 360,000 railroad ties (28,000 cubic meters); Spain, 150,000 railroad ties (12,000 cubic meters). Total, 160,000 cubic meters.

OUTPUT OF AMERICAN FORESTRY OPERATIONS WITH ADDITIONAL LABOR.

The A. E. F. has enough labor to obtain the maximum output possible from the present forestry operations.

Our construction program calls for a monthly production of 190,500 cubic meters of manufactured wood products (about 80,000,000 board feet). This will require an additional force of 18,000 technical forestry troops and 6,000 service troops. The equipment can be provided from the United States and has already been obtained in part. The timber for this increased cut must be secured from French forests. This will require about 220,000 cubic meters (au reel) prior to January 1, 1919, in addition to that already obtained. There should be provided further an operating reserve of at least three months' supply at the rate of 300,000 cubic meters per month, or a total of 1,120,000 cubic meters (au reel) additional timber.

CAPT. ARTURO KELLNER,
Italian Member, Editing Committee

APPENDIX B.

CHAPTER XXI.—SECTION V.

Forest products required by the A. E. F. for 3,500,000 men.

[A working program for Forestry Section, C. and F., from 1 July, 1918, to 31 May, 1919.]

Project.	Railroad ties (pieces).	Lumber and sawed timbers (feet b.m.).	Piling and cribbing (pieces).	Telephone poles (pieces).	Entanglement stakes, etc. (pieces).	Fuel wood (steres).	Total (feet b. m.)	Total cubic meters (au reel).
Docks and warehouses on docks		36,000,000	80,000				60,000,000	243,429
Barges		18,050,000					18,050,000	85,952
Standard railways	5,200,000	8,625,000					166,400,000	792,381
Warehouses		27,000,000					27,000,000	128,571
Barracks		115,248,000					115,248,000	548,000
Hospitals		292,500,000					292,500,000	1,392,857
Refrigerating plants		3,250,000					3,250,000	15,476
Water supply		3,000,000					3,000,000	14,286
Aviation camps		2,920,000					2,920,000	13,905
Packing cases and coffins		7,500,000					7,500,000	35,714
Railroad cars		30,922,500					30,922,500	147,250
Trench and other timbers at front		93,775,000			13,175,000		120,125,000	578,298
Light railways and roads:								
Standard	3,500							
Small	224,000	7,555,000			81,000		9,845,000	46,920
Telephone and telegraph lines		650,000		112,150	90,500		3,074,000	15,215
Fuel wood		66				2,700,000		
Standard	5,203,500	646,995,500	80,000	112,150	13,346,500	2,700,000	859,834,500	4,059,054
Small	224,000							

EXPLANATION OF REQUIREMENTS.

1. Docks, warehouses on docks, and barges must be constructed by June 1, 1919, sufficient to unload 100,000 tons of freight per day.
2. Warehouses have been estimated on the basis of 10 square feet per man, one-half the amount originally figured. Furthermore, by substituting corrugated iron for lumber sheathing, it has been possible to reduce the amount of lumber required three-quarters.
3. Barracks have been estimated on the basis of housing but one-third of the American troops, at the rate of 16 buildings, 20 by 100 feet, for 1,000 men. (This includes living quarters, kitchens, and mess halls, all without floors.) The remaining two-thirds must be billeted or sheltered in tents.
4. Hospitals are estimated on the basis of only 10 per cent hospitalization; 5 per cent additional hospitalization will be necessary and must be provided by demountable barracks or buildings taken over from the French.
5. No allowances have been made for floors or shelving.

CHAPTER XXII.

SECTION I.

REMOUNT AND VETERINARY SERVICE (BRITISH).[1]

PART 1.

REMOUNT DIRECTORATE.

(Chart 1, Chapter XXIII, Vol. I.)

At the commencement of the campaign two advanced remount depots, each with 300 animals, and a base remount depot, with 2,600 animals, arrived in France with the British Expeditionary Force.

As the demands increased additional base remount depots of the same strength were opened at each of the base ports, including Marseille, at which place the Indian Expeditionary Force had landed. Upon the signing of the Armistice, only one of the advanced remount depots was retained to work in connection with the advanced horse transport depot at Abbeville. In point of fact, the base remount depots in France were really advanced depots, the true base depots being in England. The capacity of remount depots was 4 per cent of the number of animals to be maintained, and with regular shipments from England this sufficed.

PERSONNEL.

The duties allotted the Remount Service were the provision, training and distribution of animals, the personnel was obtained in accordance with the provisions of the war establishment. It was expected that additional civilian labor could be hired, if necessary, but this was found to be impossible in France. On mobilization many cavalry reservists came out with Remount units. A large number were noncommissioned officers whose knowledge of horsemastership was invaluable. Their withdrawal to serve as cavalry soldiers taxed the Remount Service seriously. As time went on, all men of good physique were withdrawn for the combatant forces, and the service was left without good horsemen except for its officers. Of these, 6

[1] Prepared for the M. B. A. S. by Maj. G. E. Pitt, D. A. Q. M. G. through the Quartermaster General to the Forces, British Army.

per cent were always employed away from depots on road or rail conducting.

To raise the standard horsemastership in the armies it was eventually found necessary to appoint Corps Horse Advisers and Artillery Wagon Line Officers. These did not work under the Director of Remounts, but under the Inspector of Quartermaster General's Services (Horse Feeding and Economies).

METHOD OF PROCUREMENT OF ANIMALS.

1. Purchase of horses registered as subsidized in the Army Horse Reserve in peace time.
2. Purchase in open market at home and abroad.
3. Impressment.

Horses were provided from the United Kingdom, North and South America, while mules were purchased in North America, Spain and Portugal.

The average prices paid were:

	Horses.	Mules.
United Kingdom	£55 17 6	
North America	40 10 6	£37 16 11
South America	21 6 9	
Spain		42 11 5
Portugal		37 17 5

METHOD OF DISTRIBUTION AMONG THE ARMIES.

The actual number of animals allowed to formations was laid down by war establishment. When the strength of any particular formation fell below the normal, the Commanding Officer (O. C.) of that formation indented on the nearest remount depot, base or advanced, for replacements.

The main system of delivering remounts was by train to railheads of formations when possible, but a great deal of road staging had to be done owing to the shortage in railway transport. In the case of the cavalry, when an advance was expected, remounts completely equipped with saddlery, etc., were handed over to the reinforcements and went up either by road or train as possible. In either case the party was self-supporting and could proceed to join its division even if the latter had moved. The principle of issuing remounts completely equipped with saddlery to the cavalry was inaugurated at the beginning of the campaign, and maintained to the end.

SUITABILITY FOR MILITARY PURPOSES.

Among the heavy draught horses those found the most useful were the Clydesdale, Suffolk, and the Welch cart horse, but it was not

possible to supply entirely the requirements of a larger army from these breeds. The next best horse available was the clean-legged American pure bred and half-bred Percheron horse. The Shire horse was suitable for heavy traction work in docks.

Of light draught horses by far the best was the British or Irish artillery horse and the half-bred American Percheron did very useful work when of the compact type. The Hackney breed generally proved lacking in staying qualities.

Among riding horses, the British or Irish cavalry charger and troop horse of the smaller type and the British Cob were second to none for toughness and ability to maintain their condition in adverse circumstances.

The find of the animal service was the mule, which proved invaluable. In the wet and cold of the winter on the Somme mules were able to endure conditions which proved fatal to horses, while they became well liked for their sterling qualities. The only real difficulty with them was the question of shoeing. Some mules were found intractable in this respect, and their feet suffered as a result.

STATISTICS.

The total number of animals with the British Armies in France and Belgium were:

1915	232,635
1916	409,730
1917	449,880
1918	391,458

The highest census was reached in June, 1917, when the number of animals on the strength was 460,000. The loss in 1917, was also the highest recorded, 28 per cent, largely the result of the Somme offensive, and of a trying cold spring.

The number of saddle horses amounted to about 35 per cent of the strength.

There were very few pack mules.

Numbers of animals from overseas received in Remount Depots.

	Horses.	Mules.
1914	38,867	109
1915	55,113	10,695
1916	52,258	21,520
1917	93,847	36,613
1918	76,404	28,567
	316,489	96,504

Total issue to troops in France and Belgium: Horses, 570,098; mules, 131,236.

REMOUNT DEPOTS.

(Chart 3, Chapter XXIII, Vol. I.)

The base remount depots were situated at: Havre, Rouen, Boulogne, Calais, Dieppe, Marseille.

The advanced remounts depot worked with the advanced horse transport depot at Abbeville.

PART II.

ROYAL ARMY VETERINARY SERVICE.

(Chart 2, Chapter XXIII, Vol. I.)

The Veterinary units of the original British Expeditionary Force comprised: 11 Mobile Veterinary Sections, 6 Veterinary Sections for 250 sick horses each (the nuclei of the modern Veterinary Hospitals), 2 Depots of Veterinary Stores, whilst the entire strength of army Veterinary Corps personnel, including both administrative and executive veterinary officers, totaled only 121 officers and 797 other ranks. In a little over three years these units had been increased and supplemented until there were: 18 Veterinary Hospitals, furnishing accommodation for 35,000 sick animals; 4 Convalescent Horse Depots, accommodating 4,800; 17 Veterinary Evacuating Stations; 66 Mobile Veterinary Sections; 3 Depots of Veterinary Store; 1 Veterinary Bacteriological Laboratory, and numerous installations controlled by the Disposal of Animals Branch of the Veterinary Directorate (Chart 3, Chapter XXIII, Vol. I.).

The expansion of these units, together with the increased number of administrative and executive appointments and the provision of army Veterinary Corps sergeants for field units, resulted in the establishment of the Royal Army Veterinary Service that attained the figure of 651 officers and 15,000 other ranks. These figures relate to the establishment of the Imperial Veterinary Service only, the overseas and Dominion Governments supplying the following: 2 Veterinary Hospitals, 2 Veterinary Evacuating Stations, 11 Mobile Veterinary Sections, together with personnel amounting to 114 officers and 1,446 other ranks.

In reviewing the work of the Veterinary Service throughout the campaign it should be remembered that for three-fourths of the time the Royal Army Veterinary Corps was working on an establishment of officers which was at least 30 per cent below that conceived by pre-war establishments.

EVACUATION OF SICK AND WOUNDED ANIMALS.

Experience gained during previous wars showed that the policy of retaining ineffective animals with fighting formations was an unsound one. The problem of evacuating sick and wounded animals to the base hospitals was in large measure overcome by the creation of small mobile veterinary units, which by keeping in close touch with fighting formations could relieve them of their ineffective animals and convey them to stationary veterinary hospitals on the lines of communication. Mobile veterinary sections were included in the establishment of the British Expeditionary Force on the basis of one per cavalry brigade and one per infantry division, and in August, 1914, these participated in modern warfare for the first time. They took the field as lines of communication units with an establishment of one officer and thirteen other ranks.

Owing to the mobile nature of the warfare during the early phases of the campaign, and to the scanty means of intercommunication, it was not possible adequately to control the movements of these units from so great a distance. The result was that they were often completely cut off from any administrative officer who could give them instructions. Notwithstanding these difficulties the mobile veterinary sections gave prompt evidence of their value in the chain of veterinary organizations, by collecting and evacuating large numbers of animals which otherwise could not have been recovered.

CHANNELS OF EVACUATION.

For a long period animals were evacuated by rail only, but later waterways and roads provided other channels of evacuation.

VETERINARY EVACUATION STATIONS.

Sanction was given for the formation of Veterinary Evacuating Stations on the understanding that the personnel was found from existing establishments, and in May, 1918, sixteen Imperial and two Dominion Veterinary Evacuating Stations, each with an establishment of 1 officer and 38 other ranks, were placed in the field. These Veterinary Evacuating Stations were made army troops and were allotted to corps as the military situation required. The normal allotment was one per corps. Each Veterinary Evacuating Station was provided with a motor horse ambulance capable of accommodating two patients. These vehicles were presented to the Army Council by the Royal Society for the Prevention of Cruelty to Animals, and proved of inestimable assistance in the rapid and humane clearance of more seriously injured animals.

Veterinary Evacuating Stations proved to be most valuable units under all circumstances, and their introduction left the Veterinary Service well equipped in respect to the machinery for evacuation. The cessation of hostilities six months after their formation prevented their being given such a severe test as Mobile Veterinary Sections, but both units proved absolutely essential for the efficient clearness of ineffective animals. These units up to the time of the Armistice had collected and conveyed to Veterinary Hospitals over 500,000 sick animals.

Summary of work done by the veterinary hospitals and convalescent horse depots up to the Armistice.

Admitted		725,216
Cured	539,064	
Died	18,975	
Destroyed (including animals destroyed and sold for food)	127,741	
Sold to agriculture	29,524	
Remaining under treatment	19,912	
		725,216

CONTROL OF CONTAGIOUS DISEASES.

The control of contagious diseases, although the most difficult, was by far the most important task of the Veterinary Service. There have been few campaigns the history of which does not record the same tale of appalling wastage of animal life and consequent financial loss to the state from such plagues as mange and glanders. Throughout the war careful and frequently repeated veterinary inspection of all animals was carried out, with the result that disease to which animals are subject were dealt with in their incipient stages and did not spread.

As an example it may be noted that during the first twelve months of the war, mange was almost entirely excluded. The maximum incidence of mange and allied skin disease was reached in March 1917, at the end of the winter season, when 3.8 per cent of the total number of animals on the strength were affected. New methods of control were brought into force, with the result that in October and November, 1917, the percentage affected was reduced to exactly one per cent. On the cessation of hostilities there were only 0.4 per cent of the animals of the force inefficient from skin disease.

Glanders, which has been an equine scourge in all previous wars, was an almost negligible cause of inefficiency during the recent campaign. The introduction of the Mallein test afforded a means of detecting affected animals before clinical symptoms of glanders had appeared and the case was capable of spreading infection. In the autumn of 1915, the Mallein test was applied to every one of the 300,000 animals of the force. This was successfully carried out with-

out the slightest interruption of work. The prompt measures taken to isolate animals affected by various diseases, and the disinfection of water troughs and other vehicles of contagion, made disease amongst the horses of the British Force at no time a difficulty which was not held well in hand by the Veterinary Services.

BATTLE CASUALTIES.

The normal wastage from battle casualties during the first two years of the campaign was extraordinarily low. This was no doubt largely due to the stationary nature of the warfare, for, with the advent of offensive operations in the summer of 1916, the casualty list became a heavy one. During the period from July 1st to December 31st, 1916, which embraced the battles of the Somme and Ancre, the losses in animals from hostile gunfire and gas were as follows:

	Killed or destroyed	Wounded	Total
Gunshot wounds	3,941	6,063	10,004
Gas	33	352	385
	3,974	6,415	10,389

The first three months of 1917, were not marked by severe fighting and the battle casualties totalled only 1,977 (717 killed and 1,260 wounded). The operations in front of Arras in April 1917, cost 4,625 animals, of which 2,070 were killed and 2,555 wounded. From May 1, 1917, to November 11, 1918, there were 2,045 casualties from gas and 120,886 from gunshot wounds.

EDUCATIONAL ORGANIZATIONS.

It was early recognized that the knowledge of animal management necessary for the successful maintenance of one or two horses under peace conditions could be supplied by a certain amount of practical experience based on rule of thumb methods. The knowledge required to maintain the animals of a squadron or battery in good condition and fit for any emergency on active service is a vastly different matter, and can only be acquired by practical experience gained under the supervision of experienced instructors whose precepts are founded on an intimate knowledge of veterinary anatomy, physiology and hygiene. In June 1917, ten-day classes of instruction were inaugurated at five different veterinary hospitals on the lines of communications. The courses were short and the instruction of an elementary nature, because it was considered expedient to train a

large number of young officers and N. C. Os. in as short a time as possible. By May, 1918, 850 officers and 4,000 N. C. Os. had attended these classes.

INSTRUCTION IN FARRIERY.

Early in 1915, it was decided to adopt measures to increase the supply of trained cold shoers, and a series of classes of instruction in this craft was inaugurated at General Headquarters. The classes were at first controlled by the R. A. S. C., but after a few months were taken over by the R. A. V. C. By August 1918, the number of British troops qualified was 2,353 and the number of Indian troops 181, totalling 2,534.

DISPOSAL OF ANIMALS UNFIT FOR FURTHER MILITARY SERVICE.

The Disposal of Animals Branch of the Veterinary Directorate was instituted in August, 1918, to deal with animals no longer fit for military service. The chief duties of this branch were:

(a) The sale to agriculturists, in conjunction with the French authorities, of cast animals fit for work on the land.

(b) The sale to reputable contractors in Paris or other towns, of animals suitable for human food.

(c) The dressing by army Veterinary Corps personnel of carcases fit for human food, and their disposal by sale to contractors or by issue as a meat ration to prisoners of war companies.

(d) The disposal of dead animals or of animals considered unfit for food.

The average amount realized from the by-products obtained from an animal of 10 cwts., live weight, proved to be as follows:

By-products	Amount	Average value
Hide		£1 0 0
Flesh (dried)	1 cwt.	1 9 3
Grease	3 gals.	1 5 0
Bones and hoofs	1 cwt.	5 0
Hair	½ lb.	9
		4 0 0

It is of interest to note that at certain veterinary hospitals it was found possible to collect the gas generated by the decay of flesh and manure and to use it for heating purposes, thereby preventing smell and saving fuel.

The work performed by the Disposal of Animals Branch from its inception until the cessation of hostilities on November 11, 1918, is expressed in the following figures:

Detail.	Number of animals.	Approximate amount realized.
Sold by auction to farmers and breeders	7,775	£168,868
Sold to Paris horse butchers	28,384	364,438
Sold to local horse butchers	16,578	231,621
Dealt with by butchery detachments and sold as dressed carcasses	3,552	44,106
Dealt with by butchery detachments and issued to labor coys. or P. of W.	984	21,100
Dealt with in horse carcass economizer plants for conversion into by-products	7,061	28,244
Total	64,334	£858,377

TECHNICAL EQUIPMENT.

The technical equipment of the British Veterinary Service, which has always been unrivalled both in respect to its quality and utility was in considerable demand by the French, American, and Portuguese Expeditionary Forces, who were supplied on repayment with stores to the value of nearly £6,000. It is only fitting in this connection to acknowledge the fine assistance given by the Fund for Sick and Wounded Animals, organized by the Royal Society for the Prevention of Cruelty to Animals. This society, which was the only auxiliary organization authorized by the Army Council to assist the veterinary services, provided animal comforts during the four years of war to the value of £100,000.

CHAPTER XXII.

SECTION II.

REMOUNT AND VETERINARY SERVICES (FRENCH).

I. FUNCTIONS AND GENERAL ORGANIZATION OF THE REMOUNT SERVICE.

The maintenance of the animal strength of the armies, like that of man-power, is of primary importance in the conduct of operations.

The supply of animals by means of replacements from the interior, the treatment and evacuation of sick and wounded animals, and the supply of horse shoes and veterinary material, were the duties of the various orgnizations which were charged with the direction and operation of the remount services.

As a matter of fact, during the war there was not, properly speaking, a clearly defined Service of Remounts or one organized as were certain other services (Medical, Intendance, etc., for example).

The supply of animals was assured by the 1st Sections (ler Bureaux) of the staffs. Veterinary hospitals, the evacuation of sick and wounded animals, and the supply of horse shoes and veterinary material were under the 4th Sections of the staffs (4èmes Bureaux des Etats-Majors). In matters concerning the organization of remount depots and the maintenance of the strength in animals, the service was generally supervised by the "Remount Inspectors" (Officiers Inspecteurs de remontes), while, from a technical veterinary standpoint, it was directed by "Veterinary officers" (Officiers du Service Vétérinaire).

II. ANIMAL REPLACEMENTS.

The replacement of animals was controlled at General Headquarters by the 1st Section (ler Bureau) of the General Staff and, in the armies, by the 1st Sections of the armies.

Requests for the replacement of animals were addressed to the Minister of War (Cavalry Direction), who filled them by means of animals purchased in the interior of the country by the "Remount Service" at the Ministry.

Animal replacements were forwarded to the armies by the regulating stations which were designated to supply them. At first, the army

corps received their replacements direct in their "Mobile remount depots" (Dépôts de remontes mobiles). However, with the constant increase in numbers, it soon became necessary to create "Army remount depots" (Dépôts de chevaux d'Armée). These depots were charged with receiving the animals, forwarding them to the units, and with the evacuation of sick and wounded animals toward the rear. (Chart 7, Chapter XXIII, Volume I.)

These depots were frequently inspected by an officer of high rank, who was the "Army Remount Inspector" (Inspecteur des remontes de l'Armée),[1] or by the "Inspector General of Remounts" (Inspecteur General des Remontes) at G. H. Q., and, from the technical standpoint, by the "Chief of the Army Veterinary Service" (Chef du Service Vétérinaire de l'Armée).

III. TREATMENT AND EVACUATION OF SICK AND WOUNDED ANIMALS.

At General Headquarters questions pertaining to the hospitalization and evacuation of animals devolved upon a special section, known as the "Remount Section," which was attached to the Direction of the Rear (D. A.). In the armies these matters were handled at first by the "Directions and Services of the lines of communication" (D. E. S.) and, when these were abolished, by the 4th Sections (4e Bureaux) of the armies.

Animals evacuated from the army depots were received in the veterinary hospitals, which had been organized in varying numbers, either in the zone of the lines of communication or in the rear areas of the Zone of the Armies. The location, organization and capacity of these establishments was determined by the commanders of the group of armies, after approval by the Commander in Chief. The "Direction of the lines of communication" (Direction d'Etapes—D. E.) was responsible for the maintenance and administration of the hospitals.

The number of veterinary hospitals grew proportionately with the increase in the number of animals and the increased losses resulting from various causes (overwork, lack of care, insufficient feeding, particularly of hay, etc.). In 1918, there were more than 30 veterinary hospitals of varying capacity in the zone of the French armies (500 to 1,500 stalls). These were all located in regions which were well provided with pastures (valleys of the Oise, of the Marne, of the Seine, of the Eure, etc.). A number of these hospitals were equipped for the treatment of special diseases (sulphur chambers for scabies, etc.). They were all either directly connected with the railroads or located near a large railway station.

[1] Whose duties included the classification and assignment of animals for military purposes, determination of physical fitness, temporary loans to agriculturists, etc.

The veterinary hospitals were inspected by the ranking Remount Inspector of the D. E., or by the G. H. Q. Inspector of Remounts, who reported upon the condition and equipment of these establishments and upon their general operation.

The Veterinary Service was responsible for the treatment of the animals and was charged with determining which animals could be returned to their units and which were to be evacuated to the various veterinary hospitals in the Zone of the Interior.

The assignment of veterinary hospitals of the interior among the zones of the lines of communication, and the designation of the regulating stations through which the evacuations were to be effected, were determined by the Commander in Chief (D. A.).

All evacuations were convoyed and these were made periodically; they included as many carloads as possible and, occasionally, even complete trainloads were evacuated.

The supply of veterinary medicines and materials was effected as follows:

Requests made by the armies or by the D. E. were verified by the Veterinary Service. These were sent periodically: 1. To the regulating officers, for such materials and medicines as were stored at the regulating stations in the reserves of the Medical Service or which were to be supplied by certain intermediate depots (stations-magasins), especially stocked for that purpose by the Minister of War; 2. to the Commander in Chief (D. A.), for certain materials or medicines which were requested from the Minister direct.

IV. SUPPLY OF HORSE SHOES.

Periodical requests for shoes for the armies or for the D. E. were centralized at General Headquarters (D. A.), which supplied them through the "Depots for horse shoes" (entrepôts de ferrures) in the interior (such as those at Lyons and at Angers).

This special supply was always difficult because the depots usually lacked over-size shoes, special shoes for pack animals (mules and donkeys) and especially caulks, which were indispensable in case of sudden frosts. To overcome this condition to a certain extent, blacksmith shops or shops for the salvage of shoes were organized in most of the armies.

V. VETERINARY SERVICE.

The Veterinary Service was the technical auxiliary of the Command and its duties, which have already been mentioned above, can be summarized as follows:

1. Preventative veterinary hygiene and prophylaxis.
2. Treatment of sick and wounded animals.

3. Technical organization of veterinary hospitals.

4. Verification of requests for veterinary materials and medicines.

The Veterinary Service was also charged with the inspection of fresh and frozen meat for the troops, the supervision of the cattle herds, and the technical inspection of the refrigerating plants (cold storage establishments).

In each army, the Veterinary Service was under the orders of a Chief Veterinarian (Chef du Service Vétérinaire). In addition, in each army corps or division, there was a veterinarian who was in charge of the veterinary services of those units.

Each "Direction of the lines of communication" (D. E.) was assigned a "Veterinary Inspector." Finally, in 1918, an Inspector General of the Veterinary Service (Inspecteur Général du Service Vétérinaire) was appointed at General Headquarters.

CHAPTER XXII.

SECTION III.

REMOUNT AND VETERINARY SERVICES (BELGIAN).[1]

PART 1.

PEACE ESTABLISHMENT.

The Remount Depot (D. R. A.) of the Belgian Army had been established since 1913. The functions of this organization were:

a) Acclimatize and train young animals before submitting them to service in cavalry or artillery regiments, or in the units of the Transport Corps or of the Gendarmerie.

b) Build up, during the mobilization, a reserve of saddle and draft animals.

c) Furnish saddle horses for the officers.

The Remount Corps formed part of the cavalry. It consisted of a staff and a certain number of squadrons. One of these squadrons formed the "Officers' Remount Depot" (Dépôt de Remonte des Officers—D. R. O.). The number of squadrons was based upon the number of animals present in the Corps. Each squadron to be composed of not more than 400 animals.

The personnel organically provided for the entire D. R. A. consisted of the following: 1 Superior Officer, 1 Captain, 4 Subalterns, 1 Subaltern officer charged with general duties, 1 Staff secretary, 4 First-Class Sergeants (senior grade), or 4 1st. Cl. Sgts., 1 First Sergeant, 1 Quartermaster Sergeant, 12 Sergeants, 24 Corporals, 4 Trumpeters, 276 Troopers, 4 Sergeants (Farriers), 1 Paymaster (officer), 3 Veterinarians.

In addition to the above, personnel detached temporarily by the corps and services of the Army; however, the total personnel (permanent and temporary) could not exceed the maximum strength determined upon.

The "Remount Depot of the Army" (D. R. A.) was located at Brasschaet and had a capacity of 800 animals. (When fully completed this establishment will be able to accommodate 2,000 animals.)

The "D. R. O.", at Etterbeek, had a capacity of 500 animals.

Hygiene is the basic principle in the functioning of the "D. R. A." and the "D. R. O."

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[1] Prepared for the M. B. A. S. by the "Direction des Service Vétérinaire et des Remontes," at the Belgian Ministry of War.

The average duration of sojourn of animals, for purposes of acclimatization and training, at the D. R. A. was about six months. Their daily ration consisted of 5½ kilograms of oats; 3 kilograms of hay and 4 kilograms of straw. The substitution of the oats component by bran, barley, carrots, etc., and of hay by green forage, was provided for in the regulations.

The functions of the Direction of the Remount and Veterinary Services were:

a) Purchase of animals for the requirements of the Army and of the Gendarmerie.

b) Take necessary measures to insure the conservation of young animals, develop and prepare them for field service.

c) Determine purchasing periods, territory to be covered for the purpose of buying animals, average prices to be paid for various types and classes of animals offered for sale, as well as determination of conditions which animals were to fulfill for acceptance by the service.

d) Distribution among the large units, and according to needs, of horses which had been acclimatized; bearing in mind their aptitudes and type of service to which they would be finally assigned.

e) Authorize the cession of animals to officers under varying conditions.

f) Establish rules to be followed in the rehabilitation of horses and in the sale of colts.

PURCHASE OF ANIMALS.

To be accepted by the Army, animals had to fulfill the following conditions:

a) To be geldings, with flowing manes and tails, or mares from four to six years of age (four-year-old horses, not to exceed one-half of the total number of horses purchased). White horses and those with light coats and with roman noses should be rejected.

b) They must all be of excellent conformations, strong and well proportioned in all their parts, well balanced and with clean limbs, pronounced withers, long necks, the back straight, short and strong, strong hoofs, their paces free and extended.

By standard measures, from the front foot to the withers, horses should average:

	meters.
Saddle horses:	
For "Chasseurs"	1.52 to 1.54
For "Lancers"	1.54 to 1.56
For "Guides"	1.56 to 1.60
For Artillery	1.53 to 1.56
For "Gendarmerie"	1.54 to 1.60
Draft horses:	
For Artillery	1.50 to 1.56
For the Transport Corps	1.54 to 1.60

In order to encourage national breeding, the purchasing commissions endeavored to purchase animals raised in the home country as far as possible.

However, nearly all of the saddle horses in the Belgian Army were of foreign origin. Previous to 1914, Irish horses predominated.

Annual replacement of horses amounted to about one-ninth of the total strength.

PART 2.

PURCHASES OF ANIMALS DURING THE WAR.

During hostilities, purchases of horses were effected in America, England and France, as well as in the region of the Yser.

A.) *Purchases in America.*—A Belgian Commission was sent to the United States on the 8th of December, 1914. At that date, the Belgian Government had contracted with a firm in London for furnishing 18,000 ordinary draft horses at a unit price of 57 Pounds Sterling, (about 1,425 Francs). The agreement provided that the horses presented to the Belgian Commission should be suitable for war service; the cost of transport to France to be at the expense of the seller; a second commission to examine the horses at debarkation and which could refuse those injured during the trip. The purchases were thus completed only after the horses left the French ports.

The following May, it was agreed that the horses should be furnished at the rate of 800 per month; 50 per cent saddle and 50 per cent draft; the latter to be of an average weight of 1,150 pounds. On the other hand, the unit price was advanced to $150, the dealer to bear the cost up to the moment of embarkation, while the buyer was to undertake cost of the trip. Purchases were therefore completed before the embarkation of the animals for Europe.

In August, it was prescribed that there should be provided monthly: 25 per cent saddle, 50 per cent ordinary draft and 25 per cent heavy draft horses, of a weight of 1,350 pounds. About this period, 500 ponies were bought at a unit price of $110. Beginning in the month of November, the monthly supply was 25 per cent saddle, 50 per cent heavy draft and 25 per cent draft; unit price remained at $150, but the purchases were completed after examination and acceptance of the horses. The buyer paid all costs of receipt, embarkation, voyage and debarkation.

In October, 1916, it was agreed that the monthly supply could vary according to the needs of the buyer and could be determined upon a prior notice of fifteen days. Unit prices were fixed at $135 for saddle horses, $150 for ordinary draft horses, and $160 for

heavy draft horses. Finally, the following November, a special credit was allowed for 100 horses of superior saddle quality, at $160. (Sixty horses of this kind were purchased.)

In January, 1917, these operations were discontinued and the Belgian Commission returned to France. Summed up, purchases in the United States reached a total of 15,973 animals, of which 7,545 were secured in 1915, and 8,428 in 1916.

B.) *Purchases in England.*—During 1916, the Belgian Commission purchased 175 pure blooded horses in England, the average price being 60 Pounds Sterling.

C.) *Purchases in France.*—During 1917: (a) 350 saddle horses for officers were purchased at the school depot at Saumur, the average price being 1,950 francs. (b) The British remount depots at Boulogne and vicinity furnished a Belgian commission, from the 19th of March to the 21st of December, 1917, with 2,400 draft horses and 100 saddle horses and, from the 3rd of January to the 31st of October, 1918, with 2,100 draft horses and 300 saddle horses, at a unit price which is unknown as these operations consisted of a "cession" rather than a purchase.

D.) *Purchases in the region of the Yser.*—Purchases of draft horses made by the divisions of the Army in defensive positions on the Yser. The total number of horses bought, per year, was approximately as follows: 450 in 1915, 500 in 1916, 400 in 1917, 50 in 1918, the average price being 1,800 francs for heavy draft horses and 1,600 francs for ordinary draft horses.

Finally, the Army in movement requisitioned about 350 draft animals during the period from the 30th of October to the 10th of November, 1918. The Army received a total of about 23,000 animals during the campaign.

DISTRIBUTION OF THE HORSES PURCHASED.

The horses purchased or requisitioned in the zone of the Yser were issued at once to the units of the field army. Those of foreign origin passed through the remount depot. The remount depot was established in the region of Calais after the retreat of the Army upon the Yser.

At the date of the Armistice, the effective strength of animals for the field army was approximately:

Saddle	11,000
Light draft	8,500
Ordinary draft	9,300
Heavy draft	5,000
Mules	200
Total	34,000

CHAPTER XXII.

SECTION IV.

VETERINARY AND REMOUNT SERVICES (ITALIAN).

PART 1.

THE REMOUNT SERVICE.

(Chart 8, Chapter XXIII, Volume I.)

A distinction should be made between: a) The supply of animals at the base for the completion of the army corps effectives, for the organization of new units, and for the formation of reserves.

b) The supply of animals in the Zone of the Armies (Zona di guerra) to replace those lost in action.

a. THE SUPPLY AT THE BASE

The Inspectorate of Remounts at the Ministry of War was the central directing organization for this service.

The local directing organizations were: The commands of the territorial army corps, each of which had an office called the "Office for the requisition of animals".

The executive organizations were:

a) The depots for the breeding and training of horses. These were in existence before the war and procured and trained colts from two to four years of age; these animals were obtained either in the homeland or from abroad. From these depots the animals were distributed to the cavalry and artillery regiments as soon as they were four and a half years old.

At the beginning of the mobilization two special depots were formed, one at Cecina and the other at Poggio-a-Caiano, each capable of handling 2,500 horses. The special depots received the animals which had been purchased in foreign countries. During the war, these depots served as reserve depots for the supply of the central depots and also, occasionally, for that of the army remount depots.

b) Regimental remount depots for the cavalry and artillery, which served as supply centers for animals destined as replacements

or for the formation of new artillery services and units. The animals in the regimental establishments came from the training depots, the "Preventative Requisition" depot, the requisitioning commissions, the commissions for the purchase of foreign horses, or were drawn from all of these sources.

c) Commissions for the requisition of horses, which were composed of:

A military commissioner, assisted by one or more officers;

A civil commissioner, delegated by the Provincial Council;

A veterinary surgeon, either military or civilian;

An expert, nominated by the Provincial Council.

In addition, a platoon of soldiers was attached to each commission, to care for the horses which had been requisitioned.

FUNCTIONING OF THE REMOUNT SERVICE AT THE BASE.

The laws of the State empowered the Government, in case of mobilization or during a war, to requisition the horses and mules suitable for military service (with few exceptions) belonging to citizens of the State, as well as those belonging to foreigners residing in the State, at a certain estimated valuation.

As required by this law, a live file was maintained in all of the communal offices of the State in which the animals in the commune were listed, together with the names and addresses of the owners. The latter were obliged to advise of all or any changes concerning the animals (sale, purchase, exchange, death, etc.).

In order to ascertain the suitability of the animals thus listed for military service, the Ministry of War caused these animals to be examined periodically by special commissions. The commissions classified the animals and determined their estimated value.

For the purpose of requisition, the Kingdom was divided into more than 250 zones, in each of which functioned a commission for the requisition of horses. In accordance with the orders published by the district commandants, owners were required to present their animals on the day and at the hour and place established by the requisitioning commission. The latter examined the animals, took over the number prescribed by the Ministry of War, and paid for them at the prices which these commissions had fixed beforehand. The animals were then despatched, either by road or by rail, to the regimental or other depots (district, reserve, etc.) according to the orders of the Ministry of War.

To assure the supply of horses for the more important branches (Artillery, Cavalry) in advance of the requisition, a law known as the "Preventative Requisition Law" was passed. Under the terms

of this law the proprietors were required, in case of demand for any given animal, to present their animals, vehicles and harness, on a given date and within indicated limits of time. For this purpose, in peace time, the commands of the territorial army corps subdivided their zones among the units which were under their orders. The units, by means of a commission nominated by themselves, proceeded to the designation, examination and valuation of the animals to be commandeered in the zones which had been assigned to them, on the basis of the lists established by the communal offices. When need arose, the units sent a "personal notification of command" (percetto personale) to the proprietors, who were then required to bring their animals to the locality mentioned in this document, and there the animals were again examined by a suitable regimental commission.

In case of absolute necessity, the law provided for a "forced requisition," which was nothing else than an immediate commandeering, against payment of a fixed price, by one or another of the military authorities.

It was impossible to obtain sufficient horses from the home country to meet the needs of the entire Army, and it therefore became necessary to have recourse to foreign markets for the procurement of animals, particularly in England, America and the Argentine Republic. For this purpose, special purchasing commissions were sent to the above named countries.

COMMISSIONS FOR THE PURCHASE OF HORSES FROM ABROAD.

The purchasing commissions were composed of: A superior officer of the regular army, who acted as president; one or more regular army officers and one or more veterinary officers, as members.

The sub-commissions were generally composed of: An officer of the regular army and a veterinary officer.

Suitable commissions and squads of soldiers received the animals at the points of debarkation, or at the frontier, and accompanied them to the depots to which they had been assigned.

THE SUPPLY IN THE ZONE OF THE ARMIES (WAR ZONE).

The supply of animals for the different units, detachments and mobile services located in the Zone of the Armies, devolved upon the Service of the Artillery. The latter was a directing and executive organization similar to those already mentioned.

RESOURCES.

In the first line, with the units, detachments and services, a certain number of animals were held in reserve.

In the second line, under the "Intendenze d'Armata" (army supply services):

A depot for the supply of animals.

A central depot for animals.

At the base, as already stated, were depots in varying numbers for the animals held in reserve.

FUNCTIONING OF THE SERVICE.

Losses in the units, detachments and services were replaced by animals in reserve and which were organically assigned to them. Whenever the number of reserve animals was insufficent, it became necessary to reduce the number of teams or else employ saddle horses for draught purposes, etc. Subsequently, units and services applied to the depots for additional animals, through the directing administrations of the artillery.

The supply depots were restocked:

(a) From the veterinary field hospitals, and from those on the lines of communication, by means of animals discharged as cured;

(b) From the "central depots for animals" (sent by rail) which, in turn, were restocked from the "reserve depots for animals" and, in part, from the depots for the breeding and training of horses.

Toward the end of the war, the supply of animals was also provided for by means of the "reserve column" of the "parks for baggage wagons and trucks". These parks were formed by pooling the vehicles and trucks which had been withdrawn from the first and second line services, and were under the orders of the Direction of the lines of communication. The losses in horses sustained by the Cavalry were replaced, for the most part, by the regimental depots.

The remount question was the cause of grave concern throughout the war. In 1914, during the tentative mobilization, an effort was made to bring up the artillery regiments to full strength by special purchases, both in the home country and in North America.

In 1915, mobilization having been determined upon, requisition was resorted to and the Army was thus provided with the necessary animals.

In order to provide for future contingencies, purchases of horses in North America were increased and, at the same time, mules were purchased in Spain. However, to meet the needs arising from the formation of new units and services, it also became necessary to acquire animals in Brazil, the Argentine Republic, and even in China. Finally, additional animals had to be obtained at home. This was accomplished by reducing the normal limitations of age and height prescribed for animals required for Army service, and one of the

unfortunate results of this measure was the dangerous depletion of the number of animals engaged in agricultural work.

During the last year of the war, the inability of meeting the increasing requirements of the Army, due to the increased losses and the progressive formation of new units and services, necessitated a reduction in the number of animals organically assigned to the various units.

PART 2.

THE VETERINARY SERVICE.

During the war the Veterinary Service:

a) Provided shelter and treatment for sick and wounded animals.

b) Cared for the animals of the Army in the field, as well as for the Army's livestock (meat on the hoof).

c) Inspected meat (fresh or frozen) and forage supplies.

d) Provided for the supply of veterinary stores.

ADMINISTRATIVE AGENCIES.

(Chart 9, Chapter XXIII, Volume I.)

(a) The chief of the Medical Service at the General Commissariat, in accordance with the instructions of the "Intendenza Generale," coordinated the veterinary services of the armies through the Veterinary Section.

The "Intendente Generale" (Q. M. G.) had, under his direct control, a veterinary inspector of high rank who acted as his technical inspector and advisor in all matters pertaining to the Veterinary service.

(b) Army Veterinary Administrators—one for each army.

The army veterinary administrators formed part of the medical services of the Commissariat and were directly under the "Intendente Generale." They were responsible to the latter for the proper operation of the veterinary services of the armies. The principal duties of these officers were:

To look after the animals of the armies and supervise the handling of these animals: preservation, hygiene, shelter, food and maintenance (del governo della mano);

Enforce regulations for the prevention and eradication of murrain (epizooty);

Evacuate all sick or unserviceable animals;

Provide for instruction in practical horseshoeing, the training of farriers and their assignment to units;

Provide for the supply of veterinary material and farriers' equipment;

Provide for the destruction of dead animals and for the recovery of by products obtainable from animal remains, by means of special plants ("Digestori") established in the army zones for that purpose:

Provide for the disinfection of corps and units by means of "Disinfecting Sections." (See Chapter XII, Volume II, on the Medical Service.)

(c) Army Corps Veterinary Offices. These formed part of the army corps medical services and were, theoretically, under the chief of the army corps medical services; in practice, however, they received their instructions direct from the army veterinary administrators.

The headquarters of the army corps supervised the veterinary services of the army corps.

EXECUTIVE AGENCIES.

a) Divisional Veterinary Officers. Who organized the veterinary services of the units, detachments and services of the division whenever these units did not have a veterinary officer assigned to them. In addition, the divisional veterinary officers acted as advisors and inspectors for the chief of the medical services of the division to which they were assigned.

b) Veterinary officers, with the units, detachments and services, who performed the routine service, viz: examined and treated the sick animals of the units, detachments and services assigned to them.

c) Corps of farriers. Fitted the shoes and shod the animals and, in addition, assisted the veterinary officers in the treatment of sick animals.

SUPPLIES AND ESTABLISHMENTS OF THE VETERINARY SERVICE.

(Chart 10, Chapter XXIII, Volume I.)

A. The units, detachments and services were provided with the following veterinary equipment and material: small antiseptic pads (cuscinetti) for wounds, cord shoes, medical bags for veterinary use; chests and cases of veterinary stores and materials, portable forges, etc.

B. The army corps were provided with a small depot for the supply of veterinary material.

C. With the armies:

1. Field veterinary infirmaries. These were mobile establishments designed for the temporary shelter and treatment of sick and wounded animals. Infirmaries were assigned to each army, at the rate of two for each army corps, and could provide for the treat-

ment of approximately 150 animals. Some of the infirmaries were specially designated for the treatment of contagious diseases and were assigned to the army corps in addition to the ordinary veterinary infirmaries.

2. Veterinary infirmaries on the lines of communication. These were permanent establishments, constructed on the lines of communication with material obtained on the spot. They had no fixed capacity but were generally larger than the field veterinary infirmaries.

3. Veterinary convalescent depots. These establishments were designed for the purpose of returning animals to active service within as short a time as possible after their leaving the veterinary infirmaries. They were equipped with the necessary means for the preparation and cooking of food and were also provided with large grazing grounds and paddocks. Some of these depots were organized by the "Blue Cross Society" (a national association for the care of animals.)

4. Bacteriological laboratories. (One laboratory for each army.) For the examination of the pathological material sent from the veterinary infirmaries and from the units.

5. "Digestori." These were establishments, constructed in the Zone of the Armies, in which dead animals were destroyed.

6. Disinfecting Sections. Employed for the disinfection of the troops of the corps and detachments. These sections formed part of the personnel of the field infirmaries.

7. Advanced storehouses for veterinary supplies. Formed part of the advanced storehouses for medical supplies. They furnished the services and units of the first line with veterinary medicines and equipment.

8. Advanced storehouses for farriers' supplies, etc. Provided the supply of horseshoes for the entire Army. Generally, the advanced artillery storehouses furnished these supplies.

9. Central depots for veterinary supplies. Which formed part of the central depots for medical supplies. They supplied the advanced storehouses for veterinary supplies.

D. In the interior of the country (reserve establishments).

1. The Central Military Pharmacy. (See Chapter XII, Volume II, on the Medical Service).

2. Territorial artillery administrations. For the supply of horseshoes, (masserize), etc.

FUNCTIONING OF THE SERVICE.

The veterinary officers with the troops treated the sick and slightly wounded animals, using the emergency material and equipment at hand. The more seriously sick and wounded animals were

assembled by divisions and removed to the field veterinary infirmaries, under the escort of personnel provided by the units for that purpose.

The field veterinary infirmaries were located along the lines of communication of the army corps. The army veterinary administrators established them as near as possible to the troops and there was at least one infirmary to each two sections of the lines of communication. In case of an advance, when it became necessary to move the veterinary infirmaries, those further to the rear removed the animals under their care to the nearest permanent veterinary establishment and then installed themselves in the more advanced position, in accordance with the instructions of the army veterinary administrator.

Animals were also removed from the lines of communication veterinary infirmaries, upon the orders of the veterinary administrators, whenever field infirmaries were overcrowded or when it was considered advisable to clear these infirmaries for a possible emergency.

Animals pronounced unfit for further military service by the veterinary officers, on account of serious wounds or disease, were examined by a commission and then either destroyed or sold.

The establishment of veterinary convalescent depots and the removal of animals toward the interior of the country, was necessary on account of the scarcity of horses in Italy and the difficulty in obtaining sufficient animals to meet the requirements of the Army. From the beginning of the war animals were therefore removed from the veterinary infirmaries to the veterinary convalescent depots, where they could regain their strength as speedily as possible, while those whose treatment required more time were sent direct to the interior.

Animals evacuated toward the interior were shipped by trainloads to one or another of the regimental field artillery depots, located in southern Italy, where the milder climate and the better quality of forage soon restored them to health.

Animals discharged from the veterinary infirmaries as cured, were sent to the "Army depots for the supply of animals."

The units and detachments obtained their veterinary supplies through requests upon the advanced veterinary storehouses; in urgent cases, however, the army corps commands could supply the units direct from the small veterinary depots organically assigned to them. As already stated, the advanced veterinary storehouses were supplied by the central depots for veterinary supplies which, in turn, were supplied by the reserve establishments.

Statistics concerning the Veterinary Service.

Number of field veterinary infirmaries in operation	37
Number of lines of communication veterinary infirmaries in operation	20
Number of veterinary convalescent depots in operation	13
(Four of these belonged to the "Blue Cross.")	
Number of animals treated in the field veterinary infirmaries	500,000
Total number of animals lost	45,000
Percentage of mortality	5.0
Percentage of loss on total strength (320,000)	0.32
Percentage of loss on number of animals treated	2.20
Total number of animals removed to the interior from the Zone of the Armies (Zona di guerra)	6,000

Number of farriers assigned to the various units: one for every 200 animals.

CHAPTER XXII.

SECTION V.

REMOUNT AND VETERINARY SERVICES (AMERICAN).[1]

PART 1

REMOUNT SERVICE.

(Chart 4, Chapter XXIII, Vol. I.)

One of the many complex problems which confronted the War Department when the United States entered the World War in 1917, was the horsing of the vast number of units of the new army. Prior to that time the purchase of animals for replacements had been a comparatively easy task, officers being detailed for that purpose, but every officer being urgently needed in this crisis it was necessary to call into active service some of the Reserve Officers.

In May and June 1917, there were thirty or forty reserve officers called into the Remount Service, and sent to the different purchasing zones at Fort Reno, Front Royal, Fort Keogh and Kansas City. The country was divided into four grand purchasing zones, Eastern, Southern, Central and Northern, with the above mentioned places as their respective headquarters. In addition to these reserve officers, about twelve regular officers were secured for the purchase of animals.

In August, 1917, actual work was begun on the construction of auxiliary remount depots adjacent to the divisional camps. Remount officers were sent to these depots to build them, and later to be placed in command.

When these officers were sent to the remount depots it was necessary to procure officers to replace them as buyers. Fifty of the best known horsemen in the United States were commissioned as captains in the Reserve Corps, and assigned to the various purchasing boards. The work of these men was remarkable, and there were but few complaints made by organizations regarding the kind of animals received.

In order to procure enough animals for the various divisions, it was necessary to begin shipping animals to those remount depots

[1] Prepared for the M. B. A. S. by the Chief of the Remount Service, A. E. F.

before they were anything like completed. The result was that practically every depot was over-crowded with animals and short in personnel. Divisions did not fill up with personnel as rapidly as it was anticipated, and animals had to be held up in depots until such time as division commanders could receive them. It was well into the winter of 1917 and 1918, before the depots were able to issue enough animals, so that the work of repairing, cleaning and minor construction could be attempted with the men on hand.

In the meanwhile the American Expeditionary Forces, which had only one remount officer when General Pershing and his staff landed in France, had sent urgent calls to Washington for not only commissioned personnel for the Remount Service, but enlisted men as well.

A few of the A. E. F. officers and men were placed on remount work and certain cavalry units in France were also placed in that service.

January 1, 1918, saw the formation of the plan whereby not only remount officers could be supplied to the A. E. F., but trained units—Remount Squadrons—as well, which would take care of surplus animals. Forty-six of these squadrons were trained and sent to France, the first going overseas in April, 1918. The work of these units both in depots in France and with the combat units received much favorable comment, not only from divisional commanders and higher authority, but from the Commander in Chief as well.

During the war thirty remount depots were established in France, (Chart 6, Chapter XXIII, Vol. I), and authorization for five more was secured but these latter were never built. Many of these depots were taken over from the French who had designated them as "Annexes," meaning "Annex to a larger Remount Depot," and they were capable of holding only a few animals. They were secured at a time when collecting places for animals were at a premium. It was believed by the French that all that would be necessary would be to secure one of these annexes for a collecting point, and after holding animals for a few days, to issue them to organizations. However, when large numbers of green animals were brought together there was the usual outbreak of influenza and other diseases common to horses. The first outbreak of influenza among animals struck the A. E. F. in the winter of 1917 and 1918, and from then until August 1918, there was no let up. Every effort was made to check this epidemic, but before it was done a terrific toll had been taken.

After the Armistice, when there were not enough men to take proper care of all the animals owned by the Army in the United States, it was decided to declare surplus nearly 200,000 animals and sell them. This brought down a storm of disapproval upon the Remount Service from various sources. It was pointed out that the normal market in pre-war times ran around the 60,000 mark. It

was stated that if the Government decided to sell a large number of animals, that probably 50,000 or 60,000 animals would bring fair prices but after that the market would decline to such an extent that both horses and mules would prove a drug on the market. It would not only bring a great loss to the Government but to all dealers all over the country as well, it was said. A gradual selling off was advocated.

Despite these warnings it was believed that conditions were such that the animals should be disposed of as soon as possible. Plans for the disposal of the animals were worked out by Colonel L. Hardeman, then Chief of the Remount Service. The average price obtained per animal for 182,000 horses and mules was $116.60, which was 62 per cent of the original cost which averaged $192.

The prices received were considered good. The statement that the market would not absorb that number of animals was disproved by the fact that the market became stronger as the sales progressed. These sales were expedited to save the cost of feed and labor to maintain these animals. Had the sales been conducted slowly, taking four to six months longer, it is estimated that the prices would have been better, the Government probably receiving $50 to $60 a head more. (However, the cost of maintenance would have been from $100 to $120 or $180 per head.) It was shown by these figures that as long as animals brought more than 50 per cent of their original cost that these sales should be held as rapidly as possible. Many old animals which were on hand before the war were sold as surplus; also many horses purchased as cavalry, that were unsuitable, during 1914 and 1915 for Mexican border service were included. The worst of the animals on hand were disposed of and the best retained. Many of the animals which were young were in the hands of troops. These animals, handled by men ignorant of proper methods of caring for animals, suffered greatly, injuries and blemishes being common. They were also in poor condition and of much less value than when purchased.

With the country divided into four purchasing zones, officers assigned for the purchase of animals were sent to these various headquarters and worked out from there. There were two methods of procuring animals. One was by contract from dealers and the other was by purchase direct from individuals, where as many as a carload could be purchased. In this way, at least all of the territory where animals in any numbers could be secured, was covered.

The method of securing animals in the A. E. F., was very different. In France the purchase of animals was divided into three categories; those purchased in 1917, purchases of 1918, and the requisition of 1918. During the purchases of 1917 and 1918 in France, French

boards did practically all the work, but an officer representing the Remount Service and another representing the Veterinary Corps were consulted by the French authorities. The requisition was put into effect when it was found that it would be an impossibility to obtain a sufficient number of animals to meet the needs of the French and American Armies. In accordance with the French law, all of the animals in that country had been listed, and farmers who owned more than a certain number of animals were forced to turn over the surplus to the French Government. By this step alone the American Army secured approximately 70,000 animals.

When American troops were brigaded with the British Army, an agreement was made whereby they were to be equipped with animals according to the British Table of Organization. The animals needed were turned over to the American troops and, after the Armistice, a bill was presented to the American Government for payment.

One of the most interesting chapters during the war in the procurement of animals was the experience with Spain. In all, 18,462 animals were purchased in that country, but it was extremely difficult to get them across the border after they had been purchased because of the preponderance of German influence in Spain. All animals secured in Spain were purchased by contract from dealers. They were shipped in cars to Hendaye and then convoyed overland to Bayonne, where a remount depot had been established for their reception.

When the disintegration of the A. E. F. began, permission was obtained from the French Government to dispose of animals at public auction. Later animals were sold also at private sale, it being found that better prices could be obtained by this method. All sales were made under the jurisdiction of the United States Liquidation Committee.

Prior to being sold, every effort was made by the Remount Service to put the animals in the best possible condition. One remarkable feature that was found in connection with the sale of animals to the French was that horses with long manes brought better prices than if they had been hogged. By catering to the fancies of buyers in France, the American Government made many thousands of dollars.

Despite the distance of the battle lines from the United States and the paucity of shipping facilities, 67,725 animals were shipped across the Atlantic to the A. E. F., and less than 1 per cent of these animals were lost en route, which shows the excellent care they received. Had it not been for the fact that nearly half the animals that were lost on the seas were on one boat, the record made by the Remount Service would have been more remarkable.

The first animals from the United States reached France on July 31, 1917. These animals were sent in the same convoy with the troops to which they were to be assigned. However, the shipment of animals with troops was later discontinued, due to the fact that the authorities representing the French War Office offered to supply 4,850 horses and 2,100 mules for the First Division. The Commander in Chief cabled June 17, 1917, recommending the offer be accepted, and animals for the second convoy be not sent. The first animals to arrive in France from the United States came over on four transports and, out of the 28,121 shipped, only one died en route. As arranged previously, these animals were immediately turned over to the infantry units of the First Division and to the Marine brigades, all of which had just arrived. On account of the shortage of ships' bottoms, coupled with the further offer from the French Government to deliver 7,000 animals monthly, beginning September 1, 1917, it was decided to stop shipments of animals from the United States until November 10, 1917. The inability of the French Government to carry out the original offer of 7,000 animals monthly completely upset the plans of the Remount Service for horsing new divisions and S. O. S. units.

The shipments of animals from the United States had resumed November 10, 1917, and continued regularly until April, 1918, when they were stopped due to the fact that ships' bottoms were sorely needed for carrying troops, food supplies, and munitions.

In February 1918, at a conference held between representatives of the United States Army and the French War Office, an agreement was reached whereby animals could be purchased in the open market for the A. E. F.

With the supply of animals available shrinking daily, the shortage, which had been felt from the first, became acute in June 1918, when there was a shortage of 125,934 animals in the American Expeditionary Forces, and though the French had made an effort to aid the American forces in the purchase of animals, up until June 20, 1918, only 31,589 animals had been secured.

With the situation so critical, the Remount Service made an earnest recommendation to General Headquarters for a monthly supply of 42,900 animals to meet requirements. A cable was sent by General Headquarters to the United States requesting a supply of 25,000 animals a month. The War Department answered July 28, 1918, that this number could not be shipped because of a lack of tonnage, and that only 11,000 per month could be shipped prior to September 1, 1918. A further step was taken by our French Allies to give relief by putting into effect a requisitioning of animals throughout certain portions of France. A rule was made by the French Government that farmers could only have a certain

number of animals, according to the number of acres that they tilled. There were representatives of the United States Army on the requisitioning boards that were sent out. This drastic step yielded 74,070 animals. The shortage of animals in the Army, August 31, 1918, was 72,000. The Chief Quartermaster brought this condition to the attention of the Commanding General, S. O. S., and advised that a monthly supply of 46,924 animals be sent from the United States.

With the animal situation acute, and with but few signs of anything like immediate relief, it was determined to motorize a number of units, especially artillery brigades, and cut the animal allowance to each combat division from 6,719 to 3,803. At the same time a request was cabled to the War Department asking for 30,000 animals a month. An answer was made by the War Department that under existing conditions it was impossible to ship that many animals. Another cable was sent to the War Department on September 15, 1918, that it was estimated that after the proposed motorization went into effect, that it would still need a monthly supply of 31,700 animals up to June 30, 1919, to make up the shortage.

Shipments were resumed from the United States, but only three transports arrived in September 1918, and four in October 1918, with a total of 4,409 animals instead of 22,000 which should have been received in those two months as per cablegram from the War Department, July 28, 1918. It was at this time that the need of animals was emphasized on every hand. The First Army was engaged with the enemy and it was imperative that guns be moved and that supplies be carried forward. The total shortage of animals in the A. E. F. on November 11, 1918, when the enemy laid down their arms, was 163,382.

There had been a constant revision downward of the number of animals allotted to a division. On October 25, 1917, the total number of animals with a complete division, including an artillery brigade, was 7,701. This was reduced in January 1918, to 7,578 and in June 1918, to 6,663.

From August to December 1917, a total of 12,438 animals were secured from the French. Of this number 4,066 were borrowed for the 28th Division but afterwards purchased.

Although the French Army was suffering from a shortage of animals, on three different occasions they came to the rescue of the A. E. F. by turning over animals that were sorely needed by the United States Army. The animals were turned over at a time that it would have been impossible for the full effect of American arms to be felt but for the timely aid of the French. The last animals secured from the French were delivered in the fall of 1918,

for the wiping out of St. Mihiel salient, when it was imperative that the Army use all haste in order to swing around and begin the Argonne offensive.

A number of different plans were tried for disposing of dead and condemned animals. In the fall of 1918, the Salvage Division entered into a contract for the sale of the carcasses of all animals which died or were killed in the A. E. F. The contractor established rendering plants at several of the larger hospitals and depots, but, again, this scheme did not work well, except in cases when the contractor sent for the carcasses.

An agreement was finally made whereby all animals condemned, whether for butchery or sale to farmers, should be turned over to the French authorities for such disposal as they might wish to make, the uniform price of 450 francs an animal being agreed upon.

The average life of an animal in the A. E. F., based upon figures for the period of July 1917, to October, 1918, was three years and three months. Figures based on the period of July 1918, to October 1918, show the average life of animals to be 2 years, 11 months and 22 days.

SYSTEM OF REPLACEMENT AND SUPPLY.

For troops within the United States, the system of animal replacements was comparatively easy. Animals immediately after purchase were shipped to camp remount depots, where they were held until needed by organizations. When in need of animals organizations submitted their requisitions and, upon approval by the commanding general, were able to draw upon the nearest remount depot. There was an ample supply of animals, and no trouble was encountered in supplying all organizations.

In France, where the number of replacements was never equal to the demand until long after the Armistice, the question of animal supply was one of the most difficult questions of the entire war in the A. E. F.

Plans formulated by the Chief of the Remount Service of the A. E. F., provided that animals upon being purchased or received from the United States should be sent to remount depots in the Base Section, where they were held during the quarantine period. When ready for training they were to be shipped to the remount depots in the Intermediate Section, where they were shod and trained. From there they were to be sent to the remount depots in the Advance Section, to be held until needed by combat organizations. From the Advance Section depots they were to go direct to combat troops according to their needs.

In order to secure replacements, the division remount officers were instructed to communicate their needs to the corps remount officers who, in turn, submitted them to the army remount officers. The army remount officers would be informed by the G-4 of the army as to what troops would be used in forthcoming attacks in order that it would be possible to give those organizations primary consideration. In this way it would be possible for replacements to be sent where they were most needed. However, the animal question became so acute that it was an impossibility to carry out these plans as laid down by the Chief of the Remount Service. Instead of the Remount Service acting as the animal arteries of the Army and the Veterinary Corps representing the veins, there were times when animals had to be shipped direct from the base ports to combat troops. Evacuations also became so great that it was necessary for remount squadrons to be taken from their regular duties and used to evacuate the sick and wounded animals from the front.

Total number of animals authorized in A. E. F., each year.—(*a*) October 25, 1917, 7,701 animals were allotted per division. This was changed in January, 1918, when it was cut to 7,578. Due to the shortage of animals a further reduction was made in June, 1918, to 6,663 per division. In September, 1918, it was planned to motorize many of the artillery regiments which would permit the reduction of animals per division to 3,803. However, this was never carried into effect.

Total number actually obtained.—(*b*) During 1917, 21,988 animals were obtained for the A. E. F., 12,438 being purchased from the French, and 9,550 shipped to France from the United States. During 1918, a total of 221,180 animals were procured, of which 58,175 came from the United States, 123,284 from the French, 21,259 from the English and 18,462 from Spain.

(*c*) The horses in the A. E. F., were divided as follows: 12½ per cent riding horses, and 87½ per cent draft. The animals were divided, 74 per cent horses and 26 per cent mules.

(*d*) There was a total of 243,360 animals procured for the A. E. F. during the World War.

(*e*) The maximum number of animals on hand was reached December 31, 1918, when there were 192,171 animals in France. At that time there were 107,784 (approximately) animals with the Army and 84,387 in the hands of the S. O. S. The animals accredited to the S. O. S., were also in the hands of the organizations of the advanced section.

Suitability for particular use.—It is hard to arrive at any logical conclusion due to the fact that conditions were such that the only

outstanding feature was the stamina of the American draft horses. It was found that the animals shipped from the United States showed to an excellent advantage over the war worn animals we secured from our Allies. However, the American draft horse, under the same arduous conditions, did his work splendidly. Figures compiled show that we lost 25 per cent of our animals in France during the World War. The highest percentage of loss occurred October 16 to 23, 1918, when in that week 2½ per cent of all the animals in the A. E. F. were lost.

Animals on hand, November 11, 1918.

Riding Horses:		
In United States	87,027	
In A. E. F.[1]	27,327	
		114,354
Draft animals:		
In United States	193,926	
In A. E. F.[1]	135,384	
		329,310
Mules, pack:		
In United States	14,218	
In A. E. F.[1]	2,717	
		16,935
Grand total		460,599

Total animals on hand November 11, 1918.

A. E. F.	166,554
United States	295,171
In transit	17,949

It was estimated that the cancellation of contracts for public animals by the A. E. F. saved the United States $33,533,000 based on the following data:

Cost on delivery to organizations of 50,000 animals at $487.06	$24,353,000.00
Cost of feeding the same for 6 months at rate of $1.02	9,180,000.00
	33,533,000.00

The following is a table showing the estimated cost daily of keeping an animal in a remount depot of the A. E. F.

1. *Direct Charges.*

1. Forage ration	$1.02
2. Veterinary supplies	.002
3. Wear of horseshoes	.083

[1] At the time of the Armistice, of the 166,554 animals in the A. E. F., 16,000 were in veterinary hospitals.

2. Overhead Charges.

1. Pay and rations of personnel	.766
2. Leases of grounds and barracks	.008
3. Fuel and light	.008
4. Remount depot office expenses	.005
5. Estimated original cost of construction (daily prorata per animal)	.166
6. Depreciation of 10 per cent on value of Quartermaster, Ordnance, and Veterinary property (daily prorata per animal)	.250
Total	$2.308

NOTE.—British estimates show cost of $0.82 per day but this does not include pay and rations of personnel. In addition, our figures show $0.50 more for forage based on freight charges at $0.60 per ton.

Following is a detailed statement showing the average cost of an animal in the United States, the cost to hold the animal for two months in a remount depot in the United States, cost of railroad transportation in the United States and the cost of ocean transportation to France, and the cost to maintain and condition the animal in a remount depot in France covering a period of one month before issuing:

Average cost of animal in the United States	$196.39
Cost of forage for two months in United States remount depot	$196.39
Cost of shoeing in the United States	2.50
Cost of veterinary supplies in the United States	.08
Cost of railroad transportation in the United States	36.00
Cost of ocean transportation to France	127.00
	392.39
Total cost of animal at base port in France	392.39
Cost of maintenance of animal in remount depot in France for 30 days prior to issue	69.24
Total cost	461.63

The average life of an animal in the A. E. F., based upon figures for the period of July, 1917, to October, 1918, was three years and three months; figures based upon the period from July, 1918, to October, 1918, show the average life of an animal to be 2 years, 11 months, and 22 days. These figures were made upon periods that were favorable to the longevity of animals.

MEMORANDUM AS TO ANIMAL REQUIREMENTS FOR AMERICAN EXPEDITIONARY FORCES.

[August 28, 1918.]

Allowance of total animals.

Combat division	3,772
Corps troops	2,200
Army troops	10,000
Depot division	2,000

NOTE.—The above figures are less than the authorized tables except in the case of combat divisions. The figures given are the minimum numbers with which the units in question can properly function as mobile units.

In the case of corps troops, allowance is made for only one squadron of cavalry per corps, as there will probably be no larger units assigned, owing to the lack of cavalry in France.

Requirements for one Army Corps.

Four combat divisions	15,088
One depot division	2,000
Corps troops	2,200
Total, minimum requirements for mobile army corps	19,288

Requirements for one Army.

Five army corps	96,440
Army troops	10,000
Total, minimum requirements for one mobile army	106,440

Present requirements for American Expeditionary Forces.

One army	106,440
Two army corps, Second Army (now incomplete)	38,576
Services of Supply (Aug. 14, 1918)	24,192
	169,208
10 per cent replacements for three months	15,921
American Expeditionary Forces (all units possible motorized)	185,129
Present number of animals pertaining to A. E. F. (Aug. 14, 1918)	157,522
Deficit, all possible units motorized	27,607

NOTE.—With the present lack of motor equipment, the divisions should have at least 6,000 animals each. This increases the deficit existing at the present time to 95,447; there are 30 combat divisions, each of which should have 2,228 more animals than allowed in paragraph 1.

Minimum requirements for American Expeditionary Forces.

[July 1, 1919.]

Three armies	319,320
One extra army corps	19,288
Services of Supply	70,000
	408,608
10 per cent replacements for three months	40,861
Requirements, July 1, 1919	449,469
Add 10 per cent replacements, Aug. 28, 1918, to July 1	44,947
	494,416
Animals pertaining to A. E. F., Aug. 14, 1918	157,522
Total animals to be acquired to July 1	336,894
Maximum possible from Spain and Portugal	30,000
Animals to be brought from United States	306,894
Total animals per month till July 1	34,098

PART 2.

A BRIEF STATEMENT REGARDING THE VETERINARY SERVICE OF THE AMERICAN EXPEDITIONARY FORCES IN FRANCE FROM JUNE 1917 TO JULY 1919.[1]

(Chart 5, Chapter XXIII, Vol. I.)

The Veterinary Service of the American Expeditionary Forces, functioned under both the Chief Quartermaster and the Chief Surgeon. From the time the American forces entered the war until G. O. No. 39, G. H. Q. was published, the Chief Surgeon was responsible for the Veterinary Corps, although the service was being operated by the Chief Remount Officer of the Quartermaster Department.

SECTION I.

ORGANIZATION UNDER THE QUARTERMASTER DEPARTMENT.

1. General Order No. 39, G. H. Q., dated December 19, 1917, placed the advanced and base veterinary hospitals under the Remount Service, but was silent as to what jurisdiction the Chief of Remounts would have over the veterinary personnel. On December 23, 1917, the Chief Surgeon received the following memorandum from the Chief in Command.

[1] Prepared for the M. B. A. S. by the Chief of the Veterinary Service, Office of the Surgeon General, U. S. Army.

Dec. 23, 1917.

A. S. G. S.—Memo: to Chief Surgeon.

1. The C. in C. has decided, under general authority granted him by the War Department in such matters, to suspend the application of so much of the Veterinary Corps regulations as is in conflict with the organization of the Remount Service, A. E. F., as outlined in General Order No. 39, these Headquarters.

2. While the personnel of the Veterinary Corps remains under the general supervision of the Medical Department, he nevertheless directs that the assignment of all veterinary personnel be made in accordance with recommendations submitted by the Remount Service.

By order of the C. in C.

(Signed) J. A. LOGAN, Jr.,
Chief, A. S. G. S.

And again, in reply to an inquiry from the Chief Surgeon, the following memorandum was received from the C. in C., February 27, 1918:

Memo: for Chief Surgeon:

1. Replying to your memo. No. 211.233/6293, dated February 22, 1918, the order on the organization of the Remount Service now in preparation will make the Veterinary Service a part of the Remount Service under the Q. M.

2. As far as the personnel is concerned, the C. S., after supplying needed personnel to the Medical Supply Department, will report other veterinary personnel to Headquarters S. O. S., for assignment to R. S.

3. Veterinary supplies will be furnished by the Medical Department.

By order of the C. in C.

(Signed) JAMES A. LOGAN, Jr.,
Lieut. Colonel, C. S.

2. Section 2, G. O., No. 122, G. H. Q., dated July 26, 1918, revoked G. O., No. 39, G. H. Q., of September 18, 1917, and provided a field officer of the mounted or Remount Service as Chief of Remount Service, A. E. F., and assistant to the Chief Quartermaster. At the same time providing for an officer of the Veterinary Corps, to be detailed as assistant to the Chief Remount Officer, this officer to be designated as Chief of the Veterinary Service. He was to have technical supervision of all veterinary matters and to operate under the Chief of the Remount Service in an advisory capacity.

3. The organization first adopted proved inadequate and on August 24, 1918, a change was made, which directed that the Veterinary Service of the Expeditionary Forces be organized in accordance with S. R. No. 70, W. D. The transfer was made from the Quartermaster Corps to the Medical Department. This order also provided a veterinary officer as Chief Veterinarian, who was charged under the Chief Surgeon, with the administration of the Veterinary Service.

SECTION II.

UNDER THE MEDICAL DEPARTMENT.

1. The change to the Medical Department was made on August 27, 1918, by G. O. No. 139, August 24th, G. H. Q., A. E. F. The same order announced Lieut. Colonel David S. White, Veterinary Corps, as Chief Veterinarian, A. E. F.

2. The adoption of S. R. No. 70, W. D., 1917, and the appointment of Lieutenant Colonel White as Chief Veterinarian, marked the real beginning of the proper functioning of the Veterinary Service in the American Expeditionary Forces, in accordance with plans for its organization previously made in the United States. This organization provided a simple, direct, and efficient method for the evacuation and care of the sick and injured animals. Especially trained units were organized to relieve the combatant forces and transfer incapacitated animals to the veterinary hospitals in the S. O. S.

3. Veterinary officers were placed in command of the veterinary hospital and immediate steps were taken to collect scattered companies and detachments of the Veterinary Corps, and form them into efficient working organizations. The issue of convalescent animals from veterinary hospitals and units back to organizations was stopped and all recovered cases for duty were sent to the Remount for re-issue. The prompt rendering of weekly animal sick reports and their accurate compilation were insisted upon.

4. The headquarters office of the Veterinary Corps was divided into four branches as follows: Administrative, Construction, Personnel and Statistical Branches.

5. The duties of these branches were:

Administrative Branch.—Headed by an executive officer, who was Assistant Chief Veterinarian, A. E. F., and controlled the other branches of the office; he had charge of the administrative affairs of the Veterinary Corps, in general. This branch was also charged with the inspection of all veterinary hospitals in the Base, Intermediate and Advance Sections.

Construction Branch.—This branch had charge of plans for construction of hospitals and other buildings which were essential to the Veterinary Corps; also location of sites and repairs for hospitals.

Statistical Branch.—This branch kept accurate accounts of the receipt and evacuation of all animals turned over to the Veterinary Corps; compilation of reports of sickness in remount depots and in armies.

SECTION III.

EVACUATION OF SICK ANIMALS.

1. The system of evacuation adopted by the Americans was similar to that employed by the British Veterinary Service. This was accepted as a model after careful consideration.

2. Incapacitated animals were collected in organizations by organization veterinary personnel. Minor cases of injuries or sickness were treated in the organizations and those requiring further treatment were transferred to division mobile sections, usually located near a railhead.

3. The Division Mobile Sections were equipped with personnel and facilities to collect the ineffectives from the organization, treat minor cases not necessary to evacuate and diagnose, sort, classify and evacuate the balance to the corps or army or base veterinary hospitals, whichever was nearest or most convenient.

4. Corps and Arm Mobile Veterinary Hospitals were equipped to care for non-serious and emergency cases and to evacuate to S. O. S. hospitals in rear, all other cases. Before the evacuation the patients were sorted, classified and transported by road or rail, as occasion demanded, to General, Mange or Convalescent Hospitals.

5. During the early operations, all shipments of incapacitated animals were required to be marched long distances to collecting points designated at railheads before being loaded in cars for shipment to rear. This procedure caused unnecessary delays which were soon recognized by the section of the General Staff responsible for this service. About October 1, 1918, the army evacuating units were placed as near the advanced railheads as possible, to carry on the work of receiving, sorting, classifying and shipping ineffectives. This arrangement allowed the transfer direct from divisional mobile veterinary sections to corps, army or base hospitals, as the case required.

6. The Veterinary Hospitals were located as shown in chart 6, Chapter XXIII, Vol. I. Every effort was made to locate these hospitals near good transportation facilities. Certain hospitals were designated as Mange, Convalescent and General Hospitals, and insofar as possible, the cases sent to the various hospitals, were selected according to classification at time of collection by army evacuating units.

7. The evacuation of ineffective animals was handicapped during active operations on account of the shortage of replacements necessary to keep up the animal strength of organizations. There-

fore, any benefit which would have been derived from prompt veterinary treatment was lost. The loss of a great many animals was due to this cause. The holding of ineffective animals within combatant organizations also hindered the mobility and efficiency of organizations operating on the front line. Not until after the Armistice was signed did these units evacuate incapacitated animals. Sick animals which had been retained in divisions longer than necessary, were thus suddenly thrown upon the Veterinary Corps for evacuation and treatment, and congested the hospitals.

SECTION IV.

HOSPITALS.

(Chart 6, Chapter XXIII, Vol. I.)

1. No separate veterinary hospitals were established during 1917. The first hospital was located at Neufchâteau and was taken over from the French Army. It was commanded by a cavalry officer and Major Louis A. Merillat was assigned as veterinary advisor. At the time (August 29, 1918), the Veterinary Service was returned to the Medical Department, there were in operation eleven hospitals, with a total capacity of 11,580 patients. The total animal capacity of hospitals on November 1, 1918, was 12,000, and, as there were 14,861 patients on sick report, this was inadequate and it became necessary to accommodate many patients on picket lines, in corrals, or with organizations.

2. A determined effort was made to locate new hospital sites and have more labor troops assigned for duty. This was eventually accomplished and on March 1, 1919, there were in operation, 20 hospitals with a capacity of 26,664 animals.

3. The location of the principal veterinary hospitals, with their approximate capacity during the operations, was as follows:

Location.	Animal capacity.
St. Nazaire	3,000
Coetquidan	2,160
Carbon Blanc	950
Camp de Souge	1,000
Gièvres	2,000
Nevers	1,000
Neuilly-l'Evêque	1,200
Triconville	1,350
Treveray	1,000
Valdahon	1,300
Jeanne d'Arc	1,000
Neufchâteau	1,700
Claye-Souilly	1,200
Bourbonne-les-Bains	1,250
Commercy	750
Lux	700
Longuyon	1,200
Verdun	2,000
Vionville	300

SECTION V.

STATISTICAL DATA.

1. The following table shows the number of animals and sources from which received by the United States Army in the A. E. F.

Horses.		Mules.		Total.	Source.
Cavalry.	Draft.	Draft.	Pack.		
5,938	32,835	28,399	533	67,725	United States.
21,450	105,472	3,955	5,037	135,914	France.
3,408	11,057	6,436	358	21,259	England.
1,400	423	13,347	3,292	18,462	Spain.
Total in Expeditionary Forces				243,360	

2. Total died	58,958
Sold to butchers	10,967
Condemned and sold to French Government	5,149
Sold at auction and private sales	113,098
In hands of French Government for sale	15,081
Unreported losses	5,780
	209,033

3. *Medical Department Statistics:* Grand totals taken from weekly statistical report on Form 102, M. D., dated August 8, 1919.

Admitted to sick report	317,690
Returned to duty	197,873
Transferred sick	71,043
Died	17,585
Destroyed	10,198
Otherwise disposed of	20,605
Mange	105,019
Influenza	21,135
Pneumonia	2,079
Epizootic lymphangitis	549
Epizootic cellulitis	885
4. Mallein tested, glanders	948,065
Mallein retests	9,122
Destroyed as glandered	2,721

5. On June 28, 1919, there were 34,327 animals in France belonging to the Expeditionary Forces. This total was further reduced by sales and losses, so that on January 12, 1920, there were on hand in A. E. F., Germany, 2,104; total losses and missing corrected to August 31, 1919, 63,369. These losses from deaths and missing show approximately 25 per cent of all animals supplied in the A. E. F.

SECTION VI.

MEAT INSPECTION.

In the Third Army, the divisional meat inspectors were placed on duty at railheads and inspected and supervised the inspection of meats and meat food products to organizations. Some of these inspectors included the inspection of forage in their activities. Owing to the lack of development of the meat inspection service, the reports were perfunctory. Division veterinarians reported that all meats received at railheads were inspected, but there are no statistics to show what was actually done. The following figures, taken from the report of one division, show the amount of meats and meat food products and forage inspected by a division meat inspector. From January 3, to June 16, 1919, the following supplies were inspected by a veterinary meat and dairy inspector, in one of our divisions, and the following condemnations were reported by him.

	Pounds.
Beef	2,048
Bacon	107
Hay	264,119
Oats	2,901

There is no record which shows the total amount inspected.

SECTION VII.

ANIMAL DISEASES.

1. The most important equine diseases encountered in the A. E. F. were: Mange, influenza and strangles, gangrenous dermatitis and glanders. The most common non-contagious diseases were debility and digestive disorders, such as colic, chronic indigestion, etc.

Mange.—The records in the office of the Chief Veterinarian show that on February 15, 1919, animal sickness reached its highest peak. On this date there were 48,975 animals on sick report. Of this number, 30,756 were suffering from mange. As this was about 16 per cent of all animals with the A. E. F., suffering from mange, the gravity of the situation was apparent, and energetic remedial measures were taken, as a result of which, the number of cases rapidly diminished. The records show that on March 1, 1919, there were very few active cases to be found among the animals of the A. E. F.

Various methods of treatment of mange were used and proved effective. The sulphur gas chambers were used by the First Army, while the Second Army used dipping vats, containing lime and sulphur solution. The records indicated that the lime and sulphur

solution was the most satisfactory, whether used in dipping vats, or by hand.

Influenza and strangles (shipping fever).—During the early operation of the American forces in France, shipping fever took heavy toll on animals. That this condition was inevitable can readily be seen, when it is considered the veterinary hospitals were placed in remount depots and the sick could not be separated from the well. Personnel handling well animals were also required to care for the sick.

At times green remounts were purchased from the civilian population and sent to combatant organizations. These animals were given no preliminary training and were not hardened, or acclimated for active service. As a natural result, many animals perished from shipping fever or its complications. Those which did recover were in such a weak and emaciated condition that they were of little value for field service, when shipped to the front. The available records show that many of these animals were evacuated back to the S. O. S., at the first opportunity without having performed any work.

Gangrenous dermatitis.—The cause of gangrenous dermatitis was known to be present in the soil of the fighting area in France, and when it is considered the standing and roads were usually in a muddy and contaminated condition, it can be easily understood why many cases of quittor, canker, pododermatitis, etc., eventually developed into gangrenous dermatitis. No records are available to show the number of cases classified under locomotory diseases. If such records were available, however, they would show a large percentage of deaths and disabilities due to this disease.

Glanders.—Glanders made its appearance among the animals of the Expeditionary Forces shortly after our entrance into the war. It was, however, not until the summer of 1918, that this disease became an important factor among the diseases present. When the animals with the Expeditionary Forces passed the one hundred thousand mark, glanders began to crop out unexpectedly in the divisional organizations, and especially in the veterinary hospitals where sick and injured were congregated. Early in the war, the opthalmic test was relied upon, but as the British and French were using the intrapalpebral Mallein test, it was adopted by us, both in the Expeditionary Forces and in America. This test proved reliable and usually satisfactory. In addition, the complement-fixation and agglutination tests were used. After the Veterinary Service was taken over by the Medical Department, instructions were issued to test all animals of the Expeditionary Forces at least once a month. This was carried out as near as possible under existing conditions, and was the means of checking the glanders outbreak, and eventually eradicating it.

The average weekly report on glanders showed six cases per week up to November 23, 1918. At this time there was a sudden rise to thirty-four cases. The cause of this sudden rise was investigated by the Chief Veterinarian, and immediate instructions were sent out to all veterinary officers regarding the uniform method of administering the Mallein and Reading tests. Veterinary officers thoroughly familiar with the tests, were sent to all organizations where they demonstrated the practical application of the test to all veterinary officers. On November 7, 1919, the Chief Veterinarian called a conference at St. Nazarie. All veterinary officers commanding veterinary hospitals, were present at this conference. The subjects of testing and methods of control were discussed, and results published in the form of a bulletin, No. 16, G. H. Q., dated February 25, 1919. Following the conference, the number of cases reported immediately increased and for the week ending January 18, 1919, there were 391 cases reported. From that date on, the decrease weekly was very rapid. On April 19, 1919, the glanders situation was considered well in hand and no further trouble was encountered from that source. The total number of cases destroyed from glanders was 2,721, or 1 per cent of all the animals supplied to the A. E. F. This percentage is very small when the difficulties confronting our service is taken into consideration.

Noninfectious diseases.—Of all the noninfectious diseases reported in the Expeditionary Forces, debility takes first place. Under this heading are grouped all such cases as starvation, neglect, overwork, abuse, etc. Many of the cases were indirectly traced to the after-effects of influenza, shipping fever and mange. Lack of condition of remounts furnished the troops at the front also contributed its share of debility cases. Of the animal losses suffered during the war, debility undoubtedly furnished a large per cent. of the animal losses, either directly or indirectly.

Digestive disorders.—Digestive disorders were quite common, especially at the front. This was due in most cases to using poor forage, irregular feeding, etc. It is believed the number of these cases was not excessive considering the conditions under which the animals worked.

CHAPTER XXIII.

SECTION I.

WATER SUPPLY (BRITISH).

GENERAL.

The most important and urgent service devolving on the Works Directorate, in connection with the numerous establishments on the lines of communication, was the provision of an abundant and pure supply of drinking water for men and, in remount depots and veterinary hospitals, of an adequate supply of water for the horses.

The normal scale adopted was ten gallons a day per man for all purposes, drinking, cooking, and ablution; and ten gallons a day per horse or mule.

In some hospitals, on occasions, the consumption exceeded ten gallons a head but, with the exercise of a little care, that quantity should be sufficient. In infantry camps with men in huts, the ration may be reduced to seven gallons, and with men in tents to six or even five gallons, but it is preferable to allow ten gallons a head. As a rule it was possible to combine the drinking water and ablution water supply, or the supply of water for horses, with that of the personnel. This procedure had the great advantage of doing away with a second distribution system, but in some cases the supply of potable water was limited and ablution water, or the drinking water for horses, had to come from some other source.

Wherever feasible, full advantage was taken of existing town supplies, and agreements were made with local water companies regulating the quantity of water that could be furnished and the price per cubic meter (1,000 liters).

In such cases the Royal Engineers would, with the consent of the local authorities or company, tap the mains and lay their own mains, as well as the distribution system in the camps or other establishments laying on water lines to cook houses, bath houses, ablution rooms, and to stand pipes; putting up storage tanks and fixing taps, shower baths, bath houses, hot water apparatus, etc.

Where the pressure in the mains was not sufficient to carry the water up to the site of the camps, hospitals, or other establishments, special pumping installations were put in by the Royal Engineers, pumping to H. L. tanks conveniently situated whence the gravity distribution system was taken off.

This was, for instance, the case at Rouen for the camps area; at Boulogne for Henriville, Ostrohove and St. Martin's camps; at Etaples for the upper hospitals and convalescent camps.

A great many wells were sunk and pumping plants installed by the Royal Engineers and in certain places, as at Aubengue, Wimereux and Outreau, at Boulogne, deep bore wells were sunk or existing ones hired, and air lift pumps installed; lifting the water into a surface reservoir by some kind of power pump. These air lift plants would raise to the surface 4,000 gallons an hour.

Water was also obtained from natural ponds or springs, as near Mont St. Frieux, for the Camiers hospitals and the establishments at Dannes, or from a river or from existing wells, under agreement with the owners.

The pumps installed on the lines of communications were of great variety; they were at first obtained direct from the War Office, through "F. W. 5," on demand by the Senior Works Officer of the district acting on the advice of his District Officer, Electrical Mechanical Service.

In 1917, however, the Engineer-in-Chief took over control of the issue of pumps, and demands had to be submitted through the Director of Works to him.

The pumps chiefly used on the lines of communications were petrol (gasoline) driven ram or centrifugal pumps; or steam pumps, of which the one most used, and which proved very reliable, was the Worthington duplex steam, with duty of 4,500 gallons per hour against 350 feet head.

The capacities of petrol and oil pumps were chiefly: 2,700 gallons per hour against 250 feet head; 3,000 gallons per hour against 250 feet head; 3,500 gallons per hour against 300 feet head; 4,000 gallons per hour against 350 feet head; 6,000 gallons per hour against 300 feet head. Also Hayward and Tyler pumps, with Campbell engine (Ordnance supply), 3,000 gallons per hour against 600 feet head. A few large capacity centrifugal pumps of low lifting power (say 60 feet) were installed for drainage purposes.

The tanks used for storage purposes or as H. L. reservoirs, were 100 gallons, 200 gallons, 400 gallons, 1,000 gallons, 1,600 gallons, galvanized iron and also sectional 7,200 gallon tanks. The 1,000 gallon and 1,600 gallon tanks were often grouped and placed on a built-up wooden tower from 12 to 20 feet above ground.

A few large water towers were constructed. At Rouen, Messrs. Piggott, under contract, built a large steel plate sectional reservoir, in two parts, to hold 100,000 gallons each, on a steel tower 50 feet high.

At Audruicq a water tower 36 feet high was designed and constructed of timber by the D. O. R. C., to carry three 12,000 gallon tanks.

Pipes were chiefly wrought iron, socket and screw joint pipes, at first ordered direct from War Office by Senior Works officers of districts, and later on supplied partly from army stocks and partly from L. of C. stocks kept by Deputy Directors Works (D. D. Ws).

Army stock sizes were 4-inch, 2-inch and 1-inch.

L. of C. sizes were 6-inch, 3-inch, 1½-inch, ¾-inch.

In a few cases cast iron pipes were made use of, spigots and socket joined in lead, or lead wool.

In some depots extensive fire protection systems were laid, consisting generally of a 6-inch ring main with 4-inch branches, kept filled by elevated water tanks and into which a large capacity pump pumped directly on fire breaking out.

Such pumps were a "Shand Mason" steam pump with water tube boiler, capable of working up to 40,000 gallons per hour against a head of 500 feet, and "Boving" steam pumps of capacity, 12,000 gallons per hour against 500 feet head.

These pumps were installed by the Royal Engineers, who laid down the pipes and provided and fixed hydrants, valves, relief valves, etc.

CHAPTER XXIII.

SECTION II.

WATER SUPPLY SERVICE OF THE ARMIES (FRENCH).

I. FUNCTION OF THE WATER SUPPLY SERVICE.

During the war, the concentration of large numbers of men and animals needed for operations in a sometimes very restricted zone, necessitated the application of special measures for the establishment and upkeep of water supply stations and watering troughs in the camps and cantonments, as well for the supply of the drinking water for the combatant troops. This was the function of the Water Supply Service.

II. ORGANIZATION OF THE SERVICE.

The Water Supply Service (Service des Eaux), an outgrowth of the war, was specially organized to supply the needs of the Army.

Of little consequence at the beginning of the campaign and during the period of open warfare, its functions became more and more important as a result of the continuance of operations along a stabilized front and on account of the increase in man-power.

In 1915, an "Inspection of the Water Supply Service" (Inspection du Service des Eaux) was established at General Headquarters (Direction of the Rear—D. A.). This organization was the technical directing agency for the chiefs of the water supply services of each army.

In January 1917, when the army 4th Sections (4èmes Bureaux d'Armées) were established, the water supply services of each army were attached to the 4th Section (Supply Section) of the army to which it was assigned. The chief of the water supply services was kept informed as to the number of troops to be supplied in each locality or emplacement, and assured the establishment of the necessary installations for the supply of the army's requirements.

Requests from the Directions of the Lines of Communication (Directions d'Etapes—D. E.) for the installation in their zones of water supply facilities were sent to the 4th Section (Bureau) of the army group, which caused the establishment of such installations by the chief of the water supply service of one of the armies belonging to the army group.

Orders No. 800 D. A., of September 20th, 1917, placed the Water Supply Service of the Army under the orders of the General Commanding the Engineers of the Army.

The Chief of the Water Supply Service of the Army commanded his own units and such other agencies as were assigned to him by the Commander in Chief (D. A.). In technical matters, he was in direct contact with the Inspector of the Water Supply Service at General Headquarters.

III. FUNCTIONING OF THE SERVICE.

The Water Supply Service had special means of operation at its disposal:

1. *Water Supply Service Companies* (Cies. S. E.), composed of specially trained men from the older classes or of men released conditionally from service (en sursis). The strength of these companies increased progressively up to 400 men. In 1918, there were thirteen "Water Supply Service" companies in the armies (a total of 5,200 specialists).

2. *Special matériel*, pumps, motor-pumps, conduits, which were supplied by the depots of the interior (particularly Angoulême). The Commander in Chief established a "dépôt-annex" for this matériel in the Zone of the Armies (Nangis, and later Mignières-Gondreville), through which he supplied the requirements of the armies.

3. *Motor tank cars*, for the transportation of drinking water.

The Water Supply Service took various measures during the war to assure the supply of drinking water to the troops. These can be summarized as follows:

a) Water installations at the camps and cantonments (installation of pumps commensurate with the water supply requirements of the cantonment; construction of water troughs and showers, etc.).

b) Water installations in the offensive sectors (during the preparation for, or the execution of, major operations affecting large numbers of troops), soundings for underground water deposits, establishment of water stations, construction of systems of conduits, water supply of evacuation hospitals.

Owing to the lack of matériel it was not always possible to install all the necessary conduit systems and to bring these up to the trenches themselves, (although this result was generally accomplished by the water supply services of the British Army).

c) Supply of drinking water to the troops in action by means of motor-tank cars brought up as close as possible to the front, or by means of large zinc reservoirs (model so-called "milk pitchers") which were carried by pack animals (donkeys or mules).

d) Filtration of water and, especially, sterilization by "javel water" (hypo-chloride).

All of these measures contributed greatly to the general health of the troops.

CHAPTER XXIII.

SECTION III.

WATER SUPPLY SERVICE (ITALIAN).

GENERAL.

One of the most difficult, as well as one of the most important, problems which confronted the Italian Army during the war was the provision of drinking water for the troops.

The principal obstacles to be overcome were: The absolute lack or the scarcity of springs in certain of the important army zones, and the presence of springs or wells whose waters were absolutely undrinkable, presenting a source of danger for troops suffering from thirst.

These conditions required the organization of an extensive and complicated service, which grew in proportion to the increase in size of the armies engaged.

ORGANIZATION OF THE WATER SUPPLY SERVICE.

(Chart 1, Chapter XXIV, Volume I.)

At the beginning of the war the troops in the trenches obtained their drinking water by ordinary means, i. e.: by drawing it from the wells or springs which already existed.

In the course of time, the Engineer detachments assigned to the first line units constructed a small number of hydraulic plants and reservoirs with the limited resources at their disposal. Later, a Water Supply Service was organized, which employed a number of specialists. This personnel, together with suitable water supply officers, were placed at the disposal of the armies and charged with the development of water supply installations for the armies in the first line. In addition, chemical-bacteriological laboratories were attached thereto for the examination and purification of the water supply.

The Water Supply Service was organized as follows:

Each of the armies in the field was assigned a number of water supply platoons (generally from four to six), of varying strength according to requirements, and storehouses for water supply material, such as accessories and spare parts for machines or motors, pumps, tubes, etc.

Each of these water supply platoons was assigned a zone of operations.

A water supply office was organized in each of the military Engineer commands and provided with a shop for the repair of the material and a chemical-bacteriological laboratory. Theoretically, the water supply offices of the armies were under the headquarters of the Engineers at the "Supreme Command" (Comando Supremo).

Engineer headquarters examined and approved the plans for the more important water supply installations and, when these plants served more than one army, it coordinated their operation. The Engineers, through the special depot for hydraulic material and the water supply establishment located at Milan, also supplied the necessary equipment and materials and allocated them among the various armies.

The commands of the military Engineers provided for and controlled the water supply of the armies through their water supply offices. The water supply offices made studies, directed the construction and supervised the maintenance of the hydraulic plants; they obtained the necessary personnel and material for this purpose through requests upon the headquarters of the military Engineers. These offices also operated the laboratories, repaired the material, and distributed the hydraulic supplies to the storehouses of the water supply platoons.

The water supply platoons made a special study of plans for new hydraulic establishments, or for the modification of existing plants, and were responsible for the operation and upkeep of the water supply installations within their respective zones.

DEVELOPMENT AND OPERATION OF THE SERVICE

The Water Supply Service supplied water not only for the troops, but also in large measure (about 60 per cent) for watering the animals. It provided for the construction of reservoirs, the watering of the roads and the construction of plants to supply water for the bathing establishments of the troops. This service gradually assumed a considerable importance, particularly within the armies operating in zones which were poorly supplied with water resources.

Water from artesian wells (freatici), springs, and natural wells was generally pumped to the distribution or reserve reservoirs by means of electric pumps or gas engines (motori a scoppio) through suitable aqueducts, which were laid underground whenever possible. The springs or other sources of water, together with the groups of elevating pumps, were called "main reservoirs."

The transport of the water from the principal supply points to the units was effected by means of motor tank-cars, motor trucks, animal drawn transportation, in skins (ghirbe) carried on pack saddles or in containers carried on men's shoulders. At the main watering points level earthen platforms (piazzali) or loading

places, capable of holding a number of motor trucks, were constructed in order to handle the motor transport traffic, as well as the movement of men and animals engaged in the transportation of water.

The choice of locations for the establishment of main reservoirs was only made after a thorough examination, from a geological and hydrological standpoint, of the region under consideration.

The determination of the springs which were to be used was based on the physical, biological, and chemical studies carried out in the laboratories of the armies.

The Water Supply Service, in conjunction with the medical services of the various army corps, maintained surveillance over the water suply points, near the distribution valves, and over the water supply depots of the first line.

TECHNICAL MATERIAL EMPLOYED.

Great care was exercised in the choice of material employed, particularly that for use in the aqueducts or conductors. Cast-iron pipes were rejected because of their inability to resist pressure, their excessive weight, rigidity, etc., all of which rendered them unsuitable for use in the particular terrain where the hydraulic plants were to be erected.

Preference was given to unsoldered steel pipes, which were durable, flexible, of great resistance, light and well adapted for use in the region where they were to be employed; moreover, they could be easily placed into position. Whenever steel pipes were used they were given a double protection: the interior was coated with hot tar and the exterior was covered with a layer of tar and a layer of asphalted jute, also applied hot.

The aqueducts (pipe lines) and their connections were laid underground whenever possible, in order to protect them against gun fire and frost. In rocky terrain where it was impossible to excavate, the conduits were placed above ground and were protected by raised coverings consisting of rough dry walls, about 40 centimeters wide and from 60 to 70 centimeters high, composed of earth or a mixture of earth and gravel.

During the early part of the war the hydraulic pumps were operated by either petroleum or benzine engines; these were subsequently replaced by electric motors.

PURIFICATION OF THE WATER.

While arrangements were being made to increase the supply of water, steps were also taken to purify the water supply by chemical means. This was necessary on account of the presence of germs in

many of the springs. Water was purified and rendered fit for drinking purposes by the use of either chloride of lime or pure chlorine.

The chloride of lime method was used to purify water from the aqueducts or that obtained from wells, cisterns, or water courses. It consisted of the addition of certain proportions of chloride of lime to the water. The aqueducts in existence before the war were also subjected to a special chemical treatment.

Field posts were established by the army laboratories, and provided with special apparatus for the purification of the water obtained from wells, cisterns, and canals (canali). At these posts, the water was analyzed before treatment, the necessary proportions of chloride of lime were determined and added to the water, and a final analysis made after treatment. A field post had a capacity of about 20,000 liters of water per hour.

The pure chlorine method was adopted for use in connection with the mobile field hydraulic plants mounted on motor trucks and was based upon the "Wallace and Tiernan" process. On the Italian front, two types of mobile water supply units were employed; one with a capacity of 900 to 1,800 liters per hour and the other with a capacity of 5,500 liters per hour. The army chemical-bacteriological laboratories were responsible for the purification of the drinking water.

WATER SUPPLY DIFFICULTIES.

The Italian Water Supply Service had to surmount enormous difficulties. The principal one was the lack of springs or wells and the consequent difficulty of obtaining the necessary water requirements for the tremendous number of troops engaged.

From the water supply standpoint, the most difficult regions were the Carso and the "Altipiani dei Sette Communi". The Carso is a vast table land, stony, arid and desolate, and is composed of chalky soil of varying geological formation which has been corroded and eroded by meteoric elements. In this region rain water and the rare water courses lose themselves in the sub-soil, presenting what is known as "Carsic" ("Carsici") phenomena, from which the plateau derives its name: Carso. Under such conditions, it was natural that the water supply would be scarce and the task devolving upon the Water Supply Service became a continuous, but victorious, struggle against adverse natural conditions.

Similar obstacles had to be overcome in the region of the "Altipiani dei Sette Communi" where the sub-soil presents, although to a minor degree, the same "carsic" conditions which have been described above, with a resultant scarcity of surface water and springs. At the outbreak of the war the few aqueducts existing in the "Alti-

piani" regions were enlarged to provide for the needs of the troops operating in that zone.

The retreat of the Italian troops in May 1916, resulted in the loss of numerous hydraulic mains and water sources which would have served to feed new water supply installations. On the other hand, the large number of troops employed to stem the tide of invasion caused the water supply requirements to attain unforeseen proportions.

To supply these troops (estimated at 100,000 men, assembled in a zone of not more than 1,000 square kilometers) it was necessary to bring up water from the plain region to this section by means of motor tank cars. An idea of the difficulty of this supply may be gained when it is considered that, daily, from 1,200 to 1,900 liters of water, obtained from the aqueducts of Marostica, had to be transported not less than 30 kilometers, to an average height of 1,000 meters above sea level, and that this service required the employment, on an average, of 400 motor trucks per day.

STATISTICS.

Below are indicated the more important aqueducts constructed in the various zones:

1st. Army (Zone between Lake Garda and the Astico River).—Eight principal aqueducts, with an average development of 160 kilometers and at a maximum height of 1,400 meters above sea level.

For these aqueducts, double, triple, and quadruple pumps were employed with electric, gasoline, or heavy oil engines, and they were provided with from 500 to 1,500 meters of pipes, from 50 mm. to 70 mm. in size.

6th. Army (Zone of the "Altipiani dei Sette Communi").—Thirty-seven aqueducts, with an average development of 190 kilometers and at a maximum height of 1,100 meters above sea level.

3rd. Army (Zone of the Carso).—Two principal aqueducts, with an average development of about 140 kilometers and at a maximum height of 500 meters above sea level.

The pumps were operated by 750 horsepower engines (average) and carried 460,000 liters of water per hour from the main reservoirs.

3rd. Army (Zone of the Piave).—Eight principal aqueducts, with an average development of 90 kilometers and at an average height of 50 meters above sea level.

Supplied 1,000,000 liters of water per day.

4th. Army (Zone between Brenta and the Piave—Mount Grappa).—Five principal aqueducts, with an average development of about 90 kilometers and at an average height of 1,000 meters above sea level.

Average capacity of 1,200,000 liters per day.

CHAPTER XXIII.

SECTION IV.

WATER SUPPLY SERVICE (AMERICAN).[1]

ORGANIZATION.

Water supply activities in the American Expeditionary Forces were divided into three groups: (1) Water supply work for the armies; (2) water supply work for the Services of Supply; (3) supply of material for water supply, both for armies and Services of Supply. It was obvious that in the beginning the water supply work of the Services of Supply would constitute by far the larger volume of work. Active work in the field for the water supply service of the armies would commence only when the armies came into being.

A division of functions was made along the lines above indicated. Water supply for the armies and certain functions relating to supply of materials and equipment were handled in the office of the Chief Engineer, American E. F., while water supply in the Services of Supply was assigned to the office of the Chief Engineer, Line of Communications (later Director of Construction and Forestry).

A Water Supply Section was therefore formed in the office of the Chief Engineer, American E. F., charged with the responsibility of investigating the water supply of the Allied Armies, of inquiring into water supply needs for the American Army, of outlining a suitable organization and procedure to be followed, of indicating needs in the way of personnel and material, and in fact, of covering all lines of necessary activity related to water supply of the armies.

In July 1918, the Water Supply Section of the Chief Engineer's office became a part of the office of the Director of Military Engineering and Engineer Supplies. That office, however, was located at headquarters, Service of Supply, too far from the front for the efficient handling of military engineering in the armies, and as a consequence a branch of the Chief Engineer's office at General Headquarters was strengthened, and eventually the functions of military engineering came to be handled by that office, and less and less from

[1] Abstracted and compiled by the American Section, M. B. A. S., from Historical Report, Chief of Engineers, American Expeditionary Forces, and Report of the Director of Construction and Forestry to Commanding General, Services of Supply.

the office of the Division of Military Engineering and Engineer supplies at headquarters, Services of Supply.

CONTROL OF QUALITY OF WATER.

One of the most important questions in the determination of a policy regarding water supply work involved the division of duties between the Engineer Department and the Medical Department with respect to control of the quality of water supplies. Representatives of the two departments discussed this matter, and after concurrent approval by the Chief Engineer and the Chief Surgeon, General Orders No. 34, General Headquarters, 1918, was issued, and was later modified by General Orders No. 131, General Headquarters, 1918. These general orders charged the water supply organization with the responsibility of making available at water points adequate quantities of water in as pure a state as practicable, using filtration, disinfection, or both. Officers of the Medical Corps attached to tactical units were charged with the duty of such subsequent disinfection in Lyster bags, water wagons, tanks or reservoirs, as the water might require.

To control the quality of water a laboratory division was established, with headquarters at Paris. When headquarters, Services of Supply, were moved to Tours a branch laboratory was established there and other water supply laboratories were subsequently placed in operation, either as parts of Medical Department laboratories or as independent laboratories under the Water Supply Section, at the following points: St. Nazaire, Bordeaux, La Rochelle, Dijon, Neufchâteau, Brest, Nevers, Le Mans, and London. Several mobile laboratories were established in the army zone. The personnel for the laboratory branch of the water-supply section was obtained partly from the Engineer Department and partly from the Sanitary Corps of the Medical Department, as officers and soldiers having the required special training and experience were found in both departments.

DECISION AS TO QUANTITY OF WATER.

The Water Supply Section, office of Chief Engineer, American E. F., aided by the data furnished by the Water Supply and Sewerage Section, Chief Engineer, Line of Communications, obtained at this time a decision of the General Staff allowing twenty-five gallons per capita in hospitals and ten gallons per capita in other places. These figures were understood to be a maximum which could not in all cases be supplied. In the summer of 1918, it was recommended by the Water Supply Section, Services of Supply, and approved by the General Staff, Services of Supply, to cut the allowance for hospitals

to twelve gallons per capita where there were no central laundries and fourteen gallons per capita where laundries were to be installed.

The decision generally to eliminate water-borne sewerage made the problem of purification one of treating sink and shower-bath waste water containing considerable quantities of soap to the extent necessary to permit its discharge into streams. The treatment chosen was that of sedimentation for several hours and straining through straw screens. In some cases the effluent was sterilized by liquid chlorine.

GENERAL STANDARDS.

The first problems concerning the Water Supply and Sewerage Section in the Services of Supply were the determination of standards for the quantity of water to be supplied and for methods of disposing of sewage. The question of sewage disposal was first brought to a definite point in a discussion with the Medical Department of methods to be used for the six 1,000-bed units to be added to the hospital at Bazoilles.

The scarcity of material, together with the extra amount of labor involved in installation, the extra quantity of water required for flushing, and the facilities required to purify the sewage before discharging it into French streams, caused the Water Supply and Sewerage Section to recommend the use of incinerators for human excreta. This decision was accepted by the Medical Department for hospitals and was also put into effect for the other American E. F. works, exception being made in a few cases where water-borne sewerage systems already existed, and also in some cases near the ocean where mixed sewerage could be discharged into tidewater without purification.

SUPPLY OF MATERIALS.

At the very outset, in preparation for the water supply work in the American E. F., it was recognized that the service would stand or fall on the question of supply of materials. The first project undertaken in the American E. F., such as the development of base ports, the construction of camps and of hospitals, required the development of water supply systems.

A requisition for water supply material of all sorts was developed at the War Department during the summer of 1917, which resulted later in the delivery in France of large quantities of useful equipment and supplies.

This requisition was based upon a far-sighted statement, given by the chief of the French "Service des Eaux," of the requirements of water supply materials for the armies. The French statement was expanded in Washington, conforming to the Ameri-

can market and to the ideas of the water supply officers who had taken up the work.

In the fall and early winter of 1917, or as soon as personnel became available, a systematic and comprehensive study of the prospective needs of material of every kind for the Water Supply Service was undertaken. In this study, as throughout the history of the water supply work in the American E. F., the Water Supply Section of the office of the Chief Engineer, American E. F. (later Water Supply Section, Division of Military Engineering and Engineer supplies), and the Water Supply Section of the office of the Chief Engineer, Line of Communications (later Water Supply Section, Division of Construction and Forestry of the S. O. S.), continuously and closely co-operated.

WATER SUPPLY SERVICE IN THE SERVICES OF SUPPLY.

In many French municipalities and at hundreds of other places throughout the Services of Supply, which served as sites for hospitals, camps, depots and shops—in fact wherever there was a concentration of American troops—it became necessary for the Engineer Department to supply water. This obligation resulted in the creation of a Water Supply Section, as a part of the organization of the office of the Chief Engineer, Line of Communications, and later of the Director of Construction and Forestry. When the Armistice was signed water supply installations had been made, ranging from simple wells to city projects, including dams, pumping plants, pipe lines, reservoirs, filtration plants, and other accessories demanded by the best engineering practice. On all of the chief projects in the Services of Supply, water supply was one of the prime requisites.

During the latter part of August, 1917, the Water Supply Section, Line of Communications, in France, began its work with an inspection and listing of materials required for the Bazoilles hospital which had just been taken over from the French in an unfinished condition. This work was followed by a general investigation of the supplies for American troops in the vicinity of Bordeaux, La Rochelle, and Saint Nazaire, and the artillery camps at Souge, Meucon and Coetquidan.

In October, 1917, a Water Supply Section was more definitely established under the Chief Engineer, Line of Communications. Its personnel was gradually increased until in June 1918, there were fourteen officers and seven men. The system up to that time was a centralized one, so far as making the investigations, drawings, and requisitions were concerned. Plans were sent to Engineer officers in charge of construction for execution. There were, how-

ever, many smaller water-works which were planned by the construction forces in the field. Beginning about June 1st, the water supply was largely decentralized, the personnel of the central office being distributed to the various Section Engineers for the purpose of planning as well as executing the works. The central office still maintained a supervising and advisory function and also occupied itself with following up the purchase and shipment of the necessary material and in listing and requisitioning material to maintain depot stock. This activity included also the preparation of tonnage priority statements which were cabled to the United States to govern the shipment of water supply material needed.

FILTER PLANTS.

In general, water was supplied from tube wells, shallow dug wells, or streams, with or without filtration. At St. Nazaire it was necessary to build a rapid-sand filter plant of 3,000,000 gallons daily capacity and another of 1,000,000 gallons daily capacity to supply the ports and the various camps. At Mesves and Mars hospitals rapid-sand filter plants, each of about 500,000 gallons daily capacity, were installed, and at Savenay hospital two plants, each of 330,000 gallons per day. At the Romorantin Air Service plant two filters, each about 200,000 gallons daily capacity, were placed, the first of their type to be built in France. Another rapid-filter plant was at Langres hospital, and a slow-filter plant was built at the hospital at Châteauroux.

At Brest a supply to provide a maximum of 3,000,000 gallons daily was taken from the Penfield River and sterilized but not filtered, since this river is very clear throughout almost the entire year, and a reservoir of about a week's supply, with a by-pass channel, enabled the worst of the turbid water to be sent by without using.

DEEP WELLS.

At Bassens two unusually successful tube wells were sunk, having a capacity respectively of 550 and 580 gallons per minute, delivered water under a 40-foot artesian pressure. These wells had a depth of about 700 feet. At Beau Desert hospital, near Bordeaux, a well 1,520 feet deep was sunk, from which 500 gallons per minute were obtained by pumping. Other wells of smaller capacity, the deepest 1,020 feet, were used in this vicinity and tube wells were also used successfully at Gièvres, Montierchaume, Liffol-le-Grand, Bazoilles hospital, Brest and a number of other localities. The tube well was used whenever possible because it yielded clear water, thus doing

away with a filter plant. Geological studies aided the location of wells. It was found, however, that generalizations as to underground water were only of limited value as the wells at Montierchaume, for example, proved successful in a country which appeared to be very unpromising.

STERILIZATION OF WATER.

A section of the Water Supply Office was organized to have charge of the receiving, storing, erection, and repair of automatic sterilizing machines used for the armies. The largest work of sterilization undertaken by the American E. F. was that of the city of Tours, where about one part per million of chlorine was applied to from 4,000,000 to 5,000,000 gallons daily, requiring the use of about forty pounds of chlorine per day. This application was made under a contract with the city of Tours by which the city agreed to pay the estimated cost of the chlorine, while the United States gave the use of the machines and supervised the operations.

LABORATORY SUPERVISION OF WATER SUPPLY.

Water analysis laboratories for the examination of possible supplies and for the periodic examination of supplies in use were also provided. In general, there was a water analysis laboratory in each section, there being nine in the Services of Supply. In most cases these laboratories were established as branches of a medical laboratory, but were technically responsible to the Engineer Department. In this manner the chlorination of the supplies was controlled.

RAILROAD WATER SUPPLIES.

A special water problem was occasioned by the railroads, not only in connection with new yards and depots, but in augmenting the water supplies along the French railroads which were used by the American E. F. In some cases water could be supplied in connection with that furnished for other purposes, but in many cases there were needed separate installations, pumping from a river or well to existing French tanks or to new 50,000-gallon American railroad tanks, from which the water was distributed either through the existing French mains and railroad standpipes or through new 1-inch steel mains and American standpipes. A large program requiring hundreds of tanks, pumps and standpipes was under way at the time of the Armistice. Only about 30 new tanks and 75 new standpipes were put into use, although a number of additional roadside water stations belonging to the French railroads were reinforced by the addition of pumps or force mains, or both. This work was handled

through the office of the Water Supply Section in conjunction with the Water Supply Engineer of the Transportation Corps, who determined the quantity of water required and the places at which tanks and standpipes were needed.

ST. NAZAIRE WATER SUPPLY.

The water supply for the city of St. Nazaire offered so many difficulties that it constituted by far the biggest problem. The city obtained its supply of about 1,000,000 gallons a day from two watersheds, having a combined area of about 4 square miles, with storage of about 160,000,000 gallons. In dry seasons this supply was reinforced by water brought in boats from a point about 15 miles up the Loire River. This country does not yield deep well water, as it is underlaid with granitic rock. The nearest additional surface water free from salinity is at a distance of about 15 miles.

The St. Nazaire work involved the installation of 15 pumps, with a total capacity of 30,000,000 gallons daily. About 48,000 feet of 24 to 12 inch pipe, 60,000 feet of 8 to 4 inch pipe, and elevated tanks of 200,000-gallon capacity were used in the supply and main distribution system alone.

MISCELLANEOUS WATER SUPPLY WORK.

Practically all the other large projects required water supply installations of considerable magnitude, a few of which may be mentioned as of interest. For the Savenay hospital water supply a concrete arch dam 40 feet high and containing over 6,000 cubic yards of concrete, to provide a reservoir storage capacity of 100,000,000 gallons, was constructed in addition to two filter plants, each of 330,000 gallons daily capacity. Some 25,000 feet of sewer lines and 50,000 feet of water mains were laid and a concrete standpipe of 50,000 gallons capacity was installed.

For the Mars hospital supply a 10-inch force main, 5 miles long, was laid. A reinforced concrete reservoir of 100,000 gallons on towers 30 feet high were constructed. Two pumping stations, each of 500,000 gallons per day, were erected.

For the Mesves Hospital an installation practically duplication of that of Mars was made. At both Allery and Beaume hospitals some 57,000 feet of sewer pipe and 40,000 feet of water mains were laid.

The installations at Montierchaume storage involved the laying of some 30,000 feet of 4-inch, 6-inch, and 8-inch pipe; pumping stations of a capacity of 100 horsepower; the drilling of wells of a total depth of 1,700 feet; and the construction of elevated tanks of a total capacity of 150,000 gallons. The general intermediate storage

depot at Gièvres called for even a larger installation than that at Montierchaume.

PURCHASE OF MATERIAL IN FRANCE.

Much of the activity of the Water Supply Section was in connection with the location, requisitioning, and following up of deliveries of pipe, fittings, pumps, engines, motors, and other special material found in France and required on account of the slow deliveries from the United States. In this way practically the whole of the material for the St. Nazaire water supply was secured, as well as more than half of all the pumping machinery of any considerable size for the whole work of the Services of Supply.

FIRE PROTECTION.

(See footnote at the end of this section.)

The desirability of fire protection was recognized at the beginning of the Water Supply Section's work, and estimates were presented periodically as to tonnage required for hydrants and piping. The Water Supply Section took advantage of the possibility of securing 200 miles of 4-inch cast-iron pipe and fittings on prompt delivery from England, to establish the policy for the large hospitals of providing piping capable of carrying fire streams. Hydrants were also provided as fast as they could be obtained. The general question of fire protection was covered by the appointment by the Commanding General, Services of Supply, of a Bureau of Fire Prevention. Plans were made by the bureau for the installation of fire piping, reservoirs, and pumps in connection with many of the water supply systems. However, lack of tonnage and the Armistice prevented most of these installations from being made.

WATER SUPPLY SERVICE WITH THE ARMIES.

Field operations.—The Water Supply Service for army work consisted of certain officers and special Engineer troops experienced in water supply work. These troops operated as army Engineer troops, for it was of fundamental importance to assure the permanence of this special personnel. The functions of the army water supply organizations included the investigation of water resources, the development of water supplies, and the construction and operation of the army zones of such works as were necessary to make water available at water points for troops and animals, including conveniences for filling water-carts, water-tank trains, buckets, canteens, and other containers. Upon tactical units devolved the re-

sponsibility for transporting water from water points to the final point of consumption.

To a large extent the work of supervision of army water supply was done by the officer in charge of the Water Supply Section, under the Division of Military Engineering and Engineer Supplies, office of the Chief Engineer, American Expeditionary Forces.

The establishment of water points for army use involved the provision of piping, pumps, tanks, reservoirs and other facilities. One of the most important items in the program was the supply of water for animals, involving the construction of horse watering points and troughs. To control the quality of drinking water laboratories of two types, fixed and mobile, were employed, the latter being mounted on motor trucks. In addition, water-tank trains and motor trucks equipped with purification apparatus in the form of filters and chlorinators were operated. Light railways were employed whenever available for the transport of water in tank-cars.

The field service of the water supply organization began about February 1, 1918, with reconnaissances including the front of the French Eighth Army from the Moselle River westward to the Côtes de Meuse, and of the French Second Army from Côtes de Meuse, around the Saint Mihiel salient, to Troyon on the Meuse. During this period, American divisions were operating tactically under French corps and the French army water supply services were carrying the water supply responsibility.

The first responsibility of the American Water Supply Service was that of the First United States Corps, on the Toul front, from the middle of May to the middle of June 1918.

From the middle of July 1918, to the middle of August 1918, the Second Army took over the functions of the First Army in the Toul area. About August 1st, water supply troops took over partial water supply responsibility in the divisional area in the neighborhood of Baccarat.

Likewise, about August 1st, the First Army water supply services began to function in areas in the Château-Thierry region occupied by American corps, operating tactically, however, under the French Sixth Army.

About the middle of August, the First and Second Armies' headquarters organizations changed places, and the First Army began its St. Mihiel operation.

When the Third Army was created, two companies of army water supply troops, with certain companies of other special service army Engineer troops, were assigned to form a provisional regiment, and the water supply work of the Third Army was handled by that organization for a time, until it became evident that its services were no longer necessary.

St. Mihiel operations.—In preparation for the Saint Mihiel offensive, water supply installations by the First Army had been made, including seven pumping plants, twelve reservoirs or tanks, and 25,000 feet of piping. In addition, new installations for filling carts and watering animals were made and existing installations improved and enlarged. The facilities provided were sufficient for the troops during concentration.

Following the attack on September 12, water supply troops moved forward to make immediately available captured water installations and to set up canvas reservoirs to receive water hauled forward by motor tank trains. At three points, captured German plants were converted to American use and temporary plants installed. Between the 13th and 19th of September, 250,000 gallons of water were delivered to advance water points by tank trucks. Water was also sent forward by light railway in 2,000-gallon tank cars.

Argonne-Meuse operations.—In preparation for the Argonne-Meuse operations there were installed by the First Army, at eight sites, water points equipped with pumping plants, storage and purification systems, as required by local conditions. The installations were sufficient during the period of concentration. After the attack, water-supply troops followed the advance. In the area of the former "No man's land" there were installed temporarily, 26 hand pumps at springs or wells, 23 canvas tanks, of which 12 were filled from local sources and 11 by water-tank trains; 10 horse-watering points with troughs additional to those found undamaged, 2 watering points prepared at streams and 10 mobile purification truck installations.

Semipermanent and permanent installations in this same area, consisting of power pumps with elevated tanks, piping, facilities for filling water-carts, etc., were made at 23 sites. Gravity installations with storage and facilities for filling carts, canteens, and watering animals were made at seven places.

Following the advance made between November 1st and November 11th, semipermanent and permanent installations included 22 hand pumps at springs or wells, 8 canvas tanks filled by water-tank trains, and 9 horse-watering points. Permanent installations consisting of power pumps with pipe lines to elevated tanks were made at eight places. In addition a number of installations were made by the water supply services for narrow-gauge and standard-gauge locomotives.

Second Army attack.—Preparatory to the attack of the Second Army, November 10th and 11th, the water supply work consisted of the improvement and repair of existing facilities in St. Mihiel and seven other towns. German systems were restored and operated at six places. Two purification plants, each of 50 gallons per minute capacity, consisting of sedimentation basins, rapid sand filters, chlor-

inating devices and clear-water basins, were installed. Railway and cart-filling stations and shower-baths were put in operation.

No actual construction of new points in the advance area was necessary before 11 a. m., November 11th, when operations terminated.

NOTE.—There were in all 130 fires recorded in properties of the Services of Supply, up to January 31, 1919. The losses were small in comparison with the total values of properties threatened, and the total is estimated as between $1,000,000 and $1,250,000. This does not include forest fires. There were only a few fires believed to be of incendiary origin and definite proof was not secured in any case. Most of these were attributed to German prisoners, and no fire is charged to the act of free enemy agents working on a definite plan of destruction. It was difficult to carry on any destructive work in France during the period covered. The local guarding at important stations was generally effective.

LIEUT. RINALDO STROPPA-QUAGLIA

Italian Member of the Board, April, 1919–October, 1919

CHAPTER XXIV.

SECTION I.

THE DIRECTORATE OF ROADS (BRITISH).

Until November, 1916, the road question was one for which the French authorities were responsible, the British assisting with labor and transport. The working of the various French road boards had been centralized in a French road commission with British military representatives for the whole area occupied by the British forces, but by the above date the roads problem had assumed such an importance in the prosecution of the war that other arrangements became necessary both in the interest of the French, upon whom the drain in man-power had become intense, as well as of the British. The formation of the Directorate General of Transportation in December 1916 included an organization composed of officers and men specially trained in road engineering. This organization was called originally the Directorate of Light Railways and Roads, but shortly afterwards the two functions were separated. The Directorate of Roads was responsible for the maintenance of all roads within the British Army area, as well as for the construction of new roads up to a forward limit fixed from time to time in accordance with the circumstances, but which for the purposes of definition may be taken as the furthest limit to which ammunition subpark and supply column vehicles proceeded normally. Beyond this limit, road construction and maintenance rested with the army concerned. The Roads Directorate also gave considerable assistance in the upkeep of roads which were not essentially British but were used more or less by them.

The provision of road material presented many difficulties. At first certain quantities were sent from the United Kingdom and the Channel Islands, but the major part had to be quarried in France. Railway connections to isolated quarries had to be made, more rolling stock allotted, and quarrying companies recruited to supplement French labor. Every attempt was made to open up sources of supply adjacent to the point at which material was required.

In June, 1917, the length of roads maintained was 1,640 miles, and by the Armistice this had increased to 4,412 miles. The operations of the directorate covered eventually:

The whole of northern France from Havre to Dunkerque and from Boulogne to St. Quentin.

The areas in which the Canadian Forestry Corps operated in the neighborhood of Rouen, Orléans and Bordeaux, as far as the northern slopes of the Jura and Vosges mountains.

The Seine Inférieure.

The Independent Air Force district, near Nancy.

The construction work carried out during 1917 and 1918, represented nearly 2,000 miles of roads, and it may be noted that the quantity of road materials used by the Directorate of Roads during this period, exclusive of material supplied to other services, amounted to nearly 5½ millions of tons of roadstone, together with 2½ million sleepers, pit props, etc., the latter being used for the construction of roads across the flat country in the vicinity of St. Omer to provide ways for troops in the event of the military necessity for flooding this area. More than 4,000,000 tons of roadstone were quarried in France during 1917 and 1918, 3,178,883 tons coming from the Marquise quarries. A fairly adequate idea of the significance of the quantity of stone used during these years may be expressed in the statement that it was sufficient to construct a road 18 feet wide with 3 inch surface coat and 9 inch foundation of 1,331 miles in length. The timber supplied for the St. Omer district was sufficient to construct a road 9 feet wide and 374 miles in length.

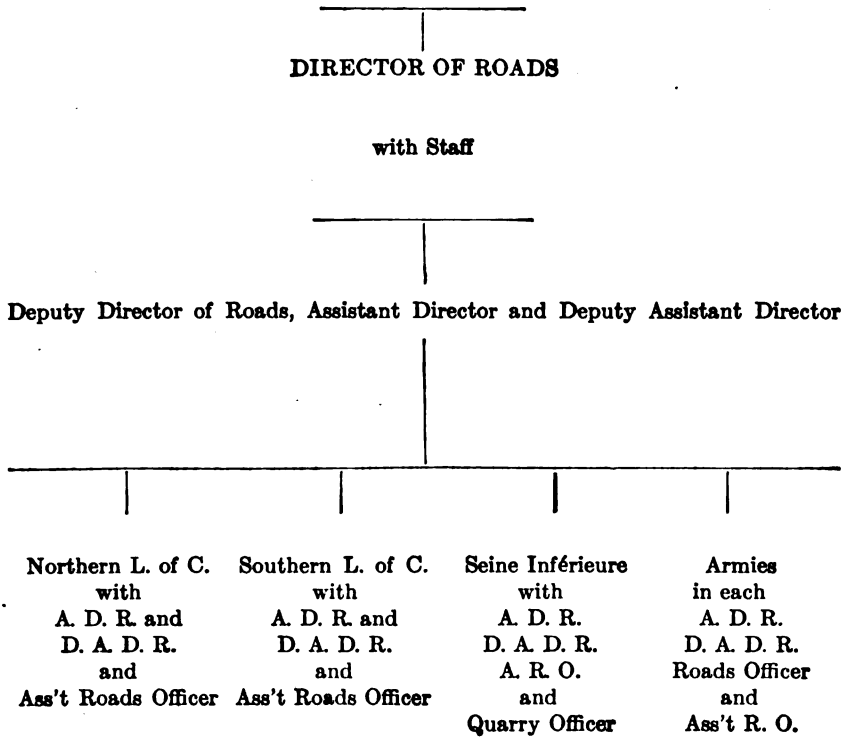
Army roads officers were appointed for each army headquarters to represent the Director of Roads in everything which concerned the construction and maintenance of roads within the army area. This officer was in close touch with the other transportation representatives at army headquarters, and was the technical adviser of the Assistant Director of Transportation regarding the capacity of roads in the area in which he was located. The roads officer was allotted a limited number of special road troops, and certain appliances. The troops were under his orders, and were used solely for road purposes. All necessary labor, as distinct from the special road troops, was requisitioned from the Assistant Director of Labor of the army concerned, and included road construction companies, labor companies, prisoners of war, Chinese, Indians, Africans, etc. At the time of the Armistice thirteen Royal Engineer quarrying companies were at work in quarries in France.

The transport of material was effected in 3-ton petrol lorries, 3 and 5 ton steam and petrol wagons, G. S. wagons, dump wagons and tip carts. At the Armistice the following were working:

Steam rollers	222	Tarring machines	60
Steam wagons	540	Water carts	171
Petrol rollers	45	Dump carts	457
Sweeping machines	114	Mud tumbler carts	83
Petrol lorries	495		

It should be noted that the Roads Directorate took over the repair of its own plant from the Chief Engineer on June 1st 1917, and a central workshop was located at Berguette, while an army roads workshop was established in each army area.

APPENDIX—CHAPTER XXIV—SECTION I.



CHAPTER XXIV.

SECTION II.

MILITARY ROADS SERVICE DURING THE WAR 1914–1918 (FRENCH).

1. FUNCTIONS OF THE ROADS SERVICE.

The constantly increasing amounts of tonnage used in transporting the supplies and material needed by the armies, as well as the numerous troop movements required by operations during the war 1914–1918, necessitated the intensified utilization of transportation over roads and notably of motor transportation. For the foregoing reasons, the number of motor conveyances in use in the zone of the Allied Armies in 1918, reached a total of 180,000[1] vehicles. It was only by means of a system of roads, constantly improved and repaired, that it was possible to maintain the regular and efficient execution of this motor transportation. This was the function of the Roads Service.

II. GENERAL ORGANIZATION OF THE SERVICE.

(Chart 3, Chapter XXV, Vol. I.)

The Roads Service (Service des Routes) did not exist before the war. It was only at the beginning of the mobilization that it was organized and perfected. Its organization was the following:

1st. At General Headquarters a "Commission of the Field Road Systems" (Commission des Réseaux Routiers de Campagne) was attached to the Direction of the Rear (Direction de l'Arrière). It had two members (one military commissioner and one technical commissioner.)

There was also a "Commission of the Road Systems of the Interior" (Commission des Réseaux Routiers de l'Intérieur) at Paris, which was similarly constituted, and which functioned under the orders of the Minister of War.

In February, 1917, the military Roads Service was reorganized; the chief of this service was placed under the orders of the Ministry of Public Works and Transportation (Ministère des Travaux Publics

[1] 95,000 for the French Army, 40,000 for the American Army and 45,000 for the British Army.

et des Transports) and was located in Paris. His assistants in the Zone of the Armies formed the Roads Service of the Army, which remained, as before, attached to General Headquarters, "Direction of the Rear" (Direction de l'Arrière). The latter functioned as the directing agency for the army roads services (Services des Routes des Armées). The duties of this service included the distribution of means of maintenance and the construction of the road bridges. Finally in October, 1918, when the D. G. C. R. A. was created, an officer of the Roads Service was attached to this organization to insure liaison between the Allied Armies and to distribute among them the means of maintenance (notably roadbed matériel).

2d. *In the Armies.*—At the beginning, there was only a "Subcommission of the Roads Systems" (Sous-Commission des Réseaux Routiers) in each army, which was attached to Engineers of the lines of communication (Génie des Etapes), under the "Direction of the L. of C. and services" (Direction des Etapes et des Services-D. E. S.).

In January, 1917, when the D. E. S. were suppressed and when the 4th Sections of the armies (4èmes Bureaux d'Armées) were created, the roads services were attached to the 4th Sections (4e Bureaux) and thereafter became important army services. They had special means at their disposal for the road work to be executed in the forward zone (zône de l'avant), and functioned under the orders of the general commanding the Engineers of the army. Besides, in each of the L. of C. Directions (Directions d'Etapes-D. E.), then organized by "Groups of Armies," there was also a roads service, charged with the upkeep of the roads in the zone of the lines of communication and with the operation of the local quarries, in conjunction with the "Administration of the Bridges and Highways" (Administration des Ponts-et-Chaussées).

III. FUNCTIONING OF THE SERVICE.

1st. *Results accomplished.*—The work accomplished by the military roads services during the war for the benefit of the armies attained considerable importance. It consisted of:

a) The construction of new highways (a total of about 900 kilometers), especially in the forward zone, to meet the needs of the railheads (gares de ravitaillement) and of the army depots (paths of access, runways, etc.). The construction of new roads is a long and complicated work which, whenever possible, should be avoided; it is better to enlarge existing roads.

b) The widening of numerous paths and roads so as to permit of their utilization by two-way traffic (about 9,000 kilometers); especially the highways which were known as "routes gardées."

These were 6 meters wide and had been constructed for important operations:

Road Bar-le-Duc–Verdun (Verdun operations 1916).
Road Amiens–Braye-Somme (Somme operations 1916–1917).
Road Fère-en-Tardenois–Fismes (Aisne operations, 1917), etc.

c) Ordinary upkeep of the road systems, which was usually a continuous operation, night and day, on the great "routes gardées" where traffic was intense. These roads had been subdivided for the purpose into "upkeep cantons" (cantons d'entretien).

d) The re-establishment of road communication in shelled areas (turning of shell craters, filling of cuts, etc.). These operations necessitated the location of supplies of materials at certain points of the front.

The armies divided their zones into sectors. In each sector the work was directed by technical officers who had the necessary labor, matériel and means of transportation at their disposal.

2d. *Labor.*—The specialized labor for road work consisted of 28 companies of "Cantonniers," each composed of 200 cantonniers and 20 laborers (troops of the R. A. T.).[2] Four sections of pavers (50 men each) and 33 companies of the L. of C. Engineers (Génie d'Etapes).

This special labor was reinforced by auxiliary labor: companies of territorial infantry, companies of colonial laborers, (Malgaches, Annamites, Chinese, Kabhyles), prisoners of war, civilian laborers, etc.

In 1917, the special and auxiliary labor assigned to the army roads services reached a total of 78,000 men (of whom 9,500 were civilians and 5,100 prisoners of war).

3d. *Means of transportation.*—The transportation for hauling material, either from the railheads (gares de ravitaillement) or from the local quarries, to the road repair sectors consisted of:

a) Transport companies with animal drawn carts, created from time to time between 1914–1917. At the latter date there were 17 companies of 100 vehicles each.

b) Motorized sections of the Roads Service (about 1,700 special trucks).

4th. *Special matériel.*—The special matériel for road work was secured in accordance with the needs of the moment and comprised: 425 steam rollers, 70 stone-crushers, 600 sweeping-machines (balayeuses), 1,000 watering-carts (tonneaux d'arrosage). For its upkeep and repair it became necessary to establish special repair shops in the Zone of the Armies.

[2] R. A. T. (Réserve Armée Territoriale) (oldest military classes).

A supply of tools (shovels, picks, etc.) was furnished by the Engineer Service from the depot at Angoulême. A reserve was also maintained in the Zone of the Armies at the disposal of the Commander in Chief (at first, at Plessis-Belleville and later at Mignières-Gondreville).

5th. *Roadbed material.*—The construction, refilling, and upkeep of the 15,000 kilometers of paths and roads, which comprised the road system of the armies, required an enormous quantity of material, which it was necessary to quarry, crush and, particularly, to transport.

These materials came in part from the quarries which were worked in the Zone of the Armies, either under the control of the "Direction of the Roads Services" (Direction du Services des routes), at General Headquarters or under the control of the "Lines of Communication" (Direction d'Etapes). The transportation problem was thus simplified, but the necessity for obtaining durable road material obliged the Roads Service to call upon the resources of the interior of the country, where a large number of quarries were opened (average monthly production in the armies: 250,000 tons of stone).

The transportation of this material was effected by the employment of all means of transportation, namely:

Railroads.—Special schedules were reserved in the railway transportation plan of the armies for the movement of train loads of macadam.[a] These trains brought their freight up to the railheads (gares de ravitaillement) where special sidings and ways were reserved for the unloading of stone.

Navigable waterways.—Notably the Oise, the Somme, the Aisne, the Marne and the State canals, on which convoys of special barges (péniches) brought material to the "water stations" (gares d'eau) which were closest to the front.

Maritime routes.—These were employed from Normandy and from Brittany to Calais and Dunkerque. They had to be abandoned in 1918, on account of the submarines.

The table which follows shows, in tons, the quantities of stone material or of "blocking material" quarried and transported, as well as the means of transportation employed:

Year.	Army quarries (quarries operated by the armies).	Quarries in the interior.				
		By rail	By navigable waterways.	By sea.	Total.	Total (in tons).
1915	2,045,400	680,433	130,191	287,156	1,097,780	3,143,180
1916	5,670,880	1,808,526	240,297	457,575	2,506,400	8,177,280
1917	5,897,740	1,925,334	232,256	229,340	2,586,930	8,484,670
1918	6,112,560	865,596	350,988	43,266	1,259,860	7,374,000

[a] A train load represented, on an average, the necessary tonnage of stones (cailloux) required for the upkeep of half a kilometer of roadway.

IV. SERVICE OF THE ROAD BRIDGES.

Immediately after the battle of the Marne, attention had to be given to the repair of breaches disrupting the road system and especially the river crossings. The bridges of ships or bridges on pontoons, which had been constructed by the Engineer companies attached to the large units, were insufficient. It became necessary to organize a "Road Bridges" service (Ponts-Routes), which was attached to the military Road Service and specially charged with the construction of bridges over the important breaks.

The types of bridges successively employed were: Wooden bridges with metallic trusses; metallic bridges, Pigeaud system, which could span 15 to 30 meter cuts and permit motor transport and 60 cm. railway traffic; metallic bridges, Gisclard system, with a span of from 40 to 80 meters.

The personnel assigned to the construction of bridges was drawn from the units of the maritime Engineers (Génie maritime) and was formed into seven companies, with the addition of one "park company" (Cie. de Parc). These units, which were often employed in close proximity to the front, constructed more than 8 kilometers of bridges during the war, of which 140 were Pigeaud and 13 Gisclard bridges.

CHAPTER XXIV.

SECTION III.

MILITARY ROADS SERVICES (BELGIAN).

ORGANIZATION AND OPERATION OF THE SERVICE.

The object of the "Roads Service" (Service des Routes—S. R.) was the construction, upkeep and repair of roads and permanent bridges in the zone occupied by the Belgian Army, as well as the upkeep of navigable waterways and of ditches for the drainage of water.

An engineer from the "Bridges and Highways" Service (Ponts et Chaussées) directed the Roads Service, under the orders of the Commandant of Engineers of the Army (Commandant du Génie de l'Armée). He made all the necessary recommendations concerning the work to be done on the road systems, as well as proposals concerning personnel belonging to the service.

The service comprised two sectors, North and South. There was an engineer at the head of each sector, assisted by foremen, clerks, supervisors, and employees of the Bridges and Highways Department.

The work was done by companies of auxiliary Engineer troops (T. A. G.) and by civilian labor.

At the time of the offensive, the Roads Service was divided into two "groupings" (groupements). The Engineer-Director of each grouping received his orders direct from the Commandant of Engineers of the Army. The zone of action of these groupings was modified in accordance with the advance of the troops. One grouping was placed immediately behind the front line, where the divisional engineers proceeded to overcome or destroy obstacles with the means at their disposal. The first grouping of the Roads Service re-established the lines of communication, while the second grouping assured the service of the lines of communication in the zone immediately in the rear of that in which the first grouping operated. As soon as the enemy had been pushed further back, the grouping in the rear took its position in the newly liberated zone. The first grouping was held in the old zone until a further advance had been made.

CHAPTER XXIV.

SECTION IV.

ROAD CONSTRUCTION AND REPAIR (ITALIAN).

In studying this service it is necessary to distinguish between the road construction and repair: (*a*) In the zone of operations (Zone of the Armies); (*b*) in the rear.

A. *Road construction in the Zone of the Armies.*—The Road Construction and Repair Service in the Zone of the Armies was directed by the army Engineer commands, which were responsible for all construction, with the exception of first line works, executed by the Engineer commands of the large units. For the execution of road construction and repair in this zone, the army Engineer commands employed units which were known as "Centurie" (companies of 100 men), detachments of Engineers not assigned to the first line, or infantry troops at rest.

B. *Road construction in the rear.*—During the mobilization, the Road Construction and Repair Service consisted of the following organizations:

An Administration of Civil Engineers with each army Commissariat: These administrations supervised and directed road construction and repair in the territory in the rear of their respective armies.

An Inspectorate of Civil Engineers, which formed part of the General Commissariat, and which directed and coordinated the work of the administrations of civil Engineers of the armies.

The executive agencies, at the time of the mobilization, had already provided for the doubling of the personnel for ordinary road repair work on the national, provincial, and communal roads. The administrations of civil Engineers provided for road construction and emergency repair work by requisitioning available personnel on the spot.

The officials and clerks of the civil Engineer inspectorates and administrations were drawn from the personnel of the Ministry of Public Works. They were given military uniforms and were subject to military discipline.

DEVELOPMENT OF THE SERVICE DURING THE WAR.

The development of the Road Construction and Repair Service soon surpassed all previous estimates.

Intensive military traffic, inadequate roadways, and the rapid deterioration of the highways, due to the fact that many of these had not been macadamized regularly, necessitated studying means for the procurement of the large quantities of stone and gravel (pietrisco) needed for the surfacing and repair of roads.

The Italian theater of operations required extensive road construction work. Roads had to be constructed in mountain regions at high altitudes and it was difficult to maintain these highways in good condition owing to heavy snowfalls and avalanches. Different, but equally difficult, conditions had to be overcome in the flat Friuli region. In this region frequent rains and the sudden overflow of rivers, canals and marshes, inundated the lowlands and rendered the soil very spongy, caused the rapid deterioration of roads, and made the construction of new roads a very difficult task. Many of the existing roads were not wide enough for the traffic which they had to carry and were so curved as to be impracticable for motor transportation. This necessitated enlarging roadways, widening curves, and reinforcing or improving numerous bridges.

The number of military and civilian laborers, as well as the means of transportation, therefore had to be considerably increased. An idea may be gained of the work accomplished by the civil and military Engineers to assure traffic along the front, as well as in the rear, by the fact that 3,115 kilometers of roads practicable for motor transportation, 1,097 kilometers of wagon roads, and 1,065 kilometers of mule paths were constructed. In addition, the repair, widening and improvement of roads located in the Zone of the Armies, and which existed before the war, was also carried out by this service.

ORGANIZATION OF THE SERVICE DURING THE WAR.

(Chart 4, Chapter XXV, Volume I.)

Army Engineer Commands.—Owing to the numerous functions devolving upon these commands, it became necessary to organize a special office in each command to take charge of the construction and upkeep of the roads, and to provide these offices with the necessary personnel and means.

The "Road Offices" with the army Engineer commands were charged with preparing plans for road construction and repairs. These offices had a number of sections under their control for the execution of the work, and the roads assigned to the road offices were divided among the sections.

Administrations of Civil Engineers.—The administrations of civil Engineers, on account of the enormous increase in the number of roads assigned to them, also had to enlarge their organization. The administrations were subdivided into sections. A civil engineer was placed at the head of each section and the sections divided the work among themselves. Sections were subdivided into detachments and each detachment had a civil engineer at its head (who ranked as Lieutenant or Engineer-Lieutenant of the Reserve).

A section was generally assigned the maintenance of from 300 to 500 kilometers of road, while a detachment was usually assigned from 40 to 60 kilometers. Special working sections were also organized to carry out the important road construction work which could not be executed by the ordinary sections.

Labor.—The Engineer commands, as well as the administrations of civil Engineers, found it necessary to employ both military and civilian labor.

The military labor was used on extensive projects, particularly in the zones which were exposed to the fire of the enemy, and in emergency work (removal of snow, avalanches, land-slides, etc.) The Engineer commands employed units known as "Centurie" (companies of 100 men), detachments of Engineers, and troops at rest. Civil Engineer detachments had detachments or "Centurie" (under the command of their own officers) at their disposal.

Civilian personnel.—Civilian labor had to be employed on account of the insufficient number of available military laborers, and also because of the fact that military labor could not turn out as much work as did the civilians, especially when speed was necessary. At first, the army Engineer commands and the civil Engineer administrations obtained their civilian labor personnel direct. Later, to prevent competition between the various administrations and Engineer commands in the procurement of labor, and also to diminish unemployment among the workmen in the poorer regions of Italy, the office of the "General Secretariat for Civil Affairs" was organized at General Headquarters and charged with obtaining all necessary labor. On account of the scarcity of valid man-power, female labor was employed experimentally in the zone of the rear and, under light working conditions, gave very satisfactory results.

Workmen coming into the Zone of the Armies from the interior of the country were provided with quarters, generally in huts, and received the same rations as the troops. The number of civilian laborers employed in the zone of the rear by the roads services under the control of the civil Engineer administrations, attained 40,000 men per day. In winter, when labor had to be used in removing snow from the roads, up to 50,000 men were employed daily.

SUPPLY OF ROAD MATERIALS—GRAVEL AND STONE (PIETRISCO).

The greatest difficulty was experienced in obtaining supplies of gravel and stone. Roads which in normal times required from 100 to 200 cubic meters of resurfacing per year and per kilometer, required from 700 to 800 cubic meters of resurfacing per year and per kilometer during the war, on account of the increased traffic.

The roads services opened up numerous additional quarries and those already in use were operated more scientifically. During the early part of the war, before the retreat to the Piave, road surfacing material was generally obtainable in proximity to the front and was transported where needed by animal drawn vehicles, motor trucks, light railways or transporting cables (teleferiche). Stones were generally crushed by hand for ordinary repair purposes, while mechanical crushers were used for the preparation of material required in new road construction or extensive repair work.

Gravel was obtained from numerous quarries and from the beds of various water courses by means of mechanical excavators.

The problem of the supply of road material became more difficult after the retreat to the Piave. The Army's rear extended to the Po River, over a flat and marshy region, and gravel was unobtainable locally; moreover, the roads in this area were in poor condition, due to the fact that for more than two years road repairs had been reduced to a minimum. Considerable work was required to provide necessary roads for each army and nearly all existing engineering works (opere d'Arte) in this region had to be reinforced. All available labor was employed and men and women of all ages were recruited from the local population.

Remains of brick furnaces and coal residues were used as material for repairing the roads, quarries in the rear of the army zones had to be enlarged and light railways (Decauville), as well as loading places, had to be constructed to connect the quarries with the nearest railroad or river stations.

The General Engineer Command, in agreement with the civil Engineer inspectorate, assigned quarries and distributed the gravel among the civil Engineer administrations and the road offices of the army Engineer commands. The Supreme Command (Comando Supremo) provided the necessary railroad, light railway, and water transportation for the purpose.

The average monthly requirements of the civil Engineer administration of the Third Army amounted to 214 trains, of approximately 4,000 cars, as well as the employment of 150 barges for water transportation.

The consumption of road material on the highways located in the region between the Tagliamento and the Isonzo, attained a maximum of two cubic meters of surfacing material per day and per kilometer. After the retreat to the Piave, for the roads in the plain region, road material requirements amounted to a maximum of three cubic meters per day and per kilometer.

WINTER SERVICE.

This requires special mention on account of the obstacles which had to be overcome and owing to the importance of maintaining Army communications over roads which were covered with snow and blocked by avalanches. Special "Roads Stations," with permanent crews of workmen, were organized to immediately clear away the snow and remove obstructions from landslides and avalanches. These stations were equipped with animal drawn (horses and even oxen) snow-ploughs and with other necessary special equipment. Particular difficulties had to be overcome during the winter of 1916–17, on account of the heavy snowfalls during the first half of December and January. Nearly all of the principal roads were blocked by avalanches and, during several days, more than 10,000 workmen were employed in clearing away the snow and opening up communications.

MEANS OF TRANSPORTATION.

Animal drawn vehicles, assisted by light railways (Decauville) and transporting cables (teleferiche), were generally used for the transport of road materials. The road offices and the civil Engineer administrations were obliged to employ "squads" of civilian teamsters, recruited in the interior of the country, owing to the shortage of military transportation. The Commissariats were also frequently obliged to assign motor trucks to the roads services.

EQUIPMENT, MACHINERY, AND MISCELLANEOUS MATERIALS.

The roads services required a large quantity of equipment and machinery. Part of this equipment was purchased direct from the military and civil organizations and part was furnished by the advanced Engineer storehouses. Special depots and repair shops were established in the Zone of the Armies for the repair of equipment and vehicles of the roads services. These shops manufactured certain matériel, such as snow-ploughs, two-wheeled carts, wagons, and floating rafts for the transport of wood, etc. Contracts were also made with various firms for the supply of certain equipment, (rollers, etc.)

CHAPTER XXIV.

SECTION V.

ROAD SERVICE (AMERICAN).[1]

ORGANIZATION.

(Chart 1, Chapter XXV, Vol. I.)

The original plans for road work in France contemplated a general Roads and Quarry Service, under the Director General of Transportation, charged with the construction, repair and maintenance of all roads used by the American Expeditionary Forces, and with the supply of metal to roads and of railway ballast to American-operated railways. Up to the transfer of this service to the Service of Utilities in March, 1918, but little had been accomplished, due mainly to lack of men and material. Not only was this unification of the highway and quarry activities not carried out, but practically all the road work was executed by organizations not reporting directly to the Chief of the Road and Quarry Service, such as the Division of Construction and Forestry and the armies.

The original project for personnel, as stated in a letter of July 10, 1917, from the Chief Engineer, American Expeditionary Forces, to the Chief of Engineers, Washington, D. C., was based on a combatant army of 500,000 men, plus auxiliary and line of communication troops. This plan called for 3,000 skilled road workers, 6,000 laborers and 1,500 wagoners for the road service. For the quarry service the plan contemplated 1,500 skilled quarrymen and stone handlers, and 3,000 laborers. The total requested, therefore, equalled 3 per cent of the assumed combatant forces.

Prior to November 11, 1918, there had actually arrived in France the following:

Roads.—Four Engineer battalions, 6 Engineer service battalions. 10 truck companies (31 trucks each), 5 wagon companies (61 wagons each).

Quarries.—Two Engineer battalions, three Engineer service battalions.

[1] Extracts Historical Report of the Chief Engineer A. E. F., and Report of Engineer of Roads, U. S. 1st Army.

To carry on the vast amount of road work required in the army area the services of many other organizations, not specially designed for road work, had to be obtained. During the early part of November, 1918, for example, when the First and Second Armies were in action in the Meuse-Argonne offensive, the number of men employed on road work were as follows: First Army Area, total men 16,346; Second Army Area, total men 10,580.

In the advance section, Services of Supply, there were employed at the same time 1,334 road troops. The total employed on road work on and near the front in November, therefore, amounted to 28,260 men, or about 4 per cent of the combatant troops then engaged along that front.

Work in Army Areas.[2]—The general type of work accomplished in Army areas may be briefly summarized as follows:

During September the First Army area came into existence and, in connection with the St. Mihiel offensive, new road construction included the Sorcy railhead road, Cumejie dumps, Sorcy warehouse-canal road, Griscourt road, Griscourt bridge, cut off northeast of Griscourt, Griscourt-Villers-en-Heye road, Belleville railhead, Andilly ammunition dumps, Ferme Boyer dump, Toul-Void road and Gudeneau dump. Resurfacing work was carried on over various projects, as well as widening. Maintenance work was also very extensive. Road troops were largely occupied in maintaining and repairing existing roads and building temporary roads in the former "no man's land" and in the captured territory.

During October the area occupied by the First Army was to the west of Verdun, and new road construction included the Froides hospital road, Varennes railhead roads, Souilly evacuation hospital roads, Neuilly ammunition park, Dombasle ammunition dump, mobile hospital No. 1, Fromerville road, Auzeville railhead, Clermont railhead, Aubreville railhead, and Neuvilly artillery park. The Neuvilly-Varennes road was widened. One hundred and seven kilometers of roads were maintained during the month in the area.

In the area occupied by the Second Army, during the month, new road work was carried on at Trondes ammunition dump, Ferme Boyer railhead, Marbache ammunition dump, Belleville motor park, Bois de la Côte ammunition dump, Etang Neuf ammunition dump, Bernecourt railhead, Mérouves-Pagney road, Villey-St. Etienne dump. Resurfacing amounted to 30,800 square meters; widening 20,500 square meters; 59 kilometers of roads were maintained during the month.

During November, in the First Army area, new construction included the Varennes railhead, Beeman dump, Souilly railhead;

[2] Under the Chief Engineers of armies.

widening of roads amounted to 37,198 square meters, and maintenance and patching work was carried on over 438 kilometers of roads.

In the Second Army area new construction included the Etang Neuf dump road, Bernecourt railhead, Villey–St. Etienne dump, salvage dump railhead at Toul, Trondes hand-grenade depot road, Bois de la Côte-en-Heye road, mobile hospital No. 35 road, road to mobile hospital No. 39, meter gauge railhead at Toul, and Voinville railhead. Resurfacing work amounted to 16,228 square meters, widening 8,534 square meters, and estimated total maintenance 96 kilometers.

December operations, covering the period December 1, to December 15, in the former First Army area included the widening of various roads and maintenance work on 255 kilometers of road.

In the Second Army area, new road construction was continued at meter gauge railhead, Toul, and on the Voinville-Vigneulles road.

In the table following, the work actually accomplished during November, 1918, by road troops in the two army areas and in the advance section, S. O. S., is briefly summarized. It should be noted that those given for the First Army represented work which was entirely completed. In the case of the Second Army and of the advance section, S. O. S., the construction, resurfacing and widening were in all stages of completion at the end of November.

Road work during November, 1918

(Chart 2, Chapter XXV, Vol. I.)

Item.	First Army.	Second Army.	Advance Section.	Total.
New construction.....square meters..	4,825	35,942	1,650	42,417
Resurfacing.....do....	.....	24,242	87,199	111,441
Widening.....do....	37,198	48,202	4,000	89,400
Maintenance.....kilometers..	438.3	[1]96.6	15,832	.....
Stone and gravel.....cubic meters..	21,323	16,297	14,759	52,379

[1] Square meters.

Operation of quarries.—The first and largest quarry to be operated by the Division of Light Railways and Roads was located at Rupt-sur-Marne (Haute-Marne). It was opened on April 15, 1918, two crushers being installed. Shipments were commenced September 9, 1918, the capacity of the plant being 300 tons of rock per day of 10 hours. More than 10,000 cubic yards of crushed stone were delivered prior to December 17, 1918. A second, but less important, quarry was operated at Les Rapailles, near Neufchâteau (Vosges).

The total stone quarried for road purposes from the numerous quarries opened in advance section and army areas is as follows, by months:

Total output blocks and macadam.

	Cubic meters.
February and March, 1918	5,251
April, 1918	8,707
May, 1918	13,000
June, 1918	14,210
July, 1918	17,075
August, 1918	20,547
September, 1918	29,660
October, 1918	33,150
November, 1918	48,640
December 1–13, 1918	3,524
Total	193,764

Road work other than that done by the armies was all done under the supervision of the Division of Construction and Forestry, and prior to the Armistice was limited virtually to that necessary in connection with its numerous large construction projects, men, material and equipment being generally lacking for more extensive work of road construction and maintenance. The necessary stone was quarried either by the labor of United States troops or was purchased from near-by privately owned quarries.

The result of this enforced limitation of road activity was the progressive deterioration of many roads used by the American Expeditionary Forces, and as a result it became necessary to enter upon a more extensive program of road maintenance and reconstruction, as described under the section of this report dealing with the operations of the Division of Construction and Forestry.

ROAD WORK IN THE SERVICES OF SUPPLY.

Road work in the advance section was assigned to the Department of Light Railways and Roads, and all road work in base and intermediate sections included as part of the activities of the Director of Construction and Forestry. During the early part of 1918, very little actual road construction and maintenance work was done under any of these departments. All activities were concentrated on works of vital necessity at that time. Such roads as were constructed were those made necessary to provide access to utilities, and a small amount of absolutely necessary maintenance work was done.

The program of work under the Department of Construction and Forestry covered the lines of communication running from the base ports to the advance section. At the beginning of the year 1918, these roads were in better condition than those in other parts of

France where the Allied Armies had been operating, and although it was impossible to furnish troops adequate for necessary maintenance, the roads stood up well under intense motor traffic until the beginning of wet weather in the late autumn. It was realized, however, early in the summer, that systematic maintenance would be necessary and a separate division was organized as part of the general construction section under the Director of Construction and Forestry, to direct and supervise this work. Study was made of the roads in use by the American Expeditionary Forces in each section and necessary road work classified under three heads: First, main lines of communication; second, minor roads utilized in distributing supplies to projects or to divisional areas where troops were concentrated; third, new roads required for the necessary communication with hospital sites, storage yards, camps, etc. Total mileage of each class of road by sections is shown in the following table:

Section.	Lines of communication.	Existing roads in project.	New roads to be built.
	Miles.	*Miles.*	*Miles.*
Base section No. 1	367	28.5	18
Base section No. 2	235	36	19
Base section No. 5	13	3.5	7
Base section No. 7	75		
Intermediate section (east)	710	7.5	43
Intermediate section (west)	350		
Advance section	250	70	80
Total	2,000	145.5	167

In each section an officer was designated by the section engineer to act as superintendent of roads, and had under his direction the necessary assistants for office work and supervision of the field operations, which were in general carried on by troops temporarily or permanently assigned for the purpose, as well as in some cases by Chinese labor or civilian forces hired for the purpose. All roads being of macadam construction, necessary material required consisted only of crushed rock.

When the Division of Roads of the Division of Construction and Forestry took over the supervision of all repairs in Services of Supply areas, there were in all the sections small organizations maintaining such roads as were most vitally in need of repairs, but there had not been the opportunity to work out a comprehensive plan for road work, nor had the necessary machinery been ordered or the troops provided. A matter of first importance was, therefore, to plan a program for future work and make requisition for necessary troops and equipment. On August 1, 1918, the equipment on hand and the

organizations in charge of road work were as shown in subjoined table:

Equipment.

Crushers	8	Plows (rooter)	4
Compressors	6	Rollers	23
Drills	11	Scrapers (slip)	2
Dump trucks	93	Scrapers (wheel)	20
Dump wagons	67	Scarifiers	4
Graders	8	Sprinklers (motor)	15
Plows (railroad)	12	Sprinklers (horse)	14
Trailers	6	Tractors	7

Personnel.

Section.	Officers.	Men.
Base section No. 1	10	600
Base section No. 2	18	1,100
Base section No. 3	None.	None.
Base section No. 4	None.	None.
Base section No. 5	None.	None.
Base section No. 6	None.	None.
Base section No. 7	None.	None.
Intermediate section (east)	3	100
Intermediate section (west)	5	200
Advance section	8	500

It was estimated that there would be needed at least 15,000 special road troops in addition to labor battalions and details from combat units for maintenance throughout the winter, or a total of 30,000 to be employed on this work throughout the lines of communication by July 1, 1919, when it was expected that there would be an American Army of nearly 5,000,000 men in France. The necessary machinery to maintain the lines of communication adequately was estimated and two requisitions were prepared, one of August 6, 1918, and one of October 17, 1918, which were forwarded for purchase to Washington. These requisitions covered the following equipment:

Compressor plants, with power	120	Graders (12-foot)	80
Drills (complete with hose and connections)	480	Graders (8-foot)	40
Drill steel (tons)	200	Scrapers (slip)	300
Decauville cars and track	500	Scrapers (wheel)	300
Crusher plants, with power	120	Plows (light)	300
Rollers (10-ton)	120	Plows (railroad)	300
Rollers (5-ton)	50	Plows (rooter)	300
Scarifiers	80	Harrows	300
Tractors, 15 to 30 horsepower	40	Dump wagons	1,000
Tractors, 75 horsepower	80	Sprinklers	120

Up to the date of the signing of the Armistice, none of this machinery had been received, but there had arrived on a former requisition prepared in the office of the Chief Engineer, American Expeditionary Forces, the following road equipment:

Crusher plants, with power	17
Rollers (10-ton)	23
Dump wagons	262

The road equipment that was available in the Services of Supply areas at the time of cessation of hostilities is shown as follows. Many of these items were rented or purchased locally:

Road equipment in Services of Supply areas.

Air compressors	20	Scrapers (wheel)	140
Crushers	24	Scarifiers	4
Drills	38	Sprinklers (motor)	2
Engines (gas)	14	Sprinklers (horse)	30
Engines (steam)	10	Tank wagons	4
Graders (road)	10	Tractors (gas)	28
Loaders (wagons)	2	Tractors (steam)	3
Plows	23	Trailers	10
Rollers (gas)	24	Trucks (dump)	88
Rollers (steam)	29	Trucks (cargo)	200
Rollers (horse)	2	Wagons	340
Scrapers (slip)	170		

During the last month of the campaign, the successive advances of the American front necessitated a great amount of road construction to maintain the lines of communication, and the great shortage of machinery and equipment required that all available be taken from the zone of the Services of Supply, and accordingly there was removed from Services of Supply road work the following equipment:

Compressors with power, drills, etc	2	Tractors	4
Crusher plants, with power	4	Road graders	5
Rollers (10-ton)	6	Mack dump trucks	90
Scarifiers	2	Sprinkler trucks	6
		Sprinkler wagons	4

The motor traffic on the lines of communication did not diminish during the early part of the armistice period, which was coincident with the arrival of rainy weather. Due to insufficient maintenance, many sections of the main lines of communication began to deteriorate. Added to the necessity of maintenance on these roads was the need for constructing roads across the regions where hostilities had been carried on and for their extension into the occupied territories. Further, the added traffic brought on roads and divisional areas in the advance and intermediate sections as troops were brought back to rest areas pending their embarkation, served to increase the amount of road-repair work required.

After conference between the American and French authorities an agreed plan for the maintenance of roads was formulated and published as General Orders No. 2, General Headquarters, January

IV. SERVICE OF THE ROAD BRIDGES.

Immediately after the battle of the Marne, attention had to be given to the repair of breaches disrupting the road system and especially the river crossings. The bridges of ships or bridges on pontoons, which had been constructed by the Engineer companies attached to the large units, were insufficient. It became necessary to organize a "Road Bridges" service (Ponts-Routes), which was attached to the military Road Service and specially charged with the construction of bridges over the important breaks.

The types of bridges successively employed were: Wooden bridges with metallic trusses; metallic bridges, Pigeaud system, which could span 15 to 30 meter cuts and permit motor transport and 60 cm. railway traffic; metallic bridges, Gisclard system, with a span of from 40 to 80 meters.

The personnel assigned to the construction of bridges was drawn from the units of the maritime Engineers (Génie maritime) and was formed into seven companies, with the addition of one "park company" (Cie. de Parc). These units, which were often employed in close proximity to the front, constructed more than 8 kilometers of bridges during the war, of which 140 were Pigeaud and 13 Gisclard bridges.

CHAPTER XXIV.

SECTION III.

MILITARY ROADS SERVICES (BELGIAN).

ORGANIZATION AND OPERATION OF THE SERVICE.

The object of the "Roads Service" (Service des Routes—S. R.) was the construction, upkeep and repair of roads and permanent bridges in the zone occupied by the Belgian Army, as well as the upkeep of navigable waterways and of ditches for the drainage of water.

An engineer from the "Bridges and Highways" Service (Ponts et Chaussées) directed the Roads Service, under the orders of the Commandant of Engineers of the Army (Commandant du Génie de l'Armée). He made all the necessary recommendations concerning the work to be done on the road systems, as well as proposals concerning personnel belonging to the service.

The service comprised two sectors, North and South. There was an engineer at the head of each sector, assisted by foremen, clerks, supervisors, and employees of the Bridges and Highways Department.

The work was done by companies of auxiliary Engineer troops (T. A. G.) and by civilian labor.

At the time of the offensive, the Roads Service was divided into two "groupings" (groupements). The Engineer-Director of each grouping received his orders direct from the Commandant of Engineers of the Army. The zone of action of these groupings was modified in accordance with the advance of the troops. One grouping was placed immediately behind the front line, where the divisional engineers proceeded to overcome or destroy obstacles with the means at their disposal. The first grouping of the Roads Service re-established the lines of communication, while the second grouping assured the service of the lines of communication in the zone immediately in the rear of that in which the first grouping operated. As soon as the enemy had been pushed further back, the grouping in the rear took its position in the newly liberated zone. The first grouping was held in the old zone until a further advance had been made.

CHAPTER XXIV.

SECTION IV.

ROAD CONSTRUCTION AND REPAIR (ITALIAN).

In studying this service it is necessary to distinguish between the road construction and repair: (*a*) In the zone of operations (Zone of the Armies); (*b*) in the rear.

A. *Road construction in the Zone of the Armies.*—The Road Construction and Repair Service in the Zone of the Armies was directed by the army Engineer commands, which were responsible for all construction, with the exception of first line works, executed by the Engineer commands of the large units. For the execution of road construction and repair in this zone, the army Engineer commands employed units which were known as "Centurie" (companies of 100 men), detachments of Engineers not assigned to the first line, or infantry troops at rest.

B. *Road construction in the rear.*—During the mobilization, the Road Construction and Repair Service consisted of the following organizations:

An Administration of Civil Engineers with each army Commissariat: These administrations supervised and directed road construction and repair in the territory in the rear of their respective armies.

An Inspectorate of Civil Engineers, which formed part of the General Commissariat, and which directed and coordinated the work of the administrations of civil Engineers of the armies.

The executive agencies, at the time of the mobilization, had already provided for the doubling of the personnel for ordinary road repair work on the national, provincial, and communal roads. The administrations of civil Engineers provided for road construction and emergency repair work by requisitioning available personnel on the spot.

The officials and clerks of the civil Engineer inspectorates and administrations were drawn from the personnel of the Ministry of Public Works. They were given military uniforms and were subject to military discipline.

DEVELOPMENT OF THE SERVICE DURING THE WAR.

The development of the Road Construction and Repair Service soon surpassed all previous estimates.

Intensive military traffic, inadequate roadways, and the rapid deterioration of the highways, due to the fact that many of these had not been macadamized regularly, necessitated studying means for the procurement of the large quantities of stone and gravel (pietrisco) needed for the surfacing and repair of roads.

The Italian theater of operations required extensive road construction work. Roads had to be constructed in mountain regions at high altitudes and it was difficult to maintain these highways in good condition owing to heavy snowfalls and avalanches. Different, but equally difficult, conditions had to be overcome in the flat Friuli region. In this region frequent rains and the sudden overflow of rivers, canals and marshes, inundated the lowlands and rendered the soil very spongy, caused the rapid deterioration of roads, and made the construction of new roads a very difficult task. Many of the existing roads were not wide enough for the traffic which they had to carry and were so curved as to be impracticable for motor transportation. This necessitated enlarging roadways, widening curves, and reinforcing or improving numerous bridges.

The number of military and civilian laborers, as well as the means of transportation, therefore had to be considerably increased. An idea may be gained of the work accomplished by the civil and military Engineers to assure traffic along the front, as well as in the rear, by the fact that 3,115 kilometers of roads practicable for motor transportation, 1,097 kilometers of wagon roads, and 1,065 kilometers of mule paths were constructed. In addition, the repair, widening and improvement of roads located in the Zone of the Armies, and which existed before the war, was also carried out by this service.

ORGANIZATION OF THE SERVICE DURING THE WAR.

(Chart 4, Chapter XXV, Volume I.)

Army Engineer Commands.—Owing to the numerous functions devolving upon these commands, it became necessary to organize a special office in each command to take charge of the construction and upkeep of the roads, and to provide these offices with the necessary personnel and means.

The "Road Offices" with the army Engineer commands were charged with preparing plans for road construction and repairs. These offices had a number of sections under their control for the execution of the work, and the roads assigned to the road offices were divided among the sections.

Administrations of Civil Engineers.—The administrations of civil Engineers, on account of the enormous increase in the number of roads assigned to them, also had to enlarge their organization. The administrations were subdivided into sections. A civil engineer was placed at the head of each section and the sections divided the work among themselves. Sections were subdivided into detachments and each detachment had a civil engineer at its head (who ranked as Lieutenant or Engineer-Lieutenant of the Reserve).

A section was generally assigned the maintenance of from 300 to 500 kilometers of road, while a detachment was usually assigned from 40 to 60 kilometers. Special working sections were also organized to carry out the important road construction work which could not be executed by the ordinary sections.

Labor.—The Engineer commands, as well as the administrations of civil Engineers, found it necessary to employ both military and civilian labor.

The military labor was used on extensive projects, particularly in the zones which were exposed to the fire of the enemy, and in emergency work (removal of snow, avalanches, land-slides, etc.) The Engineer commands employed units known as "Centurie" (companies of 100 men), detachments of Engineers, and troops at rest. Civil Engineer detachments had detachments or "Centurie" (under the command of their own officers) at their disposal.

Civilian personnel.—Civilian labor had to be employed on account of the insufficient number of available military laborers, and also because of the fact that military labor could not turn out as much work as did the civilians, especially when speed was necessary. At first, the army Engineer commands and the civil Engineer administrations obtained their civilian labor personnel direct. Later, to prevent competition between the various administrations and Engineer commands in the procurement of labor, and also to diminish unemployment among the workmen in the poorer regions of Italy, the office of the "General Secretariat for Civil Affairs" was organized at General Headquarters and charged with obtaining all necessary labor. On account of the scarcity of valid man-power, female labor was employed experimentally in the zone of the rear and, under light working conditions, gave very satisfactory results.

Workmen coming into the Zone of the Armies from the interior of the country were provided with quarters, generally in huts, and received the same rations as the troops. The number of civilian laborers employed in the zone of the rear by the roads services under the control of the civil Engineer administrations, attained 40,000 men per day. In winter, when labor had to be used in removing snow from the roads, up to 50,000 men were employed daily.

SUPPLY OF ROAD MATERIALS—GRAVEL AND STONE (PIETRISCO).

The greatest difficulty was experienced in obtaining supplies of gravel and stone. Roads which in normal times required from 100 to 200 cubic meters of resurfacing per year and per kilometer, required from 700 to 800 cubic meters of resurfacing per year and per kilometer during the war, on account of the increased traffic.

The roads services opened up numerous additional quarries and those already in use were operated more scientifically. During the early part of the war, before the retreat to the Piave, road surfacing material was generally obtainable in proximity to the front and was transported where needed by animal drawn vehicles, motor trucks, light railways or transporting cables (teleferiche). Stones were generally crushed by hand for ordinary repair purposes, while mechanical crushers were used for the preparation of material required in new road construction or extensive repair work.

Gravel was obtained from numerous quarries and from the beds of various water courses by means of mechanical excavators.

The problem of the supply of road material became more difficult after the retreat to the Piave. The Army's rear extended to the Po River, over a flat and marshy region, and gravel was unobtainable locally; moreover, the roads in this area were in poor condition, due to the fact that for more than two years road repairs had been reduced to a minimum. Considerable work was required to provide necessary roads for each army and nearly all existing engineering works (opere d'Arte) in this region had to be reinforced. All available labor was employed and men and women of all ages were recruited from the local population.

Remains of brick furnaces and coal residues were used as material for repairing the roads, quarries in the rear of the army zones had to be enlarged and light railways (Decauville), as well as loading places, had to be constructed to connect the quarries with the nearest railroad or river stations.

The General Engineer Command, in agreement with the civil Engineer inspectorate, assigned quarries and distributed the gravel among the civil Engineer administrations and the road offices of the army Engineer commands. The Supreme Command (Comando Supremo) provided the necessary railroad, light railway, and water transportation for the purpose.

The average monthly requirements of the civil Engineer administration of the Third Army amounted to 214 trains, of approximately 4,000 cars, as well as the employment of 150 barges for water transportation.

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MEANS OF TRANSPORTATION.

Animal drawn vehicles, assisted by light railways (Decauville) *and transporting* cables (teleferiche), were generally used for the *transport* of road materials. The road offices and the civil En*gineer* administrations were obliged to employ "squads" of civilian *teamsters*, recruited in the interior of the country, owing to the *shortage* of military transportation. The Commissariats were also frequently obliged to assign motor trucks to the roads services.

EQUIPMENT, MACHINERY, AND MISCELLANEOUS MATERIALS.

The roads services required a large quantity of equipment and machinery. Part of this equipment was purchased direct from the military and civil organizations and part was furnished by the advanced Engineer storehouses. Special depots and repair shops were established in the Zone of the Armies for the repair of equipment and vehicles of the roads services. These shops manufactured certain matériel, such as snow-ploughs, two-wheeled carts, wagons, and floating rafts for the transport of wood, etc. Contracts were also made with various firms for the supply of certain equipment, (rollers, etc.)

CHAPTER XXIV.

SECTION V.

'OAD SERVICE (AMERICAN).[1]

ORGANIZATION.

'Chart 1, Chapter XXV, Vol. I.)

'or road work in France contemplated a gen-
Service, under the Director General of Trans-
he construction, repair and maintenance of
ican Expeditionary Forces, and with the
..u of railway ballast to American-operated
..ie transfer of this service to the Service of Utili-
..arch, 1918, but little had been accomplished, due mainly to
..ack of men and material. Not only was this unification of the highway and quarry activities not carried out, but practically all the road work was executed by organizations not reporting directly to the Chief of the Road and Quarry Service, such as the Division of Construction and Forestry and the armies.

The original project for personnel, as stated in a letter of July 10, 1917, from the Chief Engineer, American Expeditionary Forces, to the Chief of Engineers, Washington, D. C., was based on a combatant army of 500,000 men, plus auxiliary and line of communication troops. This plan called for 3,000 skilled road workers, 6,000 laborers and 1,500 wagoners for the road service. For the quarry service the plan contemplated 1,500 skilled quarrymen and stone handlers, and 3,000 laborers. The total requested, therefore, equalled 3 per cent of the assumed combatant forces.

Prior to November 11, 1918, there had actually arrived in France the following:

Roads.—Four Engineer battalions, 6 Engineer service battalions. 10 truck companies (31 trucks each), 5 wagon companies (61 wagons each).

Quarries.—Two Engineer battalions, three Engineer service battalions.

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[1] Extracts Historical Report of the Chief Engineer A. E. F., and Report of Engineer of Roads, U. S. 1st Army.

The consumption of road material on the highways located in the region between the Tagliamento and the Isonzo, attained a maximum of two cubic meters of surfacing material per day and per kilometer. After the retreat to the Piave, for the roads in the plain region, road material requirements amounted to a maximum of three cubic meters per day and per kilometer.

WINTER SERVICE.

This requires special mention on account of the obstacles which had to be overcome and owing to the importance of maintaining Army communications over roads which were covered with snow and blocked by avalanches. Special "Roads Stations," with permanent crews of workmen, were organized to immediately clear away the snow and remove obstructions from landslides and avalanches. These stations were equipped with animal drawn (horses and even oxen) snow-ploughs and with other necessary special equipment. Particular difficulties had to be overcome during the winter of 1916–17, on account of the heavy snowfalls during the first half of December and January. Nearly all of the principal roads were blocked by avalanches and, during several days, more than 10,000 workmen were employed in clearing away the snow and opening up communications.

MEANS OF TRANSPORTATION.

Animal drawn vehicles, assisted by light railways (Decauville) and transporting cables (teleferiche), were generally used for the transport of road materials. The road offices and the civil Engineer administrations were obliged to employ "squads" of civilian teamsters, recruited in the interior of the country, owing to the shortage of military transportation. The Commissariats were also frequently obliged to assign motor trucks to the roads services.

EQUIPMENT, MACHINERY, AND MISCELLANEOUS MATERIALS.

The roads services required a large quantity of equipment and machinery. Part of this equipment was purchased direct from the military and civil organizations and part was furnished by the advanced Engineer storehouses. Special depots and repair shops were established in the Zone of the Armies for the repair of equipment and vehicles of the roads services. These shops manufactured certain matériel, such as snow-ploughs, two-wheeled carts, wagons, and floating rafts for the transport of wood, etc. Contracts were also made with various firms for the supply of certain equipment, (rollers, etc.)

CHAPTER XXIV.

SECTION V.

ROAD SERVICE (AMERICAN).[1]

ORGANIZATION.

(Chart 1, Chapter XXV, Vol. I.)

The original plans for road work in France contemplated a general Roads and Quarry Service, under the Director General of Transportation, charged with the construction, repair and maintenance of all roads used by the American Expeditionary Forces, and with the supply of metal to roads and of railway ballast to American-operated railways. Up to the transfer of this service to the Service of Utilities in March, 1918, but little had been accomplished, due mainly to lack of men and material. Not only was this unification of the highway and quarry activities not carried out, but practically all the road work was executed by organizations not reporting directly to the Chief of the Road and Quarry Service, such as the Division of Construction and Forestry and the armies.

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[1] Extracts Historical Report of the Chief Engineer A. E. F., and Report of Engineer of Roads, U. S. 1st Army.

To carry on the vast amount of road work required in the army area the services of many other organizations, not specially designed for road work, had to be obtained. During the early part of November, 1918, for example, when the First and Second Armies were in action in the Meuse-Argonne offensive, the number of men employed on road work were as follows: First Army Area, total men 16,346; Second Army Area, total men 10,580.

In the advance section, Services of Supply, there were employed at the same time 1,334 road troops. The total employed on road work on and near the front in November, therefore, amounted to 28,260 men, or about 4 per cent of the combatant troops then engaged along that front.

Work in Army Areas.[2]—The general type of work accomplished in Army areas may be briefly summarized as follows:

During September the First Army area came into existence and, in connection with the St. Mihiel offensive, new road construction included the Sorcy railhead road, Cumejie dumps, Sorcy warehouse-canal road, Griscourt road, Griscourt bridge, cut off northeast of Griscourt, Griscourt-Villers-en-Heye road, Belleville railhead, Andilly ammunition dumps, Ferme Boyer dump, Toul-Void road and Gudeneau dump. Resurfacing work was carried on over various projects, as well as widening. Maintenance work was also very extensive. Road troops were largely occupied in maintaining and repairing existing roads and building temporary roads in the former "no man's land" and in the captured territory.

During October the area occupied by the First Army was to the west of Verdun, and new road construction included the Froides hospital road, Varennes railhead roads, Souilly evacuation hospital roads, Neuilly ammunition park, Dombasle ammunition dump, mobile hospital No. 1, Fromerville road, Auzeville railhead, Clermont railhead, Aubreville railhead, and Neuvilly artillery park. The Neuvilly-Varennes road was widened. One hundred and seven kilometers of roads were maintained during the month in the area.

In the area occupied by the Second Army, during the month, new road work was carried on at Trondes ammunition dump, Ferme Boyer railhead, Marbache ammunition dump, Belleville motor park, Bois de la Côte ammunition dump, Etang Neuf ammunition dump, Bernecourt railhead, Mérouves-Pagney road, Villey-St. Etienne dump. Resurfacing amounted to 30,800 square meters; widening 20,500 square meters; 59 kilometers of roads were maintained during the month.

During November, in the First Army area, new construction included the Varennes railhead, Beeman dump, Souilly railhead;

[2] Under the Chief Engineers of armies.

widening of roads amounted to 37,198 square meters, and maintenance and patching work was carried on over 438 kilometers of roads.

In the Second Army area new construction included the Etang Neuf dump road, Bernecourt railhead, Villey-St. Etienne dump, salvage dump railhead at Toul, Trondes hand-grenade depot road, Bois de la Côte-en-Heye road, mobile hospital No. 35 road, road to mobile hospital No. 39, meter gauge railhead at Toul, and Voinville railhead. Resurfacing work amounted to 16,228 square meters, widening 8,534 square meters, and estimated total maintenance 96 kilometers.

December operations, covering the period December 1, to December 15, in the former First Army area included the widening of various roads and maintenance work on 255 kilometers of road.

In the Second Army area, new road construction was continued at meter gauge railhead, Toul, and on the Voinville-Vigneulles road.

In the table following, the work actually accomplished during November, 1918, by road troops in the two army areas and in the advance section, S. O. S., is briefly summarized. It should be noted that those given for the First Army represented work which was entirely completed. In the case of the Second Army and of the advance section, S. O. S., the construction, resurfacing and widening were in all stages of completion at the end of November.

Road work during November, 1918

(Chart 2, Chapter XXV, Vol. I.)

Item.	First Army.	Second Army.	Advance Section.	Total.
New construction.....square meters..	4,825	35,942	1,650	42,417
Resurfacing.....do....	.....	24,242	87,199	111,441
Widening.....do....	37,198	48,202	4,000	89,400
Maintenance.....kilometers..	438.3	[1]96.6	15,832	.....
Stone and gravel.....cubic meters..	21,323	16,297	14,759	52,379

[1] Square meters.

Operation of quarries.—The first and largest quarry to be operated by the Division of Light Railways and Roads was located at Rupt-sur-Marne (Haute-Marne). It was opened on April 15, 1918, two crushers being installed. Shipments were commenced September 9, 1918, the capacity of the plant being 300 tons of rock per day of 10 hours. More than 10,000 cubic yards of crushed stone were delivered prior to December 17, 1918. A second, but less important, quarry was operated at Les Rapailles, near Neufchâteau (Vosges).

The total stone quarried for road purposes from the numerous quarries opened in advance section and army areas is as follows, by months:

Total output blocks and macadam.

	Cubic meters.
February and March, 1918	5,251
April, 1918	8,707
May, 1918	13,000
June, 1918	14,210
July, 1918	17,075
August, 1918	20,547
September, 1918	29,660
October, 1918	33,150
November, 1918	48,640
December 1–13, 1918	3,524
Total	193,764

Road work other than that done by the armies was all done under the supervision of the Division of Construction and Forestry, and prior to the Armistice was limited virtually to that necessary in connection with its numerous large construction projects, men, material and equipment being generally lacking for more extensive work of road construction and maintenance. The necessary stone was quarried either by the labor of United States troops or was purchased from near-by privately owned quarries.

The result of this enforced limitation of road activity was the progressive deterioration of many roads used by the American Expeditionary Forces, and as a result it became necessary to enter upon a more extensive program of road maintenance and reconstruction, as described under the section of this report dealing with the operations of the Division of Construction and Forestry.

ROAD WORK IN THE SERVICES OF SUPPLY.

Road work in the advance section was assigned to the Department of Light Railways and Roads, and all road work in base and intermediate sections included as part of the activities of the Director of Construction and Forestry. During the early part of 1918, very little actual road construction and maintenance work was done under any of these departments. All activities were concentrated on works of vital necessity at that time. Such roads as were constructed were those made necessary to provide access to utilities, and a small amount of absolutely necessary maintenance work was done.

The program of work under the Department of Construction and Forestry covered the lines of communication running from the base ports to the advance section. At the beginning of the year 1918, these roads were in better condition than those in other parts of

France where the Allied Armies had been operating, and although it was impossible to furnish troops adequate for necessary maintenance, the roads stood up well under intense motor traffic until the beginning of wet weather in the late autumn. It was realized, however, early in the summer, that systematic maintenance would be necessary and a separate division was organized as part of the general construction section under the Director of Construction and Forestry, to direct and supervise this work. Study was made of the roads in use by the American Expeditionary Forces in each section and necessary road work classified under three heads: First, main lines of communication; second, minor roads utilized in distributing supplies to projects or to divisional areas where troops were concentrated; third, new roads required for the necessary communication with hospital sites, storage yards, camps, etc. Total mileage of each class of road by sections is shown in the following table:

Section.	Lines of communication.	Existing roads in project.	New roads to be built.
	Miles.	*Miles.*	*Miles.*
Base section No. 1	367	28.5	18
Base section No. 2	235	36	19
Base section No. 5	13	3.5	7
Base section No. 7	75		
Intermediate section (east)	710	7.5	43
Intermediate section (west)	350		
Advance section	250	70	80
Total	2,000	145.5	167

In each section an officer was designated by the section engineer to act as superintendent of roads, and had under his direction the necessary assistants for office work and supervision of the field operations, which were in general carried on by troops temporarily or permanently assigned for the purpose, as well as in some cases by Chinese labor or civilian forces hired for the purpose. All roads being of macadam construction, necessary material required consisted only of crushed rock.

When the Division of Roads of the Division of Construction and Forestry took over the supervision of all repairs in Services of Supply areas, there were in all the sections small organizations maintaining such roads as were most vitally in need of repairs, but there had not been the opportunity to work out a comprehensive plan for road work, nor had the necessary machinery been ordered or the troops provided. A matter of first importance was, therefore, to plan a program for future work and make requisition for necessary troops and equipment. On August 1, 1918, the equipment on hand and the

organizations in charge of road work were as shown in subjoined table:

Equipment.

Crushers	8	Plows (rooter)	4
Compressors	6	Rollers	23
Drills	11	Scrapers (slip)	2
Dump trucks	93	Scrapers (wheel)	20
Dump wagons	67	Scarifiers	4
Graders	8	Sprinklers (motor)	15
Plows (railroad)	12	Sprinklers (horse)	14
Trailers	6	Tractors	7

Personnel.

Section.	Officers.	Men.
Base section No. 1	10	600
Base section No. 2	18	1,100
Base section No. 3	None.	None.
Base section No. 4	None.	None.
Base section No. 5	None.	None.
Base section No. 6	None.	None.
Base section No. 7	None.	None.
Intermediate section (east)	3	100
Intermediate section (west)	5	220
Advance section	8	500

It was estimated that there would be needed at least 15,000 special road troops in addition to labor battalions and details from combat units for maintenance throughout the winter, or a total of 30,000 to be employed on this work throughout the lines of communication by July 1, 1919, when it was expected that there would be an American Army of nearly 5,000,000 men in France. The necessary machinery to maintain the lines of communication adequately was estimated and two requisitions were prepared, one of August 6, 1918, and one of October 17, 1918, which were forwarded for purchase to Washington. These requisitions covered the following equipment:

Compressor plants, with power	120	Graders (12-foot)	80
Drills (complete with hose and connections)	480	Graders (8-foot)	40
Drill steel (tons)	200	Scrapers (slip)	300
Decauville cars and track	500	Scrapers (wheel)	300
Crusher plants, with power	120	Plows (light)	300
Rollers (10-ton)	120	Plows (railroad)	300
Rollers (5-ton)	50	Plows (rooter)	300
Scarifiers	80	Harrows	300
Tractors, 15 to 30 horsepower	40	Dump wagons	1,000
Tractors, 75 horsepower	80	Sprinklers	120

Up to the date of the signing of the Armistice, none of this machinery had been received, but there had arrived on a former requisition prepared in the office of the Chief Engineer, American Expeditionary Forces, the following road equipment:

Crusher plants, with power	17
Rollers (10-ton)	23
Dump wagons	262

The road equipment that was available in the Services of Supply areas at the time of cessation of hostilities is shown as follows. Many of these items were rented or purchased locally:

Road equipment in Services of Supply areas.

Air compressors	20	Scrapers (wheel)	140
Crushers	24	Scarifiers	4
Drills	38	Sprinklers (motor)	2
Engines (gas)	14	Sprinklers (horse)	30
Engines (steam)	10	Tank wagons	4
Graders (road)	10	Tractors (gas)	28
Loaders (wagons)	2	Tractors (steam)	3
Plows	23	Trailers	10
Rollers (gas)	24	Trucks (dump)	88
Rollers (steam)	29	Trucks (cargo)	200
Rollers (horse)	2	Wagons	340
Scrapers (slip)	170		

During the last month of the campaign, the successive advances of the American front necessitated a great amount of road construction to maintain the lines of communication, and the great shortage of machinery and equipment required that all available be taken from the zone of the Services of Supply, and accordingly there was removed from Services of Supply road work the following equipment:

Compressors with power, drills, etc	2	Tractors	4
Crusher plants, with power	4	Road graders	5
Rollers (10-ton)	6	Mack dump trucks	90
Scarifiers	2	Sprinkler trucks	6
		Sprinkler wagons	4

The motor traffic on the lines of communication did not diminish during the early part of the armistice period, which was coincident with the arrival of rainy weather. Due to insufficient maintenance, many sections of the main lines of communication began to deteriorate. Added to the necessity of maintenance on these roads was the need for constructing roads across the regions where hostilities had been carried on and for their extension into the occupied territories. Further, the added traffic brought on roads and divisional areas in the advance and intermediate sections as troops were brought back to rest areas pending their embarkation, served to increase the amount of road-repair work required.

After conference between the American and French authorities an agreed plan for the maintenance of roads was formulated and published as General Orders No. 2, General Headquarters, January

2, 1919. This order directed that all roads in continued use by the American Expeditionary Forces be maintained and kept in repair by our forces. In view of the shortage of machinery, it was ordered that work be done as far as possible by hand, employing the large number of idle troops for the purpose, and that the French cantonnier system of maintenance be adopted in principle, utilizing small detachments distributed over long sections of road rather than concentrating large units for work at one point. By this order all road work in France and Luxemburg was placed under the Division of Construction and Forestry. Road work in the occupied territories was placed under the direction of the Commanding General, Third Army, although the Director of Construction and Forestry exercised general supervision in order to coordinate the entire scheme of road work in the American Expeditionary Forces.

In accordance with this order the Director of Construction and Forestry made a change in his office, establishing a new road section. Construction in the field, as before, was under the supervision of the respective section Engineers, and the authority of the Engineer of the advance section was extended to include supervision in Luxemburg and in the occupied territories of the work carried on by the Third Army. As a preliminary step, all section Engineers were immediately directed to make a complete new survey of road conditions in their respective areas, reporting all the mileage necessitating repair and maintenance classified as to whether necessity existed, for complete resurfacing; second, light resurfacing and repairs, or third, filling of pot holes and worn spots only. They were also directed to arrange immediately for the necessary troops to do this work and for their distribution as might be required, and to arrange for the necessary rock supply either by developing quarries then in use, by opening new quarries, or by procuring rock supplies from existing quarries operated by the French. A compilation of reports received in accordance with these directions showed the following amount of road work to be undertaken:

	Mileage.
Base Section No. 1	520
Base Section No. 2	800
Base Section No. 5	50
Base Section No. 7	300
Intermediate section (west)	1,520
Intermediate section (east)	350
Advance section	3,180
Total	6,720

The greatest shortage in the American equipment at this time was road rollers. Consequently, special attention was directed to pro-

curing for major repairs as many as could be found. It was discovered that a considerable number of these were in the hands of the French road authorities at Versaille and other points, and application made to them resulted in their agreement to send 48 from their stock. At the same time those privately owned were rented wherever possible. A small number of portable crushers in the Engineer storage depots were distributed for immediate use. At the same time search was made in all sections for commercial quarries and for stocks of crushed rock.

At the commencement of the enlarged program, particular attention was directed to three regions and immediate steps taken to supply equipment for work here. First, territories in which the armies had been operating where, naturally, roads were in worse shape and the necessity for continuous transportation most important; second, the embarkation camp at Brest, on which a very concentrated traffic was thrown with the beginning of the return of troops to the States; and, third, the divisional areas around Le Mans, into which troops scheduled for return were moved to await shipping. Due to its greater mileage, the advance section called for a larger amount of road machinery than any other, and in this region there were immediately distributed all salvaged rollers and other machinery which had been in use during active military operations.

By March, 1918, organizations in all sections had been properly developed and adequate supplies of crushed rock were secured, or were in process of acquisition, and enough major repairs had been made to permit of concentrating on maintenance. The following table shows number of troops on work and the weekly supply of rock at this time:

	Total number of men during week.	Rock distributed during week (tons).
Base section No. 1—St. Nazaire	4,330	6,080
Base section No. 2—Bordeaux	4,290	5,380
(Gravel distributed during week, 1,365 tons)		
Base section No. 5—Brest	21,630	13,635
Base section No. 7—La Rochelle	966	630
(Gravel distributed during week, 166 tons)		
Intermediate section (west)—Gièvres	13,160	3,800
Intermediate section (east)—Nevers	2,085	2,850
Advance section—Neufchâteau	63,000	19,000

SUMMARY.

Total number of men on road and quarry work in France	109,455
Total tons of rock distributed during the week (Mar. 1, 1919)	51,375

The extent of the road work is indicated by figures of the Director of Construction and Forestry, covering the 10-day period, March 11 to 20, 1919, inclusive, during which time 98,500 men were employed on road work in France, Luxemburg, and occupied Germany, and 127,000 tons of rock were handled. From the beginning of the year to the middle of April, 1919, it was estimated that 865,000 tons of rock had been employed on road repair and maintenance in France and Luxemburg and 200,000 tons in occupied Germany.

By far the largest amount of work was done in the advance section, where, on April 10, 32,361 men were engaged on road work. The distribution of the road force in the base and intermediate sections on April 10, 1919, was as follows: Base section No. 1, 4,839 men; base section No. 2, 6,151 men; base section No. 5, 1,930 men; base section No. 7, 1,293 men; intermediate section (west), 12,424 men; intermediate section (east), 2,716 men. The above figures include labor by troops and prisoners of war.

To reduce the amount of work on roads in the advance section, Bulletin No. 30, General Headquarters, April 10, 1919, prescribed that after April 15, 1919, only one road would be maintained by American troops from the American areas in eastern France to Luxemburg and occupied Germany. Instructions specifically limited all trucks, whether going to or returning from Luxemburg, to this one road, between Neufchâteau and Luxemburg by way of Vaucouleurs, Void, Commercy, St. Mihiel, Verdun, Etain, Spincourt, Longuyon, Longwy, Luxemburg.

The policy was adopted, insofar as it was possible to do so, to use prisoners of war on road work; in April 1919, the number thus employed totalled 16,000, the majority of them being stationed in the advance section. As rapidly as possible, American troops employed on road work were relieved by prisoner companies, while the effort was made to substitute French "cantonnier" and civilian labor to release American troops for return to the United States.

CHAPTER XXV.

SECTION I.

SALVAGE SERVICE (BRITISH).

At the outset of the war there was no special organization to deal with salvage. Such work was regarded as a part of the duties of the armies and of the various departments of supply. It was soon realized, however, that the war would be a long one and that the national resources of material would be strained to the utmost. In 1915, divisional "Salvage companies" were formed, but under local arrangements and without official recognition as independent units. These companies had to search abandoned billets and the zone behind the trenches for derelict material of all descriptions, and to form salvage dumps where material could be sorted for re-issue or for despatch either to the corps main dump or direct to the base. At the same time it was impressed on the ordinary troops that it was their duty to prevent material becoming derelict so far as was possible, and to collect the salvage material from the trench zone into convenient collecting stations from which it could be removed by the salvage company or by transport returning empty after the delivery of rations or ammunition.

In 1917, some of the new "Employment companies" of the Directorate of Labor were employed upon salvage work. This gave the salvage personnel a more definite status, though still without creating independent salvage units. The system left much to be desired, there being no certainty that the same men would remain for any length of time on divisional salvage, and a corps or army was liable to lose the whole of its salvage personnel on taking up a new area. At the least it assured that all formations had some basis on which to build up a system of salvage in which all units could co-operate. On the lines of communication the matter was left entirely to units, but two ordnance officers were appointed to inspect and advise.

The first battle of the Somme and the subsequent German retirement in the spring of 1917, introduced a new factor into the situation. Behind the zone occupied by the fighting troops a large devastated area was left full of valuable military material and strewn broadcast with the débris of war. In the summer of 1917, this tract was made a "special salvage area", to be cleared under

direct instructions from General Headquarters. To supervise the work of the labor and transport allotted to the task, a "Special Area Salvage Officer" with a small staff was appointed. He was originally known as "Controller of Salvage" a title subsequently transferred to an appointment of much wider scope.

With the development of an organization for the collection of salvage, great strides were also made in dealing with salvage material at the bases. No actual salvage depots existed there, but all material not required for local re-issue was consigned by rail from the salvage dumps in forward areas to the depots of the services of supply from which the stores emanated originally. Much valuable salvage work was thus accomplished by different departments. (Chart 1, Chapter XXVI, Vol. I.)

Early in 1918, it was decided by the Quartermaster General that efforts towards salvage and economy required co-ordination and control. In the first place, staff captains for salvage duties were appointed to the headquarters of each army and of each corps. A similar officer was appointed to the headquarters of the Lines of Communication area. In the second place, a Controller of Salvage with headquarters staff was appointed at General Headquarters. He was given a very wide brief in all matters relating to salvage and the prevention of waste. His main duties may be described briefly under three heads:

1. In army areas the Controller's function was to inspect the work being carried out by formations. He submitted reports to the Quartermaster General, and recommendations as to such further instructions as he considered necessary.

2. He had a direct executive command over the "Special Area Salvage Officer".

3. As regards the disposal of salvage at base depots, the salvage control acted as a clearing house between departments able to utilize each others' scrap, as a means of liaison with the home authorities as to the materials required in the United Kingdom, and as an agent for the sale in France of the material not otherwise required.

A further step in the development of the organization was taken in the autumn of 1918, when "Salvage Sections" of permanently allotted Labor Corps personnel were authorized. Each of these was to consist of one officer and forty other ranks, and sections were allotted on the scale of one per division, one per corps, and eighteen as a General Headquarters (G. H. Q.) pool. The divisional salvage section remained part of the divisional employment company for administrative purposes, and the corps section was affiliated similarly to the permanent corps headquarters employment company.

The collection of stores and material during the continuance of hostilities may be considered under three headings:

1. Return of stores.
2. Routine salvage.
3. Technical salvage.

Under the first heading came reparable or unserviceable stores and "empties" returned by units. A small proportion of serviceable stores, either surplus to local requirements or of obsolete pattern, was also included. The policy in regard to these was always that they should be returned through the normal channels of supply for the particular categories of stores and materials concerned, and that they should be dealt with at bases by the issuing departments.

Routine salvage represented the general responsibility of the troops for the collection and return of stores and material which had become derelict and had thus ceased to be the charge of any particular unit or department. This applied chiefly to the war zone proper, and in army back areas and on the lines of communication it was merely a matter of searching training grounds and vacated billets for material negligently abandoned. All units were responsible for salving material in the areas occupied by them, and for bringing back to convenient points all material so collected. Salvage receiving stations were established by the side of light railways, roads, duck boards or other avenues of communication. As the fullest use had to be made of transport returning empty from the front, these stations were usually placed on traffic routes. When the military situation permitted, collection of material on the battle-fields began, salvage officers reconnoitring the ground beforehand so that those districts where salvage was in large quantities and easily collected might be covered first. The types of salvage which were most important during offensive operations were to be found generally in the zone of the infantry attack. Here the salvage was never localized to the same extent as in vacated gun positions, and consequently, far more ground had to be covered in the course of collection. For carrying salvage to the nearest traffic route the Yukon pack was found useful. By its adoption labor was saved and the material collected correspondingly increased.

Main salvage dumps were placed at some suitable point on a light or broad gauge railway. There all material was sorted, unless received already classified. A considerable proportion of the derelict stores taken to salvage dumps proved to be in serviceable condition, and could therefore be issued very conveniently direct to the troops under the authority of the local representatives of the supply services concerned.

Under the heading of technical material came artillery ammunition, crashed aeroplanes, derelict tanks and various transportation stores. These were dealt with specially by the different technical services concerned, such as the Royal Air Force, the Royal Engineers, the Signal Service, the Tank Corps, the Royal Army Service Corps, the Royal Army Medical Corps, the Royal Army Ordnance Corps and the Royal Army Veterinary Corps.

Until early in 1918, each service or department had disposed of its own salvage material, but when the question was co-ordinated under the Controller of Salvage this procedure came to an end. Each department had the first claim on its own salvage material, either for repair in its own workshops in France or for despatch to the corresponding department in England. When no such departmental outlet existed it rested with the Controller of Salvage to ascertain what other use could be made of the material. It was found frequently that one department could use scrap material for which the holding department could find no use. Consequently, the salvage control formed a useful " clearing house " through which interdepartmental transfers could be made. It is to be noted that the responsibility for the executive work of handling and transporting salvage material, under the instructions of the Controller of Salvage, still rested with the various services and departments until the end of 1918.

A very considerable financial saving was effected through salvage, and the military worth of retrieved material increased out of all proportion to its actual money value. The enormous importance of efficient salvage work from the purely financial point of view may be gathered from the fact that during the month of September 1918, articles to an approximate value of £4,000,000 sterling were salved.

In addition to purely salvage work, there were three other organizations of the Quartermaster General's services dealing with economies. The first of these, the " Inspectorate of Messing and Economies " was formed in September 1916, with the primary object of improving the standard of messing. This object was attained, but in addition a more economical treatment of the ration was effected, and by-products from the ration were devoted to soap making and the manufacture of glycerine for munitions of war. In the latter instance this meant that the Ministry of Munitions was able to obtain a portion of the necessary glycerine at a price one-fifth of that paid before the formation of the inspectorate. The value of this work may be gauged from the fact that after paying all expenses the balance of profit remaining was approximately £250,000.

The second organization was the "Inspectorate of Horse Feeding and Economies," established by the Quartermaster General in the spring of 1918, when the situation called for drastic economy in all directions. The Inspector of Horse Feeding and Economies had to advise on all matters connected with the feeding of animals in army and lines of communication areas, and to suggest to the Quartermaster General methods by which economies could be brought about. The inspectorate fully justified its formation. A comparison of the statistics of the Supplies, Remounts and Veterinary Services for 1918, with those of previous years shows economies and improved animal condition.

In addition may be mentioned the Disposal of Animals Branch of the Veterinary Directorate, instituted by the Quartermaster General in August 1918, to deal with animals no longer fit for military service. In the case of animals which had to be destroyed, the hide, flesh, grease, bones, hoofs and hair were all sold, the average value of the by-products obtained from the carcass of an animal of 10 cwts. being £4. By the Armistice, 7,061 carcasses had been dealt with, producing a total sum of £28,244.

701—24——65

CHAPTER XXV.

SECTION II.

SERVICE FOR THE SALVAGE OF WAR MATERIEL (FRENCH).

I. FUNCTION OF THE SALVAGE SERVICE.

During the course of operations, which required the utilization of large quantities of war material, the battlefields were naturally strewn with wreckage and scraps of all kinds. This material had to be picked up, assembled, and sent either to the rear or to the interior, as much for the purpose of clearing the forward zone as for the purpose of salvaging material and munitions which could be rendered serviceable again.

This was the duty of the Salvage Service, which was concerned principally with munitions and artillery matériel, but which also salved matériel pertaining to the various services (Intendance, Engineer, Aviation, Medical).

II. ORGANIZATION AND GENERAL FUNCTIONING OF THE SERVICE.

The Salvage Service was completely reorganized during the war through the issuing of numerous "Notes" and "Orders" which provided for modifications necessitated by circumstances and by the nature of the operations.

A. *Period from 1914 to 1916 inclusive.*—The general direction of the service was under the orders of General Headquarters (Direction of the Rear) and salvaging operations in each army were executed, in agreement with the "Direction of the L. of C." and the services, by the Main Artillery Park (Grand Parc d'Artillerie).

These operations began in October 1914, with the salving of empty 75 mm. cartridge cases, because the crisis in munitions made it of the utmost importance that these be sent to the rear for repair.

In 1915, the development of heavy artillery required the salvaging of shell and powders. In November, 1915, it became necessary to regulate salvage operations and, particularly, the shipment of salved materials—cartridges which had been fired and empty containers were sent by the armies, in agreement with the Regulating Commissioners, to sorting centers in the interior (Rennes, Issoire, Macon, Toulouse). Unserviceable or damaged powders and ex-

plosives were, under like conditions, sent to the powder-magazines of the interior (Sevran-Livry, Moulin-Blanc, St.-Médard, etc.) or to certain artillery parks, such as Cherbourg or Poitiers. From March to August 1916, these places received enormous quantities of black powder from the fortified places in the Zone of the Armies. Besides, the troops were encouraged to assist in the salvaging by means of a system of cash bonuses.

Towards the end of 1916, the increasing importance of salvage operations, especially those concerning the artillery service, and the multiplicity of destinations of such matériel, brought about congestion in the stations and in certain powder-magazines. The Direction of the Rear therefore issued new regulations for the Salvage Service.

Fired cartridges and empty munitions containers were shipped in complete trainloads from certain specified stations, designated as salvage depots, (dépôts de récupération), to the sorting centers in the interior.

Powders and explosives, after having been collected in the sorting centers by the armies, were shipped periodically to specified powder-magazines designated by the Commander in Chief (D. A.), in agreement with the Minister. For the sake of safety these sorting centers were of similar design to the munitions depots, and they were connected with the standard gauge railroads.

Munitions, powders, or explosives recognized as being absolutely unserviceable were destroyed on the spot.

Finally, the salvaged materials belonging to the clothing service and its shipment to the clothing depots were also regulated.

B. *Period from 1917 to the date of the Armistice.*—In January, 1917, when the "Directions of the L. of C." (D. E. S.) were suppressed and the army 4th Sections created, the Salvage Service passed under the control of the 4th Section of each army. The general execution of salvage was assured by the Commanding General of the Artillery; he had the Main Artillery Park and special salvage units at his disposal for this purpose. A note 800/DA (20th September 1917) completed the reorganization of this service by providing a "Salvage Inspector" (Inspecteur de la Récupération) for each army group. This inspector was an artillery officer of field rank and he was charged with supervising the operation of the Salvage Service in the armies and with the coordination of requests for transportation (evacuation). He also prepared periodical statements which were sent to the Commander in Chief (D. A.).

Finally, in 1918, general regulations on salvage were issued by the Commander in Chief in agreement with the Minister of Armament (March 7, 1918). These regulations amalgamated all previous

"notes" and circulars which had been issued on the subject and organized the service on the following basis:

A "salvage plan" was prescribed in each army for the methodical clearing of wreckage and scraps of all kinds. This plan designated the salvage centers to which matériel was to be sent and the special sorting centers for powders and munitions. (Chart 4, Chapter XXVI, Vol I.)

In each divisional sector, a salvage detachment (about 60 men) operated, equipped with necessary means of transportation (6 park carts and 10 motor trucks). In important sectors this detachment could, in the case of need, be reinforced by labor units. Special steps were taken for carrying out salvage operations on the large battlefields. These were directed by a special "Commandant of the L. of C." (Commandant d'Etapes) and necessary troops and means of transportation were placed at his disposal by the "Direction of the L. of C." concerned.

The system of bonuses (individual bonuses for detached troops, collective bonuses for administrative units) was regulated and extended to include Aviation and "Intendance" matériel. These bonuses were immediately payable to those concerned, and were single, double, or triple, depending on whether the matériel was picked up in rear of the lines or on the front itself.[1]

Shipments to the rear.—a. By rail and by train loads to the large sorting stations (gares de triage): Blois, Trappes and Chagny which replaced the former sorting centers in the interior, which were poorly organized and too far from each other. Only powders and munitions which could be reclaimed were sent direct to the powder magazines or to designated munitions depots. To reduce the stocks to be evacuated, several large salvage centers (centres de réfection) were organized in the Zone of the Armies under the orders of the Commander in Chief (D. A.).

b. By water, whenever possible, for bulky shipments (various metals, factory material).

C. *Period beginning on November, 1918.*—After the Armistice the Salvage Service passed under the direction of the Minister of Armament, who, with the assistance of the Commander in Chief, cleared the old battlefields in the liberated regions.

The territory was subdivided into seven large zones (Lille, Laôn, Reims, Bar-le-Duc, Nancy, Epinal, Lure) where a special service, directed by the commanding general of the region, was employed in each sector to reclaim the soil, destroy damaged munitions, classify and evacuate munitions (including German munitions) and serviceable matériel.

[1] As a matter of information, the total of the single bonuses amounted to: 10 Francs for a machine gun; 20 centimes for a cartridge (artillery); 25 centimes for a munitions container; 2 Francs for a rifle; 15 Francs for 100 kilograms of copper, etc.

CHAPTER XXV.

SECTION III.

SALVAGE OF WAR MATERIAL (ITALIAN).

The salvage of war material became necessary on account of the large number of troops which the belligerents put into the field and the consequent enormous consumption of materials of all kinds.

The supply situation was particularly acute in Italy, because of the limited reserve stocks in that country and on account of the difficulties encountered in obtaining supplies from either the home country or from abroad. The necessity for salvaging material and equipment was therefore recognized from the start and organizations were immediately established to carry out this work. These organizations progressively improved as the war went on and generally rendered very valuable services.

The principal Italian salvage organizations were those which were engaged in reclaiming the following materials: (a) Metal scraps; (b) clothing and equipment; (c) hides and fats; (d) motor transport material; (e) aviation material.

A. METAL SCRAPS.

This service was organized, in the interior of the country and in the Zone of the Armies, under the direction of the Ministry of Arms and Munitions. In the interior the service was directly under the Ministry of Arms and Munitions while, in the Zone of the Armies, it functioned under the General Commissariat.

The aims of the service were to: "derive advantages from the enormous quantities of unused or unserviceable metal lying idle on the battle-fields and in the rear of the armies or in the interior; transport this metal to the national iron foundries (siderurgica) and thus diminish the importation of raw materials."

Although this service had a very modest beginning and was, originally, more in the nature of an experiment as to what results might be obtained, it gradually increased in importance and extended its work over the whole Zone of the Armies and over that of interior. It attained its maximum development immediately after the Italian Army reached the line of the Piave.

ORGANIZATION OF THE SERVICE.

(Chart 5, Chapter XXVI, Volume I.)

In the Zone of the Army.—Propaganda was carried on among the troops to encourage them, during their leisure moments, to collect pieces of shells, unserviceable arms, etc., as well as scrap iron from factories that had been destroyed by bombardment. Later, special detachments were detailed for this purpose and the metal thus collected was sent, in wagons or motor lorries, to the temporary collecting stations which had been established along the principal lines of communication, where the metal was received and fixed rewards or bonuses paid to the detachments. From these stations the material was sent to "Final Collecting Centers" (one or two for each army), where the different metals were sorted and sent by railroad to the various iron foundries in accordance with the instructions of the Ministry of Arms and Munitions, issued through the General Commissariat.

An "Office for the Collection of Metal Scrap" regulated the salvage service in the zone of each army. It also provided for the establishment of temporary collecting stations and furnished the personnel (officers and men) for the metal sorting centers, as well as that for loading and unloading operations. Requests for personnel were made to the army commissariats nad the personnel always remained under the control of the latter.

In the interior of the country.—The collection of metal scrap was entrusted to "District Committees." These committees were assigned territorial zones by the Ministry of Arms nad Munitions, and they forwarded the material which they had collected to the iron foundries in their respective zones. The bonuses for salvaged material were prescribed by the above mentioned Ministry.

B. CLOTHING AND EQUIPMENT.

This service was organized to: "re-issue clothing and equipment turned in by the various units, or abandoned upon the battle-fields and in the encampments, after careful disinfection, cleaning and repairs." Owing to the large demand for these supplies and the difficulties of procurement, the Italian Army found it necessary to provide for the salvage of this material at the very beginning of the war. A memorandum issued by the Ministry of War (General Administration of Supply (Logistical) and Administrative services), dated as early as 1914, prescribed that:

"(a) All clothing and equipment, whatever its nature, deposited by units (corpi) in the storehouses should be collected by the Army

Commissariats and sent to the Central Depots (D. C.) for removal to the Reserve Zone;

(b) appropriate establishments for repairing the clothing and equipment should be constructed, under the direction of the Commissariat Administration at Milan, and that on these establishments would devolve the removal of material assembled in the Central Depots."

The prolongation of the war and the increase in the number of combatant troops necessitated the reorganization and enlargement of the original organization for the purposes of:

a. Improving salvage operations, with the aid of the army commissariats.

b. Providing for the carrying out of repairs within the armies, as far as possible, so as not to overtax railroad transportation, and to effect the removal of such material as could not be handled by the armies to the base, where better facilities were available.

Laboratories and workshops, similar to those at the base, were created in the Zone of the Armies and their operation resulted in marked economies. This made it possible to supply large amounts of clothing and equipment in spite of difficulties in obtaining raw materials. The administration of this service was entrusted to the military Commissariat.

Disinfecting and salvage establishments, under the authority of the advanced clothing and equipment depots, were also organized in the Zone of the Armies. They included: salvage centers for the collection and sorting of materials deposited by the various units, one or more disinfecting stations, a laundry, and one or more repair shops. The personnel was chosen from among soldiers who were unfit for first line service and from the territorial militia. Although the equipment of these establishments was very limited on account of their advanced position, they handled the disinfection, washing, and repair of all articles of clothing, equipment, footwear and furs.

At the armistice there were 16 of these army workshops. Equipment and material requiring important repairs was sent by rail to the territorial military clothing and equipment workshops in accordance with the instructions of the Ministry of War, issued through the General Commissariat. There were 9 territorial workshops for clothing and equipment at the date of the Armistice, located at: Turin, Milan, Borgo Panigale, Torre Annunziata, Modena, Firenze, Aquila, Caserta and Pontedera. Of these workshops, one (that at Turin) had been in operation since 1913, and another (at Milan) since 1915, while the others were established during the war.

The shops at Borgo Panigale and at Torre Annunziata were engaged in the disinfection and repair of clothing (corredo) and also handled kitchen equipment; those at Turin, Modena, Firenze, Aquila and Caserta manufactured and repaired boots, knapsacks, and haversacks: the shop at Pontedera repaired boots only, while the shop at Milan manufactured metal articles (lamiera) such as mess cans, tin cups, bowls, cooking utensils, stoves, etc.

The above mentioned establishments were under the technical control of the "Superior Technical Administration of the Military Workshops," which had been created under the authority of the Ministry of War (General Direction of the Supply and Administrative Services).

C. HIDES AND FATS.

In the salvage of hides, a distinction was made between the material coming from the military establishments and that produced by the commercial slaughtering houses.

Hides from the Military Establishments.—During the early part of the campaign there was no special organization for the salvage of hides. As a matter of fact, in the Zone of the Armies, hides were either sold on the spot at very low prices or else were absolutely wasted.

Subsequently, a suitable organization was created, (which was improved during the war), and at the date of the Armistice this organization functioned as follows:

All hides from animals slaughtered in the Zone of the Armies were salted at once and then forwarded, either by motor transport or by rail, to the "Storehouses for salted hides" (one or more for each army) which had been established in the rear of the armies; in these storehouses, the hides were cured.

At first, hides were sent from these storehouses to Turin, where they were sold to tanneries by the "V. T." establishments. Later, hides were sent to the "Military storehouses for hides", where they were classified and sold at the end of every month (calmiere), to private tanneries, at a fixed price. These hides, after being tanned, were held at the disposal of the Ministry of War for a period of three months, during which time they could be acquired by the military administration, at a price determined by the "Office for the Supply of leather and boots", and distributed either to military or private shoe factories.

The "Technical Administration" of the military services for the salvage of hides, under the control of the General Commissariat, regulated and supervised the collection and the dressing of the hides obtained in the Zone of the Armies and provided for their shipment

to the military storehouses, in accordance with the instructions of the Ministry of War.

During the early part of the war the technical administration received a bonus for every hide salvaged, but it had to provide the necessary personnel and material for the operation of the military establishments engaged in the salvage of hides, while the General Commissariat furnished the means of transportation. Later, this system was discontinued and the personnel engaged in this work received a fixed monthly salary. The civilian personnel was replaced by men belonging to the territorial militia or by soldiers who were declared unfit for first line duty; finally, all necessary materials were furnished by the General Commissariat.

Hides from commercial establishments.—Until November, 1916, the hides produced by commercial establishments were free from Government supervision. On that date an "Office for the supply of leather and boots" was created under the authority of the Ministry of War (General Direction of the Supply and Administrative services), to determine and control the price of raw hides produced in Italy, as well as that of the materials required for tanning purposes, and to provide for the requisitioning of hides from commercial slaughter houses.

This office established numerous agencies and sub-agencies which, in conjunction with the territorial administrations of the military Commissariat, arranged for the collection of rawhides produced by private concerns and for the payments for these hides; the latter were distributed among the various tanning establishments. The tanneries paid the agencies for the hides which they had received and then delivered the dressed hides to private or military shoe manufactories in accordance with the instructions of the "Office for the supply of leather and boots."

Contracts were made with reliable firms by the General Commissariat and by the Ministry of Arms and Munitions for the salvage of fat materials. Under the terms of these contracts, these firms received the fats from the military slaughtering establishments in the Zone of the Armies and from the special army establishments (one for each army) for the destruction of unserviceable animals ("Digestori"),[1] as well as the fats produced in the military or commercial slaughter-houses in the interior of the country.

In the Zone of the Armies, all fats were sent to the military "Storehouses for hides" and from there forwarded to designated private warehouses. The firms which controlled these warehouses provided for the preservation of the fat and arranged for its shipment by rail to their establishments in the interior of the country.

[1] See Chapter XII, Section IV.

A military commission for the requisition of fatty substances, under the control of the Ministry of Arms and Munitions, determined the prices at which fats were to be ceded to the firms.

D. MOTOR TRANSPORT MATERIAL.

Motor vehicles which were considered as unserviceable were collected in the motor transport parks and sent, either by road or by rail, to the repair establishments of the central motor transport depot where a special commission, presided over by the chief of the technical motor transport section of the General Commissariat, examined the vehicles and determined their condition. In accordance with the decisions of this commission, the motor vehicles were either completely overhauled and repaired for use by the territorial services or entirely dismantled in order to recover all serviceable parts.

E. AVIATION MATERIAL.

The service for the salvage of Aviation material was controlled by the "Administration for repairs and salvage," which formed part of the General Aviation Commissariat.

Airplanes that were beyond repair were sent to the central aviation depot, through the advanced aviation depots, and from there they were forwarded to the establishments located in the interior of the country which were under the control of the above mentioned administration. In these establishments the airplanes were dismantled and all serviceable parts recovered. Aviation motors were treated in the same manner.

Unserviceable dirigible balloons were sent by rail to the territorial hangars (aeroscali), where they were dismantled and all serviceable parts recovered.

CHAPTER XXV.

SECTION IV.

SALVAGE OF WAR MATERIAL (AMERICAN).[1]

ORGANIZATION OF SALVAGE SERVICE.

(Chart 2, Chapter XXVI, Vol. I.)

An officer was assigned as Assistant to the Chief Quartermaster, American E. F., and designated as Chief of Salvage Service, S. O. S. The Chief of the Salvage Service had a representative from each of the following services:

Ordnance Department,
Medical Department,
Signal Corps,
Corps of Engineers,
Chemical Warfare Service,
Motor Transport Corps.

These liaison officers served as the immediate subordinates of the Chief of Salvage Service in all that concerned the service and facilities of their respective departments. They also served as the direct representatives of their respective chiefs of department in the latter's relations with the Salvage Service.

Certain officers were assigned as assistants to the Chief of Salvage Service as commanding officers of salvage depots. These officers supervised the repair work accomplished in their depots and had as their assistants technical officers who supervised the repair work in their respective branches.

There was a salvage officer for each section of the S. O. S., who supervised the salvage service with the exception of salvage depots within a section.

ARMY SALVAGE OFFICER.

An officer was detailed for each army and designated as Army Salvage Officer. This officer was the assistant to the Quartermaster of the army and supervised the salvage service within the command and directly controlled all personnel of the salvage service in the army area.

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[1] Extracted from Regulations for Salvage Service, American E. F.

FIELD PERSONNEL.

The Salvage Service personnel in the field were organized as salvage squads, operating directly under the army salvage officer. Salvage squads did not form a part of divisional organizations but were temporarily attached to divisions for the work of the salvage service.

During an offensive, additional men for each division in the line were organized as emergency salvage companies under the orders of the division commander.

ZONE OF ADVANCE.

Army commanders designated within the area occupied by their organization such salvage dumps as they considered necessary to insure a quick and satisfactory collection of material to be salvaged. Such dumps were at railheads or on motor transport supply lines, or on the lines of light combat railways so as to be suitable for ready and economical sorting of material.

All explosives, ammunition and component parts of ammunition were collected and delivered to dumps which were under the supervision of the army ordnance officer and located at least 1,000 feet from other dumps.

SORTING AND CLASSIFICATION.

Material arriving at salvage dumps was sorted. The army salvage officer ascertained from the various staff departments the location of the nearest field repair shops, the character of the repair which could be made, etc., at these shops and caused all material which could be repaired at such field shops to be shipped thereto for repair. He also kept himself informed as to the nearest depots of the various staff departments for the re-issue of serviceable material of such department and issued instructions for the shipment of serviceable material to these depots. Serviceable Quartermaster property was disinfected and laundried if necessary, and turned in to the nearest Quartermaster supply depot for re-issue as required.

Salvage material was separated at all dumps from which rail shipments were made into the following classes:

Class 1: To comprise all clothing, cloth equipment, blankets, web belts, web equipment, flags and brassards, haversacks, tentage, leggins, paulins, other canvas material, rubber equipment, including boots, gloves, slickers, etc.; leather equipment, including shoes, boots, harness, belts, saddles, bridles and all leather equipment of every kind; mess outfits, cooking utensils, field bakery equipment,

field ranges, metal helmets, trench tools, typewriters, mimeographs, adding machines and band instruments. This class was consigned to and repaired by the Salvage Service.

Class 2: Subsistence stores, with regard to which there was doubt as to their being fit for human consumption. This class was consigned to the Salvage Service.

Class 3: Certain Ordnance material to comprise all artillery material, machine guns, automatic rifles, small arms, bayonets, ammunition, all fire control instruments, such as range finders, panoramic sights, telescopic sights, trench periscopes and watches for all services. This class was consigned to and repaired by the Ordnance Department.

Class 4: Certain Signal Corps property to comprise field wire, cable, special Signal Corps trench fittings, binoculars and Signal Corps instruments. This class was consigned to and repaired by the Signal Corps.

Class 5: Certain Medical Department property to comprise medical, surgical and veterinary instruments and appliances, drugs, medicines and serums. This class was consigned to and repaired by the Medical Department.

Class 6: All gas masks, respirators and special Chemical Warfare Service equipment. This class was consigned to and repaired by the Chemical Warfare Service.

Class 7: All motor vehicles, motor parts and equipment. This was consigned to and repaired by the Motor Transport Corps.

Material other than as indicated above, coming into the hands of the Salvage Service, was disposed of in accordance with special instructions.

Upon the receipt of Salvage material at the salvage sorting stations it was separated, classified and forwarded to salvage depots, S. O. S., as the Chief of Salvage Service directed.

HISTORY OF THE SALVAGE SERVICE.[1]

The growth of the Salvage Service of the American E. F., with its saving of ship space for the transportation of troops in the critical days, as well as the saving of millions of dollars to the Government, was one of the striking developments of the war.

Lack of tonnage rather than money economy was the paramount reason for the establishment of the Salvage Service. Many thousands of tons of ship space were saved, and this when the result of our efforts were in the balance meant more than the saving of millions in money.

[1] From Report Chief of Salvage, American E. F.

Aside from the question of tonnage conservation, the saving to the Government in developing the by-products of modern warfare more than justified the time, energy and money expended in maintaining the Salvage Service.

The Salvage Service was organized January 16, 1918, when it was designated as a function of the Quartermaster Corps by General Orders No. 10, G. H. Q., American E. F. Much important preliminary work had to be done previously, however, as already indicated, and the first salvage depot at Saint Pierre-des-Corps began operations on January 15, 1918, with a personnel of four officers, five enlisted men and six women employees. At the time the Armistice was signed, the Salvage Service was operating an extensive chain of dumps, depots, repair shops, degreasing plants, delousing stations and laundries, both stationary and mobile, and employing thousands of French civilians besides a large enlisted personnel and a field force of enlisted men ranging from 2,000 to 12,000 according to the exigencies of the service. (On February 18, 1919, the total personnel of the Salvage Service, aside from the field force, exceeded 11,000.)

Colonel Theodore B. Hacker, Q. M. C., was designated Chief of the Salvage Service on May 4, 1918, acting directly under the Chief Quartermaster.

COLLECTIONS.

Collecting operations were conducted by salvage squads, consisting of 1 lieutenant and 29 enlisted men and having a noncommissioned officer of the Ordnance Corps, and, occasionally, noncommissioned officers of other staff departments attached. (On February 18, 1919, there was a total of 45 salvage squads attached to areas, divisions or base ports.)

DEPOTS AND AUXILIARY WORKSHOPS.

(Chart 3, Chapter XXVI, Vol. I).

Material was first collected in dumps and from these the greater portion of salvaged equipment in general use throughout the Army, such as clothing, shoes, mess kits, haversacks, webbing, harness, leather and rubber, was shipped to the various depots and shops where the articles were repaired or the material used in the manufacture of by-products. Ordnance property was shipped to the repair shops of that corps and highly technical supplies, such as periscopes, surgical instruments, range finding apparatus, etc., were also consigned to and repaired by the particular corps to which they belonged.

Depots were maintained by the Salvage Service at Lyon, Saint Nazaire, Bordeaux, Saint Pierre-des-Corps and Nantes, each depot

having seven operation departments; namely: laundry, clothing, shoes, rubber goods, leather and harness, canvas and webbing, and metal. Shops were in operation at Angers, Paris, Bazoilles, Savenay, Gièvres, Chaumont, Saint Aignan, Brest, Rochefort, Vittel, Le Mans, Tours, Nancy and Marseille, as well as at Winchester in England. (A shop was opened at Coblenz for the Army of Occupation).

The total ground space occupied by the Salvage Service on February 18, 1919, including space occupied by 108 buildings, was 2,574,080 square feet. The combined floor space of depots, shops and laundries was 989,860 square feet, of which 177,425 square feet owned by the United States, the balance being leased.

CHARACTER OF OUTPUTS.

Hundreds of kinds of articles were made in the various shops from scrap materials. For instance, when overcoats were ordered shortened, the tails clipped from them were used to make insignia, brassards, overseas caps and the uppers of hospital slippers, the soles of which were made from old campaign hats and the old type of legging. Cotton rags were sold to paper manufacturers and scrap wool cloth to the British authorities. Grave registration tags, engine curtains, effects bags and shipping bags were only a few of the countless other articles turned out as the by-products of waste.

Salvaged uniforms were dyed green and supplied to German prisoners of war, 47,000 of whom were clothed and otherwise equipped by the Salvage Service at a saving to the Government of about $2,820,000.00.

KITCHEN ECONOMICS.

The Kitchen Economics Branch of the Salvage Service, established April 14, 1918, reclaimed or disposed of condemned canned goods, flour, sugar, rice, beans, prunes, dried peaches, apples and apricots, etc.; forage salvage; kitchen by-products of field organizations, such as bones, fats and drippings, stale bread, swill, empty cans, empty sacks, burlap or wrappings from frozen beef, paper, rope, twine, bottles, boxes, barrels, kegs, etc.; and from dead animals and hair. These articles were either sold or converted into soap, tallow, dubbin, hog-food, chicken-food, glycerine, etc., at the main plant at Lapouderie, near Tours, or the subsidiary plants at Bordeaux, Brest, Gièvres, Is-sur-Tille and Saint Nazaire.

First experiments in salvaging kitchen by-products were conducted in the fall of 1917 by Captain (later Lieutenant-Colonel) Clinton G. Holden, Q. M. C., who at that time was Quartermaster of the American camps at Southampton, Ramsey and Winchester,

England. In February 1918, the establishment of a system of kitchen by-products salvage similar to that of the British was approved and the money received by the units or organizations for these by-products went into a common fund for the benefit of the men, to be used by each unit or organization as it pleased.

The first degreasing plant, taken over from the Butchers' Association at Tours, was placed in operation on April 1, 1918, but it was not until May that the Kitchen Economics Branch began to function actively.

On May 1, 1918, a degreasing plant was established at Saint Symphorien, near Tours. (September 2 this plant was destroyed by fire). September 5, 1918, a new plant was established at Ville-aux-Dames for grease rendering and the manufacture of soap and dubbin. (A specialty of this plant was the manufacture of a sanitary disinfecting soap used in the embarkation areas for troops returning to the United States.) Other degreasing and rendering plants were in operation at Bordeaux, Is-sur-Tille and St. Nazaire, with a small rendering apparatus at Gièvres.

Up to and including December 31, 1918, the Kitchen Economics Branch had made recoveries aggregating $474,515.12. In January 1919, the recoveries amounted to $104,460.02, and in February to $122,397.17, of which $79,421.41 represented sales and $42,975.76 represented supplies recovered for reissue during the month. During March, sales were effected of damaged subsistence stores amounting to $81,536.12, and materials valued at $73,735.18 were restored to condition for reissue, making an aggregate of $155,271.30.

SALVAGE FROM THE BATTLEFIELDS.

The enormous quantities of ammunition and arms of all calibers left in the wake of the retreating Germans could be appreciated only by those whose task it was to clear the bestrewn battlefields. (The estimated value of battlefield recoveries for 1918 was $15,100,000.00.) Aside from approximately 180 truckloads of other materials, the Salvage Service collected the following ammunition in the Château-Thierry area alone:

French:		American:	
8 mm.	rounds 3,831,715	30-caliber	rounds 3,260,145
37 mm.	do 1,771	45-caliber	do 1,600
75 mm.	do 28,849	German:	
105 mm.	do 213	Small arms ammunition	rounds 332,985
75 mm. empty brass cas'ngs	5,375	77 mm.	do 3,576
3-inch Stokes	rounds 4,725	105 mm.	do 8,588
Grenades, mixed	19,790	150 mm.	do 398
Pyrotechnics, mixed	12,909	Grenades	55
Fuses	14,181	Fuses, mixed	794
Powder charges	1,722	Powder charges	783

Pioneer infantry and labor battalions assisted in the collection of salvage in the St. Mihiel Offensive.

Up until October 9, 1918, when that area was taken over by the Second Army, the Salvage Service had handled property with the following valuations:

Ammunition	$1,989,000.00
Ordnance equipment, including 6,000 rifles	623,000.00
Quartermaster property	620,000.00
Miscellaneous material	18,000.00

As this account deals with conditions only up to the time of the Armistice and as the most striking and important figures regarding the work of the Salvage Service, especially those pertaining to battlefield recoveries, were not available at that time, a few of them are given as footnotes to show what was really accomplished through work well under way weeks before November 11, 1918.[3]

LAUNDRIES.

In addition to the laundries at the salvage depots, where all repaired articles were laundered preparatory to reissue, and at hospitals, the Salvage Service operated mobile laundries in the field. These movable units, complete in themselves, comprised two large automatic trucks containing mangles, boilers, electric light plants and even pumping apparatus by means of which they could obtain their own water supply from any stream or spring near which they happened to be stationed. Some of these had an average capacity of 5,000 pieces daily.

On November 30, 1918, there were 66 laundries in operation, of which 36 were mobile. During December 1918, laundry production records, exclusive of several millions of pieces handled by mobile laundries and field sterilizers, showed a total of 7,811,566 pieces. This number increased in January 1919, to 8,061,141 pieces and in March to 9,768,842 pieces.

BATHING AND DISINFECTING.

Responsibility for the establishment of bathing and disinfecting plants for troops operating in the zone of advance was fixed upon

[3] Operations were started in the Meuse-Argonne sector with one salvage squad to a division and transportation borrowed from the divisions. Twenty-five trucks were assigned on October 19, 1918, and by December 4, 1918, 12,000 men and 250 trucks were being utilized

The Chief Salvage Officer of the First Army reported to the Chief Quartermaster, First Army, that on December 24, 1918, there were at railheads approximately 5,000 French carloads of material of all kinds awaiting shipment. Classified salvage reports indicate that up to February 11, 1919, 510 cannon of all caliber, 76 caissons and 8 limbers had been shipped, and that on January 18, 1919, there were still 317 cannon of all descriptions, 116 caissons and 19 limbers in the old First Army battle area.

As a result of salvage operations in the First Army battle area during January, 1919, 1,521 cars, containing 4,272,969 articles, were shipped to the various depots.

the Quartermaster Corps by Bulletin No. 12, Headquarters, Services of Supply, May 20, 1918. Mobile delousers, both horse-drawn and steam-driven, were operated by Quartermaster personnel with the divisions in the field, and bathing and disinfecting plants were systematically built up at base ports, training areas and permanent camp locations.

After the signing of the Armistice, large bath houses and delousing plants were established in the embarkation centers and in the occupied regions in Germany. In February 1919, this branch of the work had increased until it included 282 officers and 1,398 enlisted men. On November 30, 1918, 77 disinfectors were in operation, of which 54 were mobile. In February 1919, there were 134 mobile disinfectors, 40 stationary disinfectors, 257 of the improvised type, and 79 hot air disinfectors. In the same month there were 545 stationary baths, 517 of the portable type and 21 mobile baths in operation.

SALVAGE IN ENGLAND.

In England, a large part of the salvaged material, such as could not easily be returned to use, was turned over to the British Salvage Service for disposal for the United States Government. Salvage operations there were commenced at the Winchester rest camps and were later extended to Knotty Ash and, then, in a modified form, to London. The personnel of the department at Winchester increased from one officer and three enlisted men, at the beginning, to a force of 40 men at the cessation of hostilities.

BAGGAGE SERVICE.

A comparatively new activity of the Quartermaster Corps, which functioned in direct liaison with the United States and which, next to the Army Transport Service, perhaps, was of most vital interest to the home-going American Expeditionary Forces, was the Baggage Service, organized by the Chief Quartermaster as a branch of the Salvage Service under General Orders No. 62, Headquarters, Services of Supply, December 5, 1918. This new branch was made responsible for the supervision of the movement of all baggage from the time it came into the possession of the Baggage Service, American E. F., until it was turned over to its owner in France or to the United States, or to the Director General of Transportation (Army Transport Service), on the docks at the port of embarkation.

The baggage was handled through the Central Baggage Service in liaison with the ports of debarkation at Hoboken and Newport News. The baggage service at Hoboken, N. J., and Newport

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News, Va., functioned through, and in liaison with, the lost baggage depot at Hoboken, the Adjutant General's Office at Washington, and the various demobilization camps.

STATISTICS—COST OF OPERATION.

The total cost of the operations of the Salvage Service, as compared with the value of the output of depots and shops, was 11 per cent. Dividing activities into general branches, the cost of clothing repairs equalled 5½ per cent of the value of the clothing output; canvas and webbing, 11¼ per cent; rubber goods, 7½ per cent; leather and harness, 3½ per cent; shoes 20 per cent and metal 10 per cent. These figures include all costs of material, rental, employees' salaries, and in fact, all expenses except depreciation on machinery.

The percentage of repair on rubber boots has been as high as 98 per cent. Shoes have been repaired at as low a cost as 24 cents each, this including all charges except leather and nails used. A uniform costing $16.11 was repaired for 90 cents, this including all materials, labor and overhead expenses. Hip rubber boots, costing $6.15, were repaired at a cost of 69 cents a pair, all charges included, while the complete expenses of repairing a campaign hat was 18½ cents.

The percentage of salvage recoveries from articles shipped to depots, requiring both renovation and repair, aggregated 91 per cent up to December 31, 1918. The remaining 9 per cent was largely used as raw material in patching, mending and renovation. This percentage dropped to 84 per cent in January, 1919, and fell to 74 per cent in February and 69 per cent in March, largely due to the fact that material gathered recently from the battle area was in advanced stage of deterioration.

Based on price lists furnished the Statistical Branch of the Salvage Service by the Quartermaster, Engineer, and Motor Transport Corps, the following valuations were arrived at:

Unserviceable material shipped:	
Quartermaster property	$4,956,740.11
Ordnance property	15,846,217.83
Engineer property	6,691.90
Miscellaneous property	43,159.00
	20,852,808.84
Serviceable material shipped:	
Quartermaster property	$89,747.25
Ordnance property	31,347.23
Engineer property	110,902.95
Miscellaneous property	5,000.00
	237,097.43

The totals $21,089,906.27 were discounted by $10,000,000.00 and the valuation of the field service recoveries for January, 1919, were placed at $11,089,906.27.

In addition to this, $21,124.90 worth of serviceable property was issued direct from salvage recoveries in the battle area.

German cannon of all descriptions, trench mortars, machine guns and other material were handled by the Salvage Service but never classified as of any intrinsic value. Much of this was shipped to the United States for technical military study and trophy display.

Total recoveries and sales for 1918 have been valued as follows:

Output of depots and shops	$47,018,374.01
Field recoveries	15,100,000.00
Kitchen economics recoveries	474,515.12
Waste sales	39,680.23
Rubber salvaged (1,591,565 pounds at 10 cents)	159,156.50
Wool cloth shipped to British (359,920 pounds at 20 cents)	71,984.00
Lumber salvaged (1,747,940 board feet)	69,025.20
	62,932,735.06

CHAPTER XXVI.

SECTION I.

INLAND WATER TRANSPORT (BRITISH).

Preliminary.—(1) The Docks Directorate was constituted in the autumn of 1916 as one of the transportation directorates. The object in view in the creation of this directorate was threefold:

(I) The directorate was intended to complete the chain of land transportation directorates for the movement of material under the unified control of the Director General of Transportation (D. G. T.). Its function was to link up, on the one hand, with the Railway and Inland Water Transport Directorates, and on the other with the sea transport under the control of the Transport Department of the Admiralty. The landing of stores in the docks and their passage through the dock area into railway wagon or barge formed an integral part of the complete transport operation, and it was necessary that this should be placed under the control of the Director General of Transportation in order to secure the most efficient working throughout. The directorate was not intended to deal with the movement of personnel.

(II) The shortage of shipping for the military and civil requirements of the Allied Governments was becoming more and more felt. Complaint had been made as to the congestion at French ports and to the delay to vessels occuring there. It was essential to improve the methods of landing and handling cargo at French ports so as to expedite the discharge of shipping. To achieve this purpose it was necessary to get together an expert staff accustomed in peace time to the handling of cargo at British ports, and to group the various responsibilities involved under one directorate.

(III) A third determining cause for the creation of the directorate which, however, was of less immediate urgency, lay in the necessity of economizing berth accommodations at the French ports. These ports were handling a tonnage much in excess of peace time requirements, and in order to reduce the existing congestion, as well as to meet the still larger demands likely to arise in the near future, it was essential to increase the capacity of the accommodations placed by the French authorities at the disposal of the British Army in the various ports. This could only be done by the adoption of the best appliances and the most specialized method of handling cargoes.

INLAND WATER TRANSPORT DIRECTORATE.

Chart 1, Chapter XXVII, Vol. I.)

Definite scheme evolved.—General Holland, who had investigated conditions in France with reference to inland water transport, placed before the War Office a definite scheme for the formation and equipment of such an organization. The craft which remained on the northern waterways of France were very few in number, and he therefore recommended the purchase of any craft already in commission in England and continental countries which would be suitable in size and designs for the work projected, and that orders should be placed immediately for the construction of a number of new vessels. He also pointed out that the system of towage by means of horses, which was in such extensive use in France, would not cope efficiently with the heavy demands which he foresaw would be made for the transport of war material by water. He therefore recommended that tugs be used for towage purposes, and also called attention to the needs for special types of self propelled barges, which would be capable of ensuring a more speedy transport of cargoes of material which were very urgently needed than would be possible in the case of tugs with barges in tow, whose movement are naturally slow owing to the length of time occupied in passing the barges through the locks. The suggestion was also made that vessels designed especially for dealing with the reconstruction and maintenance of the waterways should be provided. The necessity of an efficient telephone system connecting station to station on the waterways was pointed out, and proposals were put forward as to the number and necessary qualifications of officers, non-commissioned officers and men who would be required for the service.

Responsibilities of the Inland Water Transport Service (I. W. T.) The provision of the vessels and personnel required for work on the waterways; transport of supplies and materials of all kinds, as required by the armies; clearing of debris from the waterways caused by accidents or demolitions of the enemy; repair and renewals of locks and lock gates; working of the inland waterway quays and docks required for military purposes; provisions and maintenance of telephone lines required for working the canal and river traffic; regulating of traffic on the waterways; operating of lift and swing bridges across the waterways in the rear of the British Army; and the working of the locks in Belgium and France behind the Army until again taken over by the "Bridges and Highways" (Ponts et Chaussées) establishments of these countries.

Acquisition of craft.—While this work in connection with the provision of personnel was going on, the preparation of the designs

for the different types of vessels required was put in hand, and orders for the craft were placed with various ship-building firms. A number of tugs, motor launches, and other vessels already in use in England and of suitable dimensions were purchased, and steps were immediately taken to equip them with the necessary stores in readiness for their work in France. The question of the supply of stores and equipment for the carrying on of the work in France was also thoroughly considered, and this section of the general organization of the work of the Inland Water Transport service was started on an efficient basis.

The zone in which the early operations of the Inland Water Transport Service took place was limited to the northern waterways; the transport work taking place on the rivers and canals connecting Calais, Dunkerque, Armentières and Béthune.

The utility of what was then being done, however, soon made itself apparent. The relief afforded to the railway system—which was at all times heavily taxed—was appreciated, and as the military operations increased in intensity and the area over which the Army was operating enlarged, so the demands for water transport grew, and additional waterways and district stations had to be opened up. In the summer of 1915, the transport of materials for the British Army on the River Somme was commenced, and during the ensuing months, and especially during the period of active operations on the Somme, the Inland Water Transport Service rendered valuable help in the transport of wounded, rations, road metalling and ammunition for the divisions operating in that area.

At a later date, (September 1916) the congestion of the docks on the Seine having become a serious proposition, a fleet of I. W. T. craft was sent round to this river. Quays were constructed by I. W. T. labor and a very considerable traffic commenced in the port of Havre, while a fair amount of transport work was also undertaken at Rouen and La Mailleraye. In the summer of 1917, when the Fourth Army took over the coast sector of the Allied line, a considerable amount of transport work was undertaken for this army, road metal, engineering stores, troops and wounded being conveyed along the Dunkerque-Furnes and Furnes-Nieuport canals to various discharging points.

On the 8th July 1917, the retreat of the enemy having rendered the navigation of the River Scarpe possible, and the necessity for water transport in that neighborhood being felt, operations were commenced on that river. While the tonnage figures regarding the work in this area are not large, the transport effected was of a valuable nature in that it was possible to take up trench material, etc., to within a very short distance of the front lines by means of small craft in tow of motor launches, in addition to which the con-

veyance of wounded by barges from the forward to the back areas was coped with in a satisfactory manner. (Chart 2, Chapter XXVII, Vol. I.)

The transportation of the large and varied mass of material and supplies required to meet the needs of the armies operating at and near the front, the carrying of wounded by means of specially designed hospital barges, the provisions of purified drinking water to the troops by " Water Filtration " units, the reconstruction and maintenance of the waterways and the building of new quays and erection of barracks and workshops, the repair and maintenance of the I. W. T. fleet and the many other subsidiary services which the Inland Water Transport had had the opportunity of rendering are the subject of detailed review in other chapters.

It would not be out of place here, however, to give a few details in order to illustrate in a general manner the size of and the amount of work done by the British Inland Water Transport Service in France.

The personnel in France increased considerably in strength from its beginning in the early part of 1915, for awhile, at the end of January of that year, there were only five I. W. T. officers and five other ranks in France, a year later those numbers had been increased to 71 officers and 1,623 other ranks, and at the end of December, 1918, the total strength of the Inland Water Transport Service in France was 187 officers and 7,469 other ranks.

In December, 1915, the length of waterways being navigated amounted to 356 kilometers. In December, 1916, a further 125 kilometers had been opened up for traffic, while in December, 1918, the total number of kilometers of navigable waterways on which the I. W. T. was operating reached the figure of 762. The following particulars of the number of craft in operation at various times will convey a general idea of the increasing navigational activities of the service.

Strength of the I. W. T. fleet in France.

	Tugs and launches.	Self propelled barges.	Dumb barges	Dredges	Total.
January, 1915			42		
December, 1915	44	30	266		
December, 1916	81	96	356	8	
December, 1917	132	115	558	4	
December, 1918	175	164	637	4	

Approximate tonnages of materials, etc., carried.

Year ended—	Tons.
December, 1915	205, 047
December, 1916	839, 519
December, 1917	2, 378, 342
December, 1918	2, 843, 795

CHAPTER XXVI.

SECTION II.

TRANSPORT BY INLAND WATERWAYS (FRENCH).

I. ROLE PLAYED BY NAVIGABLE WATERWAYS.

Waterways form a valuable adjunct to railways and highways; they can relieve the traffic upon the latter and can even supplant them if necessary. On account of their slowness and of natural peculiarities (ice jams, overflows, drouths) which may temporarily hinder or interrupt traffic upon them, waterways cannot be employed for rapid transits and their use is therefore limited to the movement of heavy or cumbersome materials or for the evacuation of the sick, as these transports can be carried out at reduced speeds (3 to 4 kilometers per hour at the maximum).

II. GENERAL ORGANIZATION OF THE SERVICE.

(Chart 3, Chapter XXVII, Vol. I.)

The Inland Water Transport Service (Service des Voies Navigables) was not organized by armies, but covered the whole theatre of operations, as did the Railway Service.

At the beginning of the war, the service was organized as follows:

a) In the Zone of the Armies, there was a "Field Navigation Commission" (Commission de Navigation de Campagne), which was attached to General Headquarters (Direction of Railways—"Direction des Chemins de fer"). This commission maintained a number of "Navigation sub-commissions" (Sous-Commissions de Navigation) and had a limited number of special units, i. e.: Companies of mariners (Compagnies de mariniers) at its disposal.

b) In the Zone of the Interior, there was a "Navigation Commission" which was composed of representatives of the Ministry of War and of the Ministry of Public Works.

At the end of 1916, the stabilization of the front and the constant increase in transportation requirements necessitated a more intensive use of navigable waterways, as well as the reorganization of the Inland Water Transport Service. The "Service for the military

operation of navigable waterways" (Service de l'exploitation militaire des voies navigables) included:

1. A Chief of the service, who was a superior officer, engineer of the "Bridges and Highways Corps," and who was stationed at Paris at the Ministry of Public Works.

2. An Assistant Chief, detailed to General Headquarters (Direction of the Rear—D. A.), who was charged with the operation and upkeep of navigable waterways in the Zone of the Armies. He was in command of the special units which were assigned to the Navigation Service. These units, moreover, had been increased and reorganized.

III. OPERATION OF THE SERVICE.

1. *Execution of transports.*—The theatre of operations of the Allied Armies was well provided with navigable waterways: first, there was the system of canals in the "Départements" of Nord and of Pas-de-Calais, numerous canalized rivers (Oise, Somme, Aisne, Marne) and the network of canals in the east of France (canal from the Marne to the Rhine, canal from the Rhône to the Rhine).[1]

Although it was impossible to organize these navigable lines of communication completely and upon the same principle as the railway lines of communication, the methodical exploitation of sections of important canals or of canalized rivers gave very satisfactory results and often made it possible to bring supplies in proximity of the front lines. With this end in view the Inland Water Transport Service at General Headquarters (D. A.) organized "Navigation Regulating Commissions" (Commissions Régulatrices de Navigation)[2] which were charged with the upkeep of certain waterways and with the execution of the transportation plans drawn up by General Headquarters or by the armies. These "Regulating Commissions" cooperated closely with the engineers of the Navigation Service, to assure coordination between the civil and the military barge transportation in the Zone of the Interior. They also cooperated with the armies (as separate units) and with the "Directions of the L. of C." (Directions d'Etapes) for the determination of loading and unloading points. Inasmuch as the employment of waterways necessarily entails the transshipment of cargoes, ports or "water stations" (gares d'eau) had to be regulated very carefully and these also had to be connected either with standard gauge railroads, or, in the advanced zone, with the road or narrow-gauge railway systems.

2. *Personnel and means of transportation.*—Special units were placed at the disposal of the regulating commissions. These were

[1] Chart 4, Chapter XXVII, Vol. I.

[2] In 1917, there were four such Regulating Commissions located at Dunkerque, Compiégne, Toul, and Montbéliard.

called "Sapper Navigation Companies" (Compagnies de Sapeurs de Navigation) and were composed of professional men. Each company consisted of about 200 men. There were six of these companies in 1917–1918.

They were charged with the actual operation of water transports, as well as with the improvement and maintenance of the waterways. For these purposes the "Sapper Navigation Companies" were reinforced by Engineer units which were placed at their disposal temporarily.

Theoretically, each company was equipped with thirty-six barges of from 280 to 300 tons burden (Flemish barges: 36.5 m. by 5 m. by 1.8 m.). This represented floating material with a capacity of about 10,000 tons.

On small canals, such as the "Rhône-Rhine" and the "Somme" canals smaller barges were used (70 to 150 tons). These barges were called "Ourcq flutes" (flûtes de l'Ourcq).

A number of steam tugs were also employed, particularly on the Somme, and especially for the evacuation of seriously wounded (80 to 90 cots per boat).

3. *Output.*—On account of the nature of military operations, navigable waterways were used very little at the beginning of the war. However, when the front became stabilized, water routes became more important.[3]

Supplies of material for the Roads Service and certain Engineer materials made up about 75 per cent of the total tonnage transported; the remaining 25 per cent was taken up, for the most part, by transports of wood, coal, forage and gasoline (petrol).

The following table will give an idea of the traffic on navigable waterways:

Year.	Navigable waterways in the Zone of the Armies.	Tonnage handled in the Zone of the Interior.	Total.
	Tons.	*Tons.*	*Tons.*
1915	452,000	200,000	652,000
1916	670,000	250,000	920,000
1917	750,000	450,000	1,200,000
1918	750,000	350,000	1,300,000

The greatest tonnage handled in the Zone of the Interior by the civil navigation companies was on the Seine, between Le Havre, Rouen and Paris (where barges of from 500 to 1,200 tons were employed).

[3] The British Army organized the important system of canals at its disposal so as to obtain maximum results. It employed over 700 barges (with 60 steam-tugs and 100 motor-tugs) which served large transfer stations. Some of these "stations" could unload nearly 3,000 tons per day. Moreover, about 150 sea-going barges could bring cargoes (without transshipment at the ports of Dunkerque or Calais) from England direct to Guines, Bergues, St. Omer.

CHAPTER XXVI.

SECTION III.

INLAND WATER TRANSPORT SERVICES (BELGIAN).

INTRODUCTORY.

At the beginning of the war, the density of the Belgian railway systems and the abundance of rolling stock permitted the Belgian Army to effect all its transports by rail and caused it to neglect the organization of water transportation.

But, from the time when the base at Antwerp was transferred to the region of Ostende, the necessity for the rapid movement of all supplies obliged the Belgian Army to utilize all available means of transportation, including boats and steamers, at its disposal.

Later, the stabilization of the Belgian front in a region which was criss-crossed by canals, added to the loss of a great amount of railroad facilities and material and to a considerable increase in importations of all kinds, rendered the use of navigable waterways more and more imperious and brought about the formation of a complete organization: "the Service for Transports by Inland Waterways" (Transports par Eaux Intérieures—T. E. I.) in the Belgian Army, for the intensive exploitation of inland waterways.

However it was only in 1917, after this service was actually in operation, that regulations were drawn up which placed this organization on a proper status and enunciated principles of navigation based on practical experiences and requirements.[1]

HISTORY OF THE INLAND WATER TRANSPORT SERVICE OF THE BELGIAN ARMY.

The "Inland Water Transport Service" (Transports par Eaux Intérieures—T. E. I.) was created by the Belgian Army in April, 1915, by means of facilities then existent in the Direction of Maritime Transport. It was an Army service, however, and its chief was under the orders of the Chief of the General Staff, except in the matters of administration, for which he was directly responsible to the Ministry.

[1] A copy of the Regulations for the T. E. I. Service is in the files of the American Section of the Military Board of Allied Supply.

The object of this service was the transportation, within limits prescribed by the General Staff, by inland waterways of materials and supplies destined for the Army.

The service consisted of a "Main Direction" (Direction Centrale) located at Dunkerque, zones of exploitation (operation), navigation personnel, technical branches (annexes), a company of mariners and an administrative unit.

There were five zones of exploitation:

1) The zone of Calais, which extended from Calais to the West.

2) The zone of the Aa, including Gravelines and Bourbourg, and which extended to the West and to Arques (exclusively).

3) The zone of Dunkerque, extending from Bourbourg to Ghyvelde and from Watten to Bergues and Hondschoote.

4) The zone of Furnes, extending from Ghyvelde to Nieuport and Rousbrugge.

5) The zone of Béthune, extending from Beuvry and from Merville to Arques (inclusive).

The technical "annexes" (branches), in order of their importance, consisted of a large dock for repairing ships and a shop for tug-boats, both located at Bourbourg; a salvage service, charged with raising boats which had been sunk by bombardments and with breaking the ice which impeded navigation during the winter freezes.

The system of canals comprised in the above named operating zones included about 300 kilometers of navigable waterways sub-divided as follows: The canal from Calais to the West; the Aa, from St. Omer to Gravelines; the canal of Neufosse, towards Aire and Béthune; the canal of the Haute Colme, from Watten to Bergues; the canal of Bourbourg, from the Aa to Dunkerque; the canal of the Basse Colme, from Bergues to Hondschoote; the canal of Bergues, going from Bergues to Dunkerque; the canal of Furnes, going from Furnes to Furnes-Nieuport; the canal of Loo; the Yser; the canal of the Yperlée, and, in addition thereto, the system of "vaarten" or small secondary canals, which are very numerous in the valley of the Yser. This entire system was not at the exclusive disposal of the Belgian Army, however, but was operated under the supervision of the Interallied Commission at Calais and was used jointly by the British Inland Water Transport, the Belgian T. E. I., and the French Navigation services.

On all the large canals, traction was by means of towing, while on the "vaarten" motorboats were generally employed.

The Belgian T. E. I. Service required about 800 mariners (boatmen) and 11 officers. At the height of its activities, it employed 21 tugs and a flotilla, varying in number according to needs, of from

200 to 300 barges of various tonnage. During the entire period of stabilization, that is to say during more than three years, the T. E. I. transported large quantities of materials and supplies of all kinds to the Belgian front, such as gravel, stone, coal, wood, paving blocks, rails, oats, flour, etc.

The following table will give an idea of the number of tons transported monthly from August 1917 to November 1918, inclusive:

Transported monthly by the T. E. I.

Month.	Materials.	Food.	Fuel.	Miscellaneous.	Total.
1917					
August	24,082	8,255	14,200	26,558	73,095
September	20,583	6,111	14,280	31,870	72,844
October	18,356	4,647	13,890	22,272	59,165
November	11,318	8,731	9,346	10,292	39,687
December	7,851	11,762	21,014	6,418	47,045
1918					
January	4,977	5,334	18,770	7,667	36,748
February	17,062	6,279	13,595	18,639	55,575
March	15,454	10,129	12,694	19,284	57,561
April	13,923	13,943	3,684	22,565	54,115
May	6,041	19,321	1,652	25,957	52,971
June	3,867	7,748	2,509	22,014	36,138
July	13,708	13,205	7,827	29,298	64,038
August	9,810	9,171	7,775	20,956	47,712
September	9,169	7,990	8,040	14,668	39,867
October	9,347	12,853	9,626	9,925	41,751
November	16,319	6,206	5,823	5,503	30,851

All these transports were effected with great regularity and were particularly useful in the movements of large quantities of heavy or cumbersome material.

The T. E. I. rendered great services during the period of stabilization, but it was during the final offensive and the reoccupation of Belgium by the Allies that its role became particularly important.

From a military point of view it was indispensable, from the beginning of the offensive, that the T. E. I. be capable of greater efforts and of greater flexibility. To the credit of this service, it can be affirmed that the various duties entrusted to it were successfully performed and in this connection the following accomplishments should be noted:

1) In the forest of Houthulst, the Belgian medical services were swamped and numerous wounded had to be left on the ground, due to the lack of means of evacuation. The T. E. I., however, succeeded in passing motorboats over the dikes and into the middle Yser and was thus able to organize an evacuation service which, working day and night, saved hundreds of wounded.

2) On the 17th, 18th and 19th of October, 1918, when it became necessary to revictual Ostende, which had been cut off from all bases, the services of the T. E. I. succeeded in bringing supplies overseas and through the mine fields with its barges.

3) Through the same means it became possible to immediately reestablish communication by water with Bruges, although direct connections by canal had been disrupted through the destruction of Nieuport, and liaison between the front and the rear thus remained unbroken.

4) Starting from Bruges, the T. E. I. made reconnaissances in the zones which had been abandoned by the enemy.

The cooperation between the military services and the Public Works services, thanks to the zeal and activity displayed by all, permitted the rapid reestablishment of the lines of approach toward Ghent. As the advance progressed, the lines of communication by water were constantly lengthened so that, when Belgium was re-occupied, these lines extended from Liège to Calais and comprised more than 2,000 kilometers of navigable waterways.

This extensive system had to be operated with the same military personnel which was in service during the stabilization, and this despite the fact that the demands for transportation made upon the T. E. I. increased daily.

After the Armistice, the Direction of the T. E. I. was located in Brussels, and re-occupied Belgium was divided into new zones of operation: Antwerp-Liège, La Louvière-Ghent, Ostende, Bruges; besides Calais and Dunkerque.

When the Army was demobilized, on September 30, 1919, the administration of the T. E. I. passed from the Ministry of War to the Ministry of Railways.

CHAPTER XXVI.

SECTION IV.

TRANSPORTS BY INLAND WATERWAYS (ITALIAN).

GENERAL.

In determining when and to what extent the use of inland water transport is desirable, two points must be considered. One fact is essentially military in character, while the other is primarily economic.

1. The utilization of the waterways for transportation purposes is practicable only when large quantities of bulky supplies are to be transported over great distances.

2. Transport by waterways is warranted only when the floating bottoms (gallegianti) are employed to their maximum capacity.

The first is based upon the fact that the less expense and the longer time required to carry small cargoes by waterways is not compensated by the proportionate relief to the railroads.

The second fact is based on a principle common to all other means of transportation, viz: that the advantage to traffic is increased when a minor quantity of gross weight is required to be moved. Moreover, for water traffic using small floating bottoms in order to more economically utilize the motive power, it would be necessary to unite many barges to a single tug. However, this procedure is impracticable on account of navigational difficulties (locks, width of channel, currents, etc.), and not more than four or five carriers could be used in this way.

The general network of navigable waterways which intersect the Padana valley and the Veneto-Friulano region are more suitable for carrying transports from west to east, on account of the easterly direction of the flow of the more important arteries and because the capacity of these water courses increases toward the east. Therefore, from a military standpoint, the river and canal network of Italy is particularly adaptable in the case of operations along the eastern frontier.

The practicability of using inland waterways in conjunction with the railways for heavy military transport, and of determining when and for what class of supplies this means of transportation may be

adopted, is dependent upon the number of navigable lines and tonnage of available carriers.

In general, a waterway has an almost unlimited capacity because the floating bottoms can follow each other closely and can often travel side by side. The loading and unloading can be effected with more or less ease along the whole course, as it is not necessary to stop at fixed stations as in the case of railways. But, the possibilities of navigable ways are limited by the tonnage of the carriers, the number of available tugs, and by the necessity of crossing engineering works (bridges, etc.), which in Italy's case were quite inadequate in proportion to the waterways on which they were found.

These limitations show that it would not be advisable to employ transportation by waterways to a maximum, but only for such transportation as would effectually relieve railway traffic. As it is the slowness in the loading and unloading of merchandise trains which clogs and encumbers the stations and immobilizes the rolling stock for a long time, it is apparent that the greatest advantage to be derived from inland water transport is in the transportation of bulky material, but not for the movement of personnel.

With particular reference to the initial Italian theater of operations, which remained practically unchanged until the autumn of 1917, the navigable waterways of Upper Italy, particularly those best adapted for transportation purposes, presented the following peculiarities:

A great and unique longitudinal artery, surrounding the theater of war on the south, formed by the Po river (from the confluence of the Ticino) and the network of canals and short rivers which ascend from the Adriatic coast and cross the lagoons of Venice, Marano, Grado, as far as the Isonzato (a tributary of the Isonzo).

A number of transversal waterways (rivers and canals) connecting with the main longitudinal artery mentioned above.

These transversal lines afforded the only passages through the mountains to the rear, and, on account of the mountainous conformation of the front as a whole, natural obstacles were encountered in various parts of the network of waterways which restricted their use as a means of transportation. These difficulties were responsible for the substantial differences in the methods of employment of the waterways in the various sectors.

To the west, in the Upper Garda-Trentino sector, the few existing waterways could not be used for the direct supply of the advanced establishments, either because their courses were too irregular or because the navigable portions of these waterways did not penetrate far enough to the rear. The result was that they

could only be employed for the collection and transport of local products which were then carried to the principal river ports.

In the center, the Cadore-Carnia sector, the transversal branches of the main artery, although conforming closer to the line of the advanced establishments, could not be used directly for the service of these points. Some of the waterways, however, were employed for restocking the important intermediate establishments located at Treviso and Padua.

To the east, on the contrary, in the Carso sector, the numerous transversal waterways of the Friulano plain flowed in the general direction of the second line establishments (Portogruaro, Porto Nogaro, Cervignano) and were well suited to the transport of supplies to these establishments.

Examination of the network of Italian waterways showed that they could be advantageously employed either in forwarding foodstuffs and other supplies, collected in the Lombard-Emilian plains and in the Lower Veneto, to the troops in the Carsico sector, or, for the removal of the sick and wounded, as well as for the salvaged material coming from this sector, to the ports of the central and western parts of the network itself, particularly those on the Po river. To the waterways transport was assigned the first of these functions, with successful results.

This means of transport was of great assistance in the supplying of the Carso sector, especially as the highways in this sector were few and the railway line (Mestre-Portogruaro-Cervignano) had a very limited capacity, on account of its inferior type of equipment.

During the second part of the war, when the Italian Army found itself drawn up on the Piave, the reduced number of navigable waterways necessitated a change in the existing system of water transport. The second line establishments then received their supplies from the Lombard lakes and from the Po by means of water transport, while the first line establishments on the right flank of the new theater of war, which had behind it vast zones of lagoons that were difficult of access, were often supplied in this way.

During the period immediately following the retreat from Caporetto, the Water Transport Service was used for the removal, to the ports on the Po river, of an enormous quantity of material which, owing to the circumstances of the moment, had to be placed in safety.

THE WATER TRANSPORT SERVICE AT THE BEGINNING OF THE WAR.

On the eve of the declaration of war, the Transportation Office and the headquarters of the Medical Service ("S. M.") decided that the Inland Water Transport Service should be employed princi-

pally for the evacuation of the sick and wounded from the advanced medical establishments to the depots in the rear; it was also decided that the supplies of foodstuffs and materials from the interior to the base should be carried in the same manner.

This policy appeared rational because a well organized system of water transport undoubtedly constituted an ideal means for the transfer of the sick, and more especially of the wounded. Some time previous, the Italian Red Cross had even organized a flotilla of ambulance-barges.

As soon as the mobilization was completed, the Transportation Administration at the General Commissariat ordered the "Lagoon Battalion" of the Fourth Regiment of Engineers (its executive agency for the operation of inland water transport) to requisition and prepare 50 floating ambulances, with a total capacity of 1,500 beds. It was to initiate the transport of the sick and wounded in conjunction with the Red Cross flotilla, provide tugs for towing purposes, as well as the necessary personnel for the operation of the floating ambulances, while the Red Cross was to furnish the personnel for the treatment and care of the sick and wounded.

It was soon evident, however, that the evacuation of the sick and wounded by water, on account of the slowness of this means of transport, required the employment of too much medical personnel and in excess of that which the administration could possibly furnish.

The average duration of a round trip by water, as compared with railway transport, covering the same distances and operating under similar conditions, was proportionately three to one, and, in an inverse ratio for the number of medical personnel required.

The use of water transport for the movement of sick and wounded was therefore practically abandoned and, with the prolongation of the war, this means was used more and more for the transport of bulky materials or for the shipment of foodstuffs for the establishments and depots in the rear. Where armies could not be directly supplied from depots, water transport was used in certain localities to form stores which were placed at the disposal of the armies thus situated. In this manner, depots for straw, hay and wood, were organized and placed at the disposal of the Second, Third and Fourth Armies, respectively, as these armies were located so that they could readily avail themselves of the waterways in their rear.

Waterways were also used for the transport of the greater part of the lumber for construction purposes and for that of the mobile huts used by the Third Army. (Chart 5, Chapter XXVII, Volume I.)

MEASURES TAKEN DURING THE WAR TO DEVELOP WATER TRANSPORT.

During the war important construction projects were carried out to develop and increase the usefulness of the waterways. The course of the Tagliamento was improved; a connecting canal was cut between the Venetian lagoons and the Po river; the navigation facilities of the Sile river were also improved; the course of the Bacchiglione, between Padua and Vicenza, was rendered navigable and a canal, six kilometers in length, was cut between the Venetian lagoons and the Isonzo to connect the Tagliamento with the Grado lagoons.

Conditions in the network of navigable waterways were improved and the work of the Inland Water Transport Service facilitated by the inauguration of a system of lagoon canals and by the establishment of telephone communications between the various water stations on the line Venice-Grado. Important inland ports were connected by means of the State telephone systems. Extensive connecting works (raccordo) were also inaugurated between the water ports and the railway stations at Piacenza, Cremona, Mantua and Pontelagoscuro.

ORGANIZATION AND FUNCTIONS OF THE INLAND WATER TRANSPORT SERVICE.

At the beginning of the war the Transportation Administration at the General Commissariat, to which the Inland Water Transport Service belonged, had a "Lagoon Battalion" of Engineers at its disposal. This battalion was subsequently enlarged to meet the ever increasing requirements of the service and, in June 1918, it was transformed into a "Lagoon Regiment" which, in addition to the military personnel organically assigned to it, included 800 workmen and civilian boatmen.

For operation purposes, the Inland Water Transport Service had:

a) Means of transport: Consisting of floating barges or bottoms of various carrying capacities and types. The majority of these were requisitioned from private sources and placed at the disposal of the Lagoon Regiment. There was a total of approximately 1,500 floating bottoms.

b) Means of towing: Consisting of 111 motor vehicles and 270 horses.

The Inland Water Transport Service was organized as follows:

1. The Command of the Lagoon Regiment, at Venice. The command was charged with the technical and administrative direction of the service in accordance with the instructions of the Transportation Administration at the General Commissariat.

2. Three River (Fluvial) Commissions, located at Mantua, Venice and Marano Lagunare. The river commissions assured the opera-

tion of and coordinated transports on the waterways within the territory which had been assigned to them.

3. Thirty-six River Commands, located at the principal ports on the inland waterway systems and responsible for the direct supervision of the transports on the waterways under their jurisdiction.

4. Nine Lake Commands, for the operation of the Inland Water Transport Service on the lakes of Garda, Maggiore, Idro and on the adjacent canals.

During the war, in addition to its strictly military activities, the Inland Water Transport Service cooperated with the sugar and fecula industries and also assured the movement of a great part of the grain supply for the Province of Venice.

Previous to the Italian offensive on the Piave, the Lagoon Regiment prepared a large number of empty floating bottoms for use on the Venetian lagoons. At the beginning of the advance on the Lower Piave numerous small vessels, which had been held in the zones of the Sile and the Piave rivers, were provided to meet the needs of the Army and with the progression of the Italian advance, the impossibility of using the railways, which had been disrupted by the destruction of bridges and equipment, caused the greater part of the transportation requirements to fall upon the Inland Water Transport Service.

The reorganization of the Inland Water Transport Service in the occupied territory was very difficult, as the lines were almost entirely in marshy ground, moreover, the canals were practically unserviceable, as they had been obstructed or partially destroyed by the Italian troops during the retreat of 1917. Finally, telephone communications, which are of great importance in the proper operation of water transport, were almost completely disorganized.

CHAPTER XXVI.

SECTION V.

INLAND WATER TRANSPORT (AMERICAN).[1]

The French railroads having been severely taxed to handle their traffic prior to the commencement of American Expeditionary Forces' operations in France, consideration was early given to the utilization of the inland waterways as a means of diverting part of the American Army's traffic from the railroads. The principal movement was on the Seine between the ports of Le Havre, Rouen, and Paris, with a small movement from Paris to interior points.

[1] Extracted from Report of the Director General of Transportation, A. E. F., "Transportation Service at the date of the Armistice." See Chapter XIV, Vol. II.

CHAPTER XXVII.

SECTION I.

ELECTRICAL SUPPLY (BRITISH).

The principle governing the provision of electric lighting was that hospitals should be lit by electricity, but not camps, except in cases where a supply could be obtained from an existing French electrical company at a reasonable cost per unit.

In all cases, advantage was taken of the existence of French supply companies, and separate electrical installations were only put up by the Director of Works for hospitals, ammunition depots, motor transport, ordnance, or supply depots, and for workshops that could not be served by a public supply company. Later in the war, some separate electrical installations were put up to supplement the supply from French companies, when for some reason that supply became insufficient for the growing requirements.

Electric lighting was never provided specially for camps, remount depots, veterinary hospitals, etc.

In 1914–1915, electrical work was carried out by French contractors, including supply lines, internal wiring and lighting, and even maintenance, there being no establishment in the Works Directorate for electrical and mechanical services.

Early in 1915, the Director of Works brought out a number of civilians, graded as temporary "Inspectors of Works" with temporary and honorary rank.

Among these were men with civilian knowledge and experience of electrical work and of machinery, and from them a "District Officer, Electrical Mechanical Service" (D. O., E and M.), was appointed to take charge of all electrical and mechanical services in each district administered by a Senior Works Officer.

They were assisted by military electricians and military mechanists from the Royal Engineer Corps (R. E.).

The maintenance of electric lighting systems by contract was not satisfactory, and became worse as French labor available for the contractors became more scarce, owing to the call for man-power at the front.

In 1915, District Officers, Electrical-Mechanical Service, obtained the services of a few Royal Engineers (R. E.) electricians from

various Royal Engineer companies employed on the lines of communication, and by the end of 1915, Senior Works Officers had collected a number of "permanent base" (P. B.) infantry with civilian knowledge of electrical and mechanical work to assist in maintenance, and to run machinery, chiefly pumps. This personnel was, however, not organized at all.

In June, 1916, four "Artisan Works" companies were formed for the lines of communication, of which two were allotted to the northern line of communication and two to the southern line of communication. The electrical and mechanical personnel were then attached to these companies.

In January, 1917, two "Electrical and Mechanical" (E. & M.) companies were formed for the lines of communication, of which one was allotted to Line of Communication (North) and one to Line of Communication (South). The men with these companies were obtained by the Director of Works, partly from existing personnel and partly by fresh recruiting from permanent base infantry details, the men being transferred to the Royal Engineers.

The establishment laid down for electricians in an "E. & M." company was only thirty, which was quite insufficient.

As hospitals, camps, depots and workshops increased on the lines of communication with the increase in the armies, the task of maintenance, wiring new institutions and of erecting new electrical plants strained the resources of the Works Directorate to the uttermost, and many important electrical installations were greatly delayed, or hung up for want of personnel.

It appears essential that for a line of communication an establishment should exist to carry out electrical and mechanical services, which can be expanded as increased requirements necessitate.

In 1914–1915, electrical stores were chiefly obtained through contractors, or by local purchase, supplemented by demands made direct on the War Office by Senior Works Officers.

In 1915–1916, electrical machinery, plant and stores had principally to be obtained from England through the War Office.

In 1917, the Engineer-in-Chief assumed control of the provision of all electrical stores, and demands for the same were submitted to him through the Director of Works, who placed demands for electrical machinery direct on the "Chief Mechanical Engineer" (C. M. E.) at the War Office.

At the end of 1917, an Electrical Committee was formed, among whose duties it was to advise on proposed power installations, to standardize transformers, motors and other electrical plant, and to act in a consultant capacity with regard to proposed installations.

It should be noted that in the French Service, electrical and mechanical services were separated, but on the British lines of com-

munication as a rule, both services were carried out by one District Officer, Electrical-Mechanical Service.

The District Officers of the Electrical-Mechanical Service were ex-civilian electrical engineers, who had been holding important appointments in civil life, and it was found that they possessed ample technical knowledge of machinery to erect the pumping engines, prime movers for generators, etc., required to be installed on the lines of communication.

So far as the area occupied by the lines of communication is concerned, it is of the greatest advantage, in an important campaign in a civilized country, to minimize the number of small separate sets of electrical plants and to restrict them as far as possible to movable units.

For fixed installations, such as lighting in camps, hospitals and depots, and power in ordnance, motor transport and other workshops, advantage should be taken of any existing civil generating installations, which would normally in these days provide alternating current conveyed on high tension lines.

Such civil installations may have to be supplemented by generating plants installed by the military, generally turbo-alternators of 1,000 to 2,000 kilowatts.

In France, the current provided was alternating, 3-phase, 50-cycle, and transmitted at voltages of from 3,000 volts up to 45,000 volts and over.

Where civil installations did not exist, it was generally advantageous in any important district to erect a central alternating current generating plant, and to convey power by high tension lines at suitable voltages.

In such cases, the nature of electrical current provided should be similar to that from existing civilian installations, so that it may be possible to feed into existing systems, and also so that transformers, motors, etc., may be standardized.

In the recent war, the number of British troops engaged was at first very small, while the duration of the campaign was greatly underestimated, it was consequently very difficult to form any prevision to what would be necessary. There was a natural tendency to provide small sets, and departments and corps, such as the Motor Transport, the Ordnance, the Royal Air Forces, etc., ordered small low tension direct current generating plants for their own needs.

As workshops and depots increased and expanded, this multiplication of sets involved a great absorption of personnel and a great expenditure in copper. The prime movers were generally petrol engines, requiring considerable personnel to run and to maintain,

and they were not reliable when running day after day for long hours.

For the lighting of hospitals, etc., on the lines of communication, the Director of Works took advantage of the power available from civil electric power installations, and gradually this power was introduced into most workshops, etc., and alternating current motors substituted for direct current motors.

In France, on the low tension side, the system was 110 volts for lighting and 190 volts for power, but for military installations it is recommended that the system should be 3-wire, 220 volts for both power and lighting, except in towns where civil regulations have to be observed.

There are a few cases where direct current is needed; for example, in hospitals for X-Ray work, but the power required is small and the Gaiffe break meets the case. For cranes in docks, direct current may be necessary, generally at 550 volts; this can be provided by motor generators or rotary converters. However, it is not impossible that in the near future alternating current motors may be designed that can run at variable speeds.

In one case only, the supply should certainly be separate and self-contained, i. e., for searchlights, as these are required during enemy air raids just when the current must be cut off at the main sources of supply.

Owing to the lack of technical personnel, it is improbable that motors, etc., installed in Motor Transport and Ordnance workshops, etc., can be installed and run by the District Officer, Electrical-Mechanical Service, of the district, but it is considered that all the internal wiring should be done by the District Officer, Electrical-Mechanical Service, or under his direct supervision, that he should have the right of frequent inspection, and that no new motor should be added without his concurrence in writing. There is otherwise a great danger of a line being overloaded, with resultant grave risk of fire.

CHAPTER XXVII.

SECTION II.

THE ELECTRICAL SUPPLY SERVICES OF THE FRENCH ARMY DURING THE WAR.

I. ORGANIZATION OF THE UNITS CHARGED WITH THE PROVISION AND UTILIZATION OF ELECTRICAL POWER.

To each army and to each "Headquarters of the Lines of Communication" (Direction d'Etapes), was attached an electrical service charged with the study, construction, operation and upkeep of high and low tension military electrical installations, either for lighting purposes or for power. (Chart 1, Chapter XXVIII, Vol. I.)

This service was attached to the "Command of the Army Engineers," (Commandement du Génie) or to the "Headquarters of the L. of C. Engineers" (Direction du Génie d'Etapes) and was commanded by an officer who was the chief of the electrical service of the army or of the "Direction of the L. of C." (Direction d'Etapes—D. E.)

To each army or to each "D. E." was assigned a company of electricians who were under the orders of the chief of the electrical service.

The duties of the Electrical Service were as follows:

First. *High tension installations.*—The service had exclusive charge of the construction, as well as the operation, of all high tension electrical installations: lines, transforming stations, defensive electrical accessories.

Second. *Low tension installations.*—(A) *Lighting.*—The construction, operation, and maintenance of all lighting installations were assured by the Electrical Service, with the exception of installations belonging to units organically provided with generating plants and operating personnel (Headquarters, Medical Service, Air Service).

However, when these units used electrical current from an industrial district or from a military central station, the Electrical Service had technical control of their installations, on account of the influence which they could have upon the entire system.

B. *Electrical power.*—Electrical power stations were installed by the Electrical Service. These stations were operated and maintained by the units which used them.

The companies of electricians included sections for the construction of high tension lines, sections for the construction of low tension lines and a repair shop.

To these companies were attached squads for the operation of air compressing outfits.

II. NATURE OF THE MATÉRIEL USED.

The matériel utilized for the production of electrical power and for the conversion of electricity for lighting and power purposes, such as alternators, steam engines, transformers, generators, motors, lights, wires, cables, insulators, accessories, either for alternating or direct current, were of the standard types in normal use commercially. Only the matériel for the electrification of defense accessories comprised certain appliances which were specially designed for the usage to which they were to be applied.

Standardization, at the beginning of 1917, in the construction of high tension service lines which were fed by the existing civil central electrical stations in the Zone of the Armies, brought about a great reduction in the quantities of gasoline (essence) previously consumed in generating light and power.

Contracts were drawn up between the "Central establishment for the supply of special matériel" (Etablissement central de matériel spécial—E. C. M. S.) and the civil electrical supply districts in whose zone the lines were constructed. These contracts provided for repurchase after the war.

The output of electrical power from these central stations to the armies was further augmented, at the time of the arrival of the American Army, by increasing the power of the central stations. This increase was obtained by the addition of turbo-alternators and boilers to the engines which were already installed. Their repurchase by the civil districts was provided for under the same conditions as those relating to the lines.

Since the great arteries of distribution, consisting of these high tension lines, were of interest to all of the armies, monthly conferences were held at the headquarters of the "Direction for the study and use of special matériel" (Direction de l'etude et du matériel spécial) at Paris. At these conferences were gathered representatives from the General Headquarters of the army groups, the chiefs of the electrical services of the armies and of the "D. E.'s," and specialists belonging to the electrical service of the "E. C. M. S."

After the arrival of the American Army, interallied conferences were held for the purpose of coordinating the distribution of electrical power to the armies.

III. FUNCTIONING OF THE SUPPLY OF MATÉRIEL—RELATIONS BETWEEN THE "E. C. M. S." AND THE CONSTRUCTING ESTABLISHMENTS.

The electrical services of the "E. C. M. S." were charged with supplying the armies, not only with electrical matériel for lighting and power purposes; but also with field matériel, generating outfits and their accessories and matériel for permanent high tension and low tension installations. Requests for matériel from the chiefs of the electrical services of the armies were transmitted by General Headquarters to the "E. C. M. S.," which filled them by drawing upon the stocks in its storehouses. These stocks were constantly renewed by orders given to industrial firms.

ANNEX—CHAPTER XXVII—SECTION II.

Matériel delivered to the French Armies or to the Allied Armies.

	French Army.	American Army.
Continuous current generators	2,477	289
Triphase motors	1,035	114
Transformers	723	36
Electrical bulbs	1,800,000	
Apparatus for the electrification of defense accessories	70	10

MATÉRIEL, OTHER THAN ELECTRICAL, DELIVERED BY THE "E. C. M. S."

Air compressors		113	1
Elevators		58	1
Conveyors		531	1
Electrical winches for mines		147	4
Mine ventilators		2,486	14
Protective masks against carbon oxyde in mine warfare		241	39
Mine bars		177	43
Drilling apparatus, small bore		5,552	
Drilling apparatus, large bore		290	
Listening sets for mines, direct connections		2,593	1,266
Listening sets for mines, telephone connections		449	1,233
Aural signalling apparatus		2,553	121
"Mattei" combat apparatus		3,634	14
Periscopes		82,823	8,982
Road-bridges, system "Pigeaud"	M.	500	
Suspension road-bridges "Gisclard-Pigeaud" system	M.	1,000	
Armored shelters for observers and sentinels		20,779	15,530
Parts of Light rounded and corrugated sheet-metal shelters		194,881	56
Bucklers (shields)		230,316	134,831

CHAPTER XXVII.

SECTION III.

ELECTRICAL SERVICES (ITALIAN).

FORMATION OF THE SERVICES.

At the beginning of the war, the Engineer commands of the large units had no special organization to provide for the various electrical services and, as exigencies required, the commands made contracts with private concerns for the supply of the necessary electric power.

However, the military electrical services soon became so complicated and important as to necessitate the formation of special technical organizations with the military Engineer commands and, in November, 1915, the "Army Electrical Plant Offices" were organized.

These offices consisted of directing and operating personnel and included a small laboratory.

Subsequently, in June, 1918, General Headquarters (Comando Supremo) directed that an "Autonomous Electrical Section," be organized in each command of army Engineers. This organization absorbed the above-mentioned electrical offices.

The duties of these sections were:

1. Produce, carry, and distribute electric power to headquarters, hospitals, offices, cantonments, huts, etc., and furnish adequate lighting facilities for the services with the greatest possible security, particularly in the huts and depots.

2. Supply the necessary power to the various parks, shops, laboratories, pumps, dredges, drilling machines, aerial railways, and hydraulic plants.

3. Carry power into the advanced zone for heating and lighting purposes and for the electrification of defensive entanglements.

4. Establish a regular electrical traction service with accumulators and overhead railways.

A large quantity of electrical power was needed to satisfy the above requirements and it was essential that the production and distribution of the necessary current for the various services should never fail.

Electrical supply services were organized in the various armies, partly by taking over civilian plants and lines which were located in

the forward zones, partly by operating plants in the territory formerly occupied by the enemy, by combining the above mentioned plants with subsidiary ones, establishing divisional stations (Smistamento) and transformation plants, enlarging the existing distribution lines or constructing new ones, subdividing the lines themselves into circles, and by establishing appropriate connections between the various producing centers so as to assure the supply of power to the lines in case of damage to any given center or to any given portion of the main conductors.

HYDROELECTRIC CENTERS AND STATIONS.

The electric current supplied to the services, either for illumination or for power purposes, was generally provided by the hydroelectric centers. The primary lines left these centers and carried the electric current to the junction stations, to the secondary lines, and to the transformer stations.

The current was triple phase (trifase) and its tension varied throughout the vast zone under the control of the Engineer commands. There were currents of 30,000 volts, (as at the center at Fonzaso); of 25,000 volts (at Carpane) and of 10,000, 7,000, 5,000, and 2,000 volts, respectively. Appropriate transformers produced a tension adapted to the various plants of the army services.

Among the more important hydroelectric centers restored by the army electrical services may be mentioned those of Foghano, Montfalcone, Redipuglia and Vermegliano, which produced electric power up to 10,000 volts.

These centers had been seriously damaged by the enemy before retiring and were still further damaged by artillery fire, so that extensive repairs to the basins and canals, turbines, alternators, etc., were necessary before they could be put into a thorough state of efficiency. It was even necessary, in certain cases, for the military electricians to rebuilt alternators.

The junction stations were generally constructed of brick; the transformer stations of brick, tarpaulin and wood, according to the durability required. Some transformer stations were built on poles. To obtain an idea of the importance of this work, it may be stated that, up to the end of October 1917, in the territory of the Third Army, the military electrical units constructed 10 junction stations and 80 transformer stations. In the Sixth Army, from November 1917 to October 1918, these troops built 29 transformer stations and sub-stations.

Special precautions were necessary, at the centers and in the stations, to protect the plants from static, as well as from over-

tension due to other causes, such as the action of the donkey-engines (motori asineroni) attached to the complicated lines, or that of old and defective alternators.

CONDUCTORS (CONDUTTORI).

For conductors on pole lines, as far as possible, the existing supports were employed; for new ones, chestnut and pine poles that had been treated with creosote were used; while for the crossing of railways and rivers, where more strength was needed, tripods were employed.

Conductors constructed within sight of the enemy, or in the advanced zone, were placed on shorter poles than those in the rear zones, moreover, dark insulators were used.

Where the lines were exposed to enemy fire, underground reserve cables (cavi) were used and these were also employed to carry high tension conductors. The underground system followed a different route from that of the aerial lines, in order to assure power for the various services in the event of a break in the aerial lines.

To economize copper in the construction of lines and to restrict its use to a minimum, the principal triple-phase artery was laid with "neutro"; regions where only one light was necessary were fed by one-phase lines. Interior installations were of two types, according to the nature and use of the buildings in which they were installed.

For brick buildings, insulated wires were generally adopted; for wooden huts and munitions depots, ammunition-loading establishments, saw-mills, etc., conductors were inclosed in Bergmann tubes, and interruptors and currents were adopted which gave the greatest insulation and protection. The lamps were inclosed in suitable globes provided with metal protectors.

As examples of the construction carried out by the troops, the following figures are of interest: The Third Army, up to October 1917, constructed over 197,500 meters of high tension lines (10,000; 5,000; 2,000 volts) and the Sixth Army, during the period from November 1917 to October 1918, constructed about 48,000 meters of high tension lines (25,000; 7,000; 5,000 volts) and 235,000 meters of low tension lines.

THERMO-ELECTRIC CENTERS.

The necessary electric power for the various services of the Army was produced only by the hydro-electric centers, but, in some of the advanced zone positions, the lighting, ventilating and heating plants were provided by means of thermo-electric groups which

consisted of engines of varying power, assisted by dynamos. The plants were completed by switches and light and power circuits to which were attached lamps, ventilating fans and electric stoves. These electrical groups were obtained, in general, from those taken from the enemy and restored to a working condition.

ELECTRIC TRANSPORTATION.

In order to decrease the excessive consumption of benzine by motor transportation, electric power was also employed for transportation purposes and was used to operate auto-trucks equipped with accumulators or aerial railways.

Groups of accumulators were established at suitable centers and each center had a certain number of auto-trucks assigned to it, according to the exigencies of the service in that zone. Each auto-truck was assigned an average daily run of about 60 kilometers.

For the aerial railways, the electric power furnished by the primary lines underwent an appropriate transformation, either in transformers which reduced the tension, or in groups of converters which supplied continuous current to the contact lines of the aerial railways. The continuous current which fed the line of contact had a tension of 600 volts.

The following deserve special mention:

(a) The Primolano-Enego aerial railway, length 12 kilometers, with an average suspension of 6 per cent and a maximum of 11 per cent, rose to a height of 567 meters in 10 kilometers and had a curve of 5 meters.

The line of contact was supported on larch or pine poles at a height of 5.5 meters above the road. The triple phase electric power furnished by the hydroelectric center at Fonzaso at 30,000 volts was reduced to 6,000 volts and carried to two converting sub-stations, which supplied a continuous current of 600 volts for the line of contact. In this manner it was possible to obtain a total power of 150 kilowatts, which was sufficient to assure a traffic of five carriers in both directions on the aerial railway, with a total transporting capacity of 100 tons daily.

(b) The Bribano-Agordo aerial railway, length 31 kilometers. It had three sub-stations, fed by a triple-phase current of 10,000 volts, which produced 400 kilowatts of continuous current for the line of contact.

(c) The Calalzo-Auronzo aerial railway, length 20 kilometers, had one converter sub-station, fed by a triple phase current of 6,000 volts, which provided 100 kilowatts of continuous current for the line of contact.

(d) The Fonzaso-Fiera di Primiero aerial railway, length 30 kilometers, had three converter sub-stations, fed by a triple phase current of 10,000 volts, which produced, altogether, 450 kilowatts of continuous current for the line of contact.

These plants were put out of commission during the events of October 1917. However, a considerable quantity of the material used in their construction was salvaged.

After the above mentioned period, the Tirano-Bormio aerial railway was constructed, having a length of 40 kilometers, with four substations for transforming the triple phase currents of 10,000 and 6,000 volts into a continuous current of a total strength of 550 kilowatts. Similar provisions were made for the operation of the Edolo-Ponte di Legno aerial railway, length 20 kilometers.

ELECTRIFICATION OF WIRE ENTANGLEMENTS.

Another very important duty entrusted to the military electrical services was the electrification of the wire entanglements. For this purpose, possible only for those entanglements constructed with wooden stakes (even where many of the strands touched the ground), use was made of either direct 2,000-volt current, or of an intermittent 10,000-volt current.

Where it had been foreseen that a continuous current of 2,000 volts might lose its effect after a stated time, in special circumstances, feeding cables of 10,000 volts were started in order to throw currents into the entanglements of such intensity as might be deemed necessary.

SUPPLY OF ELECTRICAL MATERIAL.

Material taken from the enemy was repaired and used for the electrical plants mentioned above, as well as that from the Engineer parks and storehouses, and materials were provided directly by commercial firms whenever the parks were unable to furnish them. It should be remembered that it was not always possible to obtain apparatus and material of similar design to those in existing plants and it became necessary, therefore, to use whatever material was found at hand or that which could be purchased readily.

CHAPTER XXVII.

SECTION IV.

ELECTRICAL-MECHANICAL SERVICE WITH THE ARMIES (AMERICAN).[1]

ORGANIZATION.

An Electrical-Mechanical Section was established in the office of the Chief Engineer, American Expeditionary Forces, in August, 1917, and charged with responsibility in all matters of an electrical-mechanical nature.

The American Expeditionary Forces was divided into districts, with an officer in responsible charge of all electrical and mechanical matters within each district. These districts were coordinated by the Electrical-Mechanical Section, Office Chief Engineer, American Expeditionary Forces.

In general, the zone corresponding to the line of communications (Services of Supply) and the zone of each army comprised the respective districts. These were further divided into subdistricts as developments required. They were determined by territorial rather than military jurisdictional boundaries in order to avoid shifting control of plant or overlapping of effort.

As the electrical-mechanical work developed there came about a clear division between the Electrical-Mechanical Section, Office Chief Engineer, and the Plant Construction Division of the Division of Construction and Forestry. The activities of the former were limited to operations within the army zones, while electric-power developments within Services of Supply areas were carried out under the Division of Construction and Forestry.

FUNCTION.

The functions of the Electrical-Mechanical Service comprised the installation, operation, maintenance, inspection, transfer and salvage of all stationary electrical and mechanical plant other than that controlled by staff departments and other services not included within

[1] Extracted and compiled from Historical Report of the Chief Engineer, A. E. F., and Report of Director of Construction and Forestry to the Commanding General, Service of Supply.

the Engineering Department. All plant of an unusual nature which would not otherwise have been specifically cared for was thus definitely placed, as well as the usual plant for lighting, power, etc. The functions also included the performing of all service of an electrical-mechanical nature and the installation, operation, maintenance, etc., of pumping plant for the Water Supply Service in the advanced areas, the Electrical-Mechanical and Water Supply Services cooperating where they thus came in contact.

An Engineer regiment of electrical and mechanical specialists was assigned to each army as the latter were formed.

The electrical-mechanical organization was extended to the district comprising the line of communications (Services of Supply) in January 1918, when arrangements were made with the Chief Engineer thereof to establish an Electrical-Mechanical Section in his office, to which officers of suitable qualifications were assigned.

The early work consisted of some 30 separate plants, ranging in size from 1 to 200 kilowatts, with an approximate aggregate capacity of 600 kilowatts, together with the necessary wiring of buildings.

The advantages of utilizing all available French sources of power for the needs of the American Expeditionary Forces were early seen and a complete investigation was made of all French power plants and transmission lines within the French Zone of the Army, along the front from Château-Thierry to the Swiss border. This information was later distributed in the form of complete maps.

An investigation was made of European markets with a view to securing all possible electrical-mechanical supplies therefrom so as to relieve congestion in tonnage and to overcome difficulties due to delays in the receipt of supplies from the United States. As a result a great part of the early supplies were obtained in Europe. A systematic record of electrical-mechanical supplies was established and maintained until the Armistice.

Among its other activities the Electrical-Mechanical Section prepared and issued to all concerned an "Electrical-Mechanical Manual," in which was included technical information needed in the field, and a complete catalogue of standardized supplies.

Standard lighting outfits, including generator set and all material necessary for lighting corps and division headquarters and for the dugouts and evacuation hospitals were developed and issued from the depots as complete units.

Under the reorganization of the Engineer Department in July, 1918, when the Division of Military Engineering and Engineer Supplies was created as a subdivision of the office of the Chief Engineer, the Electrical-Mechanical Section was attached thereto. It, however, retained its former duties and its relations with the

Chief Engineer, American Expeditionary Forces, as well as with the Division of Military Engineering and Engineer Supplies, and kept in touch with the electrical-mechanical activities in the field. Numerous complete power plants were requisitioned in Europe, this being done whenever possible to save tonnage. However, in order to meet the rapidly increasing demand for power which the markets of Europe could not supply, designs and specifications of certain suitable standard steam electric power plants complete were made, and requisitions placed on the United States for a total of 56 of them, in sizes of 125, 350, and 500 k. v. a.

At the time of the Armistice, the activities of the Electrical-Mechanical Section, American Expeditionary Forces were covered as follows:

Office of Chief Engineer, American Expeditionary Forces, Division of Military Engineering and Engineer Supplies, Electrical-Mechanical Section as Central Headquarters Office with four officers, engaged in supply of Electrical-Mechanical Service throughout American Expeditionary Forces.

Armies: Electrical-Mechanical troops, with special equipment, shops, etc., engaged in actual execution of pumping, lighting and power plants, etc., within the army areas.

Officers were attached as electrical-mechanical assistants in Office of Chief Engineer of each army, curtailment of electrical-mechanical activities after the Armistice brought about corresponding changes and reduction in all electrical-mechanical personnel. When the Division of Military Engineering and Engineer Supplies was abolished the Electrical-Mechanical Section of the Division of Military Engineering and Engineer Supplies was reattached directly to the Office of the Chief Engineer, American Expeditionary Forces.

UTILIZATION OF ELECTRIC POWER IN THE S. O. S.

In 1918, when the Services of Supply were known as the Lines of Communication, the Chief Engineer Officer, L. O. C., ordered an estimate prepared of the probable power needs of the American Expeditionary Forces in France. It was then foreseen that power would be needed for such purposes as the lighting of hospitals, camps and other army centers, as well as for operating the machinery at many big shops for ordnance, motor truck, locomotive and miscellaneous repair work. A thorough investigation of the situation was made, and it was found that the construction program then contemplated would involve the utilization of 31,000 kilowatts. Translated into nontechnical terms this amount of power would be sufficient to keep about one and a quarter million electric lights burning.

There was organized, as soon as these findings had been submitted, a department, under the Chief Engineer, L. of C., of Electrical and Mechanical Engineering Section, charged with the duty of making all investigations of an engineering nature relative to furnishing power either by French sources or from power plants installed by the American Expeditionary Forces. The policy was adopted of utilizing, wherever possible, French power systems both by building transmission lines, and by increasing the capacity of plants with machinery purchased by the United States Government.

FRENCH POWER MOBILIZED.

All of the power producing plants of France had been mobilized under Government control and placed under the French "Ministry of Armament" (Ministère de l'Armament). This bureau decreed that authority for the use of any power from French sources must be obtained through it, and that such requests should pass through a centralized agency of the American Army. Inasmuch as the Ministry as well as a large number of the main offices of the larger power companies were located in Paris, it was apparent that this American Army agency should also be located there. This resulted in the formation of what was called the Technical Board, placed under control of the General Purchasing Agent and through the latter reporting to the Commanding General, Services of Supply. The Office of the Chief Engineer, American Expeditionary Forces, reporting to the Commanding General, Services of Supply, was responsible for engineering supplies. This organization was later organized into the Division of Military Engineering and Engineer Supplies, under Major General Langfitt, as Chief Engineer, American Expeditionary Forces. All material obtained in foreign market by the latter was through the Engineer Purchasing Officer, under the direction of the General Purchasing Agent at Paris. On questions of a technical nature, direct contract was arranged between the Technical Board and the Engineer Purchasing Officer in Paris.

In the formation of the Division of Construction and Forestry, all engineering, both design and supervision of the construction in connection with electric power was allotted to the chief of the Electrical-Mechanical Section of this division, which had been consolidated with other sections into the Plant Construction Division. The work embraced all electrical and mechanical plants with the exception of water supply installations.

WHERE ELECTRIC POWER WAS NEEDED.

Under the direction of this Electrical-Mechanical Section fell all electrical installations for hospitals, involving about one hundred

and fifty 1,000-bed units, including the 20,000-bed hospitals at Mesves, Mars, Savenay, and Beau Désert, 10,000-bed hospitals at Beaune and Allerey, 5,000-bed hospitals at Périgueux, Kerhoun, Reignac, Avione, La Suge and Montoire, the latter four of which were just started at the date of the signing of the Armistice. There was also designated approximately 125 miles of triple-phase transmission line, of which 25 miles was 40,000-volt, 20 miles 30,000-volt, and the remainder being 10,000 and 5,000-volt, together with power plants for temporary operations and four permanent power plants for the operation of hospital centers. Arrangements were made wherever possible to use electric power for all activities, including pumping, as there is a recognized fuel economy in one large central plant over a number of small units.

Detailed plans were prepared for electrical installation in connection with Gantry cranes for the docks at Marseille, Bassens, La Pallice, and St. Nazaire.

ORDNANCE SHOPS BIGGEST ELECTRICAL JOB.

The Ordnance repair shops at Mehun was the largest single electrical installation for the American Army in France. The engineering for this project had previously been done by the American firm of Stone and Webster for the Ordnance Department. It was, however, necessary to make arrangements for power supply. This necessitated the augmentation of an existing plant (Mazières, at Bourges) with a 5,000-kilowatt turbine generator unit and construction of approximately nine miles of 33,000-volt transmission line. The power requirements of the shop on October 1st, was approximately 2,500 kilowatts with an ultimate requirement of 7,200 kilowatts.

The electrical work in connection with Gantry cranes at Bassens was under direction of the Section Engineer, Base Section No. 2. No electrical construction was started for Gantry cranes at the other points mentioned, although all necessary preliminary plans and arrangements had been made. By special arrangements the 3,500 kilowatt power plant near La Rochelle for serving the car works at Aytre and the dock project at La Pallice, including Gantry cranes, was handled direct by the Section Engineer Officer, Base Section No. 7, material being obtained by the Technical Board of the General Purchasing Agent.

The rotary sub-station of 3,000 kilowatt for serving the Tank factory at Neuvy Pailloux was designated by the Plant Construction Department, Division of Construction and Forestry, as was also the ten mile 30,000 volt transmission line to Châteauroux for serving the same. Material was obtained by the Technical Board of the General Purchasing Agent, the installation made by the Anglo-American Tank Commission.

POWER FOR AIR SERVICE SUPPLIED.

Complete plans were prepared for a 750-kilowatt steam plant at Romorantin, serving the Air Service requirements in the large assembly and repair project at that location. A 1,000-kilowatt steam plant at Bassens docks, as an emergency standby unit for the American Army requirements, was designed to operate on a double-buss system with the "Enérgie Electrique du Sud-Ouest" at that location. Both of the latter plants were obtained in Spain, being complete power plants purchased on the ground, dismantled, and shipped to France. The power plant of the refrigeration plant at Gièvres, was increased to 650-kilowatt capacity to care for the power needs at that location.

CHAPTER XXVIII.

SECTION I.

THE DIRECTORATE OF POSTAL SERVICES (BRITISH).

The Director of the Postal Services was under the orders of the Quartermaster General. He had two deputies under his orders, one at Boulogne and one at Le Havre. (Chart 1, Chapter XXIX, Vol. I.)

The influence of a good postal service upon the morale of the troops can hardly be exaggerated, and the Directorate of Postal Services shows an extraordinary record of efficiency in all situations.

Letters for the troops in France and Flanders bore as address only the name and rank of the addressee and the full designation of the unit to which he was attached, but no indication of its position. In the case of units on the lines of communication and such others as were stationed more or less permanently within reach of a stationary army post office, the address included the number of such office.

All letters were sorted at the home depot in London, and put into bags labelled as follows:

Bases: APO. 1, APO. 2, etc.
Stationary offices on L. of C.: APO. S. 1, APO. S. 2, etc.
Corps troops: H. 1, H. 2, etc.
G. H. Q. troops: G. 1, G. 2, etc.

At the Armistice there were 111 stationary and 412 mobile post offices.

The postal authorities at the bases were kept informed of all movements of troops, and on arrival at the ports the bags were sorted into the following categories:

1. A separate group for each division or corps troops for despatch to railheads by the appropriate supply train.

2. Express bags for the headquarters of armies, corps, divisions and brigades for despatch by road, the whole of these bags being loaded at Boulogne.

3. Mails for despatch by road or rail to centers on the lines of communication.

4. Mails for local delivery, i. e., for units stationed at the base.

5. Supplementary bags containing letters and newspapers received in the home depot too late for inclusion in the unit bags, e. g., the

unit bags were closed in London late at night and the next morning's newspapers posted to subscribers were despatched only partially sorted to the base post office in France.

The methods of delivery of mails from England, and also of the "Cross Post" correspondence, i. e., from one unit to another in France, are shown in Chart 2, Chapter XXIX, Volume I.

Homeward mails were at first despatched to the bases in returning supply trains and leave trains. Later, when express lorry services were organized for headquarters mails, the lorries were used to convey the homeward letters from all branches of the Army to the bases, but parcels, undeliverable correspondence, and empty bags continued to be sent by supply trains. To avoid congestion at the base, the homeward mails were sorted to a certain extent at railhead and field post offices, but this was dependent upon the time available and the circumstances under which the work had to be performed.

Associated with the British Postal Service were contingents from India, Canada, Australia, New Zealand, South Africa, Portugal, America (certain units).

All of these units organized their services along the lines of the British.

On several occasions during the war, the Army Postal Service performed special service in connection with Parliamentary elections. The general election in the United Kingdom at the end of 1918, involved the delivery by the Army Postal Service to the troops in France and Flanders of 4,000,000 items of election literature and 2,000,000 ballot papers.

At the beginning of the war, the weekly average number of bags of letters and parcels received for the British Expeditionary Forces was approximately 2,000. The enormous growth in the service will be seen from the following statistics:

At the Armistice.

Number of letters received from England weekly	11,000,000
Number of parcels received from England weekly	850,000
Number of letters despatched to England weekly	9,000,000
Number of cross post letters, etc., i. e., from one part of the field to another	4,200,000
Value of postal orders sold or cashed weekly (sterling)	£57,000
Total number of bags of mail received from England	18,500,000

CHAPTER XXVIII.

SECTION II.

FUNCTIONING OF THE POSTAL SERVICE IN THE FRENCH ARMIES DURING THE CAMPAIGN 1914–1918.

The "Postal Service" (Ravitaillement Postal) was a very important service because it affected the morale of the Army. It was a most difficult "supply system" to carry on, because each letter had an individual destination, which had to be reached wherever the addressee was located, and this despite the fact that individuals moved frequently; moreover, these changes were to remain secret. Delivery of mail had to be effected rapidly, since a letter is of little value if the news which it contains is stale.

Precision, *speed*, *secrecy*. These were the conditions which had to be met. How were they fulfilled?

POSTAL SECTORS (SECTEURS POSTAUX).

The military personnel of the armies was divided into "postal areas" (circonscriptions postales) which were known as postal sectors. These "sectors" followed the grand divisions of the order of battle. Each division, each army corps and each army headquarters had its own postal sector (Chart 4, Chapter XXIX, Vol. I). There were about 200 postal sectors for the entire Army.

In giving their addresses to correspondents soldiers furnished the number of the postal sector in which they were located, and every address followed the model form below.

Mr. X. Soldier in——— No.———Infantry Regiment,
Postal Sector 106.

There was no indication of the location, nor of the number of the division, army corps, or army; hence, complete secrecy.

The above indications were sufficient, nevertheless, and each letter reached its destination through the following agencies.

THE CENTRAL MILITARY POST OFFICE OF PARIS (BUREAU CENTRAL MILITAIRE DE PARIS).

This was a vast sorting agency and the only one in France. It was constantly kept informed concerning the detailed organization of the postal sectors, their changes and their frequently changing assignments to the various postal regulating stations.

All letters passed through the Central Military Post Office and remained there, at most, only a few hours.

In one room, letters were sorted out by postal sectors and those for each sector were grouped in packages. Each package corresponded to a unit (a regiment, for example), which was served by a "military letter carrier" (vaguemestre). Certain postal sectors included from 150 to 200 units.

The packages of letters were placed in sacks and each sack was marked with the number of the postal sector and nothing else.

In a nearby room, a special agency, independent from the sorting agency, added the indication of the army post office to the mark already on the sacks.

In this manner the personnel which was acquainted with the contents of the sacks had no idea of their destination, and the personnel which had some idea of their destination knew nothing about their contents. Thus secrecy was maintained as completely as possible.

ARMY POST OFFICES (BUREAUX FRONTIÈRES).

The sacks thus made up were shipped by the shortest routes to the army post offices (bureaux frontières). There was an army post office at the regulating station of each army. This was simply an agency for sorting the mail sacks but not the letters.

There, the Postal Regulating Officer (Commissaire Postal Régulateur) functioned. He was kept informed of the constant changes in the order of battle of the army which he served. He directed the sorting of the mail sacks and forwarded them, unopened, to the "pay offices" (bureaux de payeur) by the daily supply trains.

PAY OFFICES (BUREAUX DE PAYEUR).

The officer in charge of the pay office (Payeur) sent light postal trucks to the railhead (gare de ravitaillement) each day, to pick up the mail sacks of the postal sector which he served.

He brought the sacks to the pay office, opened them, and distributed the unopened packages of letters to the "military letter carriers" (vaguemestres) concerned.

The military letter carriers delivered the mail the same day to the addressees.

Such was the path followed each day by three to four million letters and 200,000 small "parcel post" packages, each helping to bind together and sustain the morale of the interior and that of the armies.

A lesser amount of mail came back each day from the front toward the interior and this exchange of thoughts, so necessary to those who were fighting at the front, as well as to those who remained in the interior, was accomplished without interruption, in spite of the changes in units, the movements of troops and the fluctuations of the battles.

CHAPTER XXVIII.

SECTION III.

THE POSTAL SERVICE OF THE BELGIAN ARMY.[1]

FUNCTIONS OF THE POSTAL SERVICE AND GENERAL INSTRUCTIONS IN CONNECTION THEREWITH.

The functions of the Postal Service of the Army consisted in the forwarding and distribution of both official and private correspondence to and from persons in the military service, as well as registered mail, insured packages, and small parcels not exceeding two kilograms in weight. It also included payment of postal coupons or money-orders through sergeant-majors (or clerks) of troop units.

The forwarding of parcels exceeding two kilograms in weight was assured by personnel of the Railroad Administration and the latter distributed such shipments through the military organizations (daily supply trains, parcel delivery service of transportation units).

Official mail, which was known as "Service mail" (correspondance de service) had priority over private mail. Official mail bearing the marks: XXX *in red* was characterized as "express" or urgent.

TRANSMISSION OF MAIL.

A. *From the base to the divisional railheads* (*Gares divisionnaires*).—Mail and parcel post packages (weighing 2 kilograms or less), either upon arrival or departure, were collected in a central office which functioned at the supply base of the Army.

This central office classified mail, upon arrival, according to units which were served by the same distributor (see further). It then forwarded the mail to the divisional railheads via the daily supply trains in closed, sealed, sacks. The mail sacks were placed in the railway van and taken in charge by the convoys of the supply trains; these convoys were responsible for mail in transit. Upon arrival at the divisional railheads the mail sacks were receipted for and unloaded by military postal personnel assigned for that purpose.

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[1] Extracted from "Regulations for the Postal Service of the Army," furnished the M. B. A. S. by Belgian General Headquarters.

B. *From the divisional railheads to the General Headquarters and staffs.*—Postal personnel designated to receive divisional mail was provided with motor transportation (including driving personnel). This transportation was furnished by the divisional transport corps and was used to transport mail from the divisional railhead to the divisional headquarters and to the staffs of the infantry and cavalry regiments, of the artillery groups, of the Engineer battalions and of the transport corps.

The mail service of the General Headquarters and for the unassigned units was handled through one or more army divisions, according to circumstances.

C. *From the headquarters or staffs to the addressees.*—A military postman, who held the rank of corporal, sergeant or first sergeant, was assigned to the staff of each Engineer battalion and of each transport corps train. There was also a military postman for each "group" of five or six unassigned labor companies. In army divisions in which the cavalry strength did not exceed that of the divisional cavalry group, this subdivision was amalgamated with the regiment.

Upon arrival of the mail at the headquarters or staffs, the postal agent turned over the mail to the military postmen. The latter held themselves in readiness and awaited the arrival of the mail truck.

PERSONNEL.

The Postal Service of the Belgian Army functioned under a chief of service, who was under the orders of the D. R. E. A.

A group of postal agents, under the orders of a controller or of an assistant director, was assigned to each division.

The postal personnel of the central office, as well as that assigned to the divisions, was furnished by the Postal Administration. This personnel was supplemented according to needs by the Chief of the Postal Service, by requisition for personnel belonging to permanent post offices. Postal personnel thus obtained was mustered out of the Army as soon as their services were no longer required.

Military postmen were detailed by the military authorities from among the postal employees and postmen belonging to the militia classes which had been called to the colors. Combatant personnel was transferred to postal duty only in case of necessity.

For the proper functioning of the mail service, military postmen were placed under the authority and control of the official who was in charge of the divisional postal services. As these military postmen belonged to the Army they remained amenable to military laws and regulations.

CHAPTER XXVIII.

SECTION IV.

MILITARY POSTAL SERVICE (ITALIAN).

GENERAL.

The Military Postal Service was responsible for the transportation and distribution of official and private mail, as well as, within certain limits, postal parcels and postal money orders. The service was operated by personnel of the Ministry of Posts and Telegraphs who were placed under military jurisdiction and considered as combatants.

ADMINISTRATIVE ORGANS.

At the time of the mobilization the following organizations were created:

A Superior Postal Administration, forming part of the General Commissariat, and which had directing and supervisory authority over the entire military postal service.

Army Postal Administrations, forming part of the various Commissariats, with directing and supervisory authority over the postal services of the various armies.

EXECUTIVE ORGANS.

A Main Mail Concentration Office, at Bologna.

A Post Office with each command of the large units: Supreme Command (Comando Supremo), army commands, army corps commands, divisional commands.

OPERATION OF THE SERVICE.

(Chart 5, Chapter XXIX, Volume I.)

All correspondence, from and to the army, in the theater of operations passed through the military main concentration office at Bologna, where it was sorted and forwarded as follows:

Mail addressed to the interior of the country was sent to the civil post offices of the Kingdom. Mail addressed to the theater of operations went to the military post offices, with a few exceptions, and the

latter were charged with the subsequent forwarding. The post office of each large unit was responsible for the mail service of the command to which it was assigned and for that of the units under the control of that Command.

The main concentration office, in order to promptly forward the correspondence to the units of the army in the field, was informed daily concerning the changes in the composition of the large units.

It was then prescribed that:

a) Daily, each large unit would communicate the changes in the composition of troop units to the Commissariats of the respective armies.

b) The army Commissariats, on the basis of the information given them, would forward the mail for the detachments belonging to their respective armies and that they would also transmit the mail matter for the detachments which had been transferred to another army.

c) The General Commissariat, on the strength of the information received each day concerning such changes, would compile an "index" of such transfers and changes and would forward this report daily to the main concentration office. This system proved satisfactory and resulted in rapid handling of the mails.

EXECUTIVE ORGANS CREATED DURING THE WAR.

During the war, to meet the exigencies of the service, it became necessary to create additional executive agencies in connection with those mentioned above.

(a) Subsidiary mail concentration offices. To relieve the Main Concentration Office at Bologna, as well as for other reasons, the following "Subsidiary mail concentration offices" were established:

A subsidiary mail concentration office at Treviso, to assist the main office at Bologna.

A subsidiary office at Bari, to handle the mail of the Italian Expeditionary Corps in Albania.

A subsidiary office at Naples, for the mail and parcel post of the Italian Corps operating in Macedonia.

A subsidiary office at Taranto, for forwarding the parcel post to the Italian Expeditionary forces in Albania.

(b) Post offices with the General Commissariat and with the army Commissariats.

These were established to assist the post offices at the Supreme Command (Comando Supremo) and with the army commands. They were responsible for the mail service of the lesser commands, detachments and offices and were attached to and controlled by the Commissariats.

(c) Post offices with the "Reconstitution" camps.

These were created to serve the troops which had abandoned their units during the retreat of October 1917. (These troops were subsequently concentrated in designated localities for reorganization and reassignment to combatant units.)

(d) Post offices with the "Returned Prisoners of War" camps.

Created immediately after the Armistice, for the mail service of the Italian prisoners who had been repatriated by Austria.

(e) Military postal sections.

These were detachments from the post offices of the large units and assured the mail service of corps and detachments which were located at a distance from a military post office.

(f) The "Flying post."

Created to serve outlying detachments of the large units, located far from military post offices and scattered over widely extended zones. For this purpose, the post office of the large unit concerned detailed a postal official and furnished him with motor transportation to enable him to perform his duties.

MODIFICATIONS IN THE DUTIES PERFORMED BY THE MILITARY POSTAL SERVICE.

The experiences of the war brought about several modifications in the organization and operation of the military postal services. Among the more important changes, introduced at various times, were the following:

a) Suppression of the insured mail service. Originally admitted up to the value of 300 Lire, insured mail caused trouble and confusion almost from the start, particularly in connection with the carrying out of the censorship regulations by the military authorities and this service was abolished at the beginning of 1916.

Only the handling of insured mail from abroad and the transmission of special postal "payment orders" (titoli) up to the value of 5,000 Lire, were continued, and this for the purpose of encouraging subscriptions to the various national loans among the troops. Later, the handling of insured mail from abroad was also abolished.

Official insured mail up to the value of 100 Lire continued to be accepted, to provide for the transmission to the mobilization centers of small objects of value belonging to dead or missing soldiers.

With the exception of the particular cases cited above, it was prescribed that money should be sent exclusively by means of postal money orders.

b) Suppression of mailing of registered samples to the troops at the front. This class of mail had to be suppressed because the

majority of the packages contained foodstuffs of all kinds, thereby seriously interfering with the operation of the mail service; however, the mailing of such packages from the front toward the interior continued to be permitted.

c) Abolition of the ordinary parcel post. On account of the great encumbrance to the post offices, the mailing of ordinary parcel post matter was abolished and this was substituted by special "military parcels," which permitted sending clothes, tobacco, and personal objects of a maximum weight of one and a half kilograms (except for packages containing boots, for which the maximum weight was two kilograms).

d) Abolition of the telegraph money orders. At the beginning of the war the handling of telegraph money orders imposed great responsibilities upon the paying offices, moreover, their usefulness was practically nil, considering the delays which occurred before the telegraph money orders reached the payees, therefore this service was also abolished.

e) Authorization of "service money orders" in favor of private individuals. For military reasons and at the request of the military authorities, the transmission of "military service orders," up to 1,000 Lire, in favor of private individuals was authorized to provide for payments of expenses pertaining to the army in the field or for the payments of subsidies to the families of soldiers.

f) Provisions to enable all soldiers to use the postal savings service. Regulations prescribed that, in war time, the postal savings system would be limited to the placing of deposits and making of payments on postal savings accounts issued before the war by the various civil post offices. During the war, however, these regulations were amended so that soldiers who did not already possess a postal savings book were enabled to avail themselves of this service, and appropriate rules in connection therewith were issued by the Ministry of War in conjunction with the Ministry of Posts and Telegraphs.

g) Modifications in the use of franked mail matter. To facilitate the exchange of correspondence between the troops in the field and their families, a service of franked military postcards was inaugurated. These cards were distributed to the troops gratuitiously and, at first, in unlimited quantities; later, restrictions were placed on the number of cards issued, in order to keep the postal traffic within reasonable bounds. Franking privileges were also accorded for the mailing of propaganda, Red Cross postcards, and for the special cards of inquiry for soldiers in hospitals, etc.

h) Establishment of a postal money exchange office at Bologna. To prevent unlawful speculation in the rates of exchange between the French and Italian currencies, a special postal office was estab-

lished at Bologna. This office cashed the postal money orders which had been issued in Italy in favor of the Italian troops operating in France, and its payments were based on current rates of exchange.

PERSONNEL.

At the mobilization, the necessary personnel for the organization and operation of the Superior Postal Administration, the main concentration office, and the post offices of the large units, was obtained by designating 409 mail clerks as postal officials and by drafting 185 more as ordinary soldiers.

It soon became necessary to enlarge this force and, in June 1915, the postal personnel was increased by 133 mail clerks and 35 postal agents; while, in December 1915, the personnel of the military postal services had attained a total of 779 mail clerks and 328 postal agents. From then on, however, the expansion of the postal personnel was slow and the maximum was reached in 1917, with 810 mail clerks and 379 postal agents.

To provide the personnel for the post offices which were established from time to time and to assist the postal officials employed in the technical branch of the service, on account of the limited number of postal agents at the disposal of the military Postal Service, it became necessary to detail a number of soldiers to the post offices of the large units and to the main concentration office at Bologna. These requirements amounted, on an average, to the detail of ten men to each of the military post offices and of 600 men to the main concentration office at Bologna.

The large number of soldiers detailed as mail clerks, etc., at the various post offices and at the main concentration office, necessitated the organization of a special unit for the administration of this personnel.

Movement of correspondence.

		(Pieces.)
Maximum of ordinary mail	per day	4,680,000
Maximum of registered mail	do	31,000
Maximum of insured mail	do	11,490
Maximum of parcel post packages	per month	600,000

SUPPLIES.

At the beginning of the mobilization expendable office supplies (stationery, string, sealing-wax, lead, etc.) were normally issued by the Provincial Postal Administrations under whose jurisdiction the military post offices functioned, although, in cases of emergency these post offices were occasionally authorized to purchase supplies commercially. However, this system was unsatisfactory because

the provincial administrations were unable to furnish the supplies when needed and, in January 1918, the Superior Postal Administration was charged with the supply of postal materials, with the exception of stationery (Cancelleria) which continued to be supplied by the provincial administrations. Finally, in October 1918, post office supplies were furnished by the Commands of the large units.

An idea as to the tremendous amount of mail matter handled by the military post offices may be gained from the following figures, showing the consumption of postal supplies from January 1916 on:

	(Kilograms.)
String	45,890
Sealing-wax	28,600
Paper for despatches	21,000
"Vaclite"	3,577

CHAPTER XXVIII.

SECTION V.

AMERICAN E. F. POSTAL EXPRESS SERVICE.

(Chart 3, Chapter XXIX, Vol. I.)

The operation of the mail service in the American Expeditionary Forces by the United States Post Office Department covered a period of about one year, during which time fifty-one stationary and field post offices were established and the strength of the American E. F. increased to nearly 1,000,000 men. All mail for interior points was shipped from the base ports to the central post office in Paris for distribution. The transportation of mail being handled entirely by the French "Bureau des Postes et Télégraphes," until the establishment of American train service between Tours and Chaumont, in the spring of 1918, provided another means of transporting mail between these points.

It needed only a few months experience to show conclusively that an efficient postal service for the American E. F., must be an integral part of the military organization. Arrangements were made with the Post Office Department for transfer of control and responsibility, and on July 1, 1918, the Postal Express Service, organized as a branch of the Adjutant General's Department, took over the postal service in the theater of operations. The only function remaining in the hands of civil postal agents was the sale and redemption of postal money-orders and sale of stamps.

The order [1] establishing the Postal Express Service also directed the organization in each corps and division of permanent postal detachments.

There were two kinds of post offices, fixed and mobile. The fixed offices were located in the cities and towns where troops were regularly quartered and each covered a certain geographical area. Mobile offices were organized and located with organized armies, corps, and divisions. These offices moved with the units and a code number was assigned to each office, which became the permanent address of the mobile post office. Mail received at fixed offices was assorted for delivery to the army units served by the office. All mail addressed to mobile post offices was delivered to the army corps, or division postmaster, and distributed through him.

[1] G. O. 72, May 9, 1918.

The organization of mobile post offices consisted of army corps or division postal detachments, consisting of 1 lieutenant, 2 sergeants, 4 corporals and 20 privates. A postal detachment received the mail for its organization at the nearest railhead, made the distribution by units and arranged for the delivery of such mail, as well as collecting the outgoing mail through regimental or company mail orderlies.

At the close of the year 1918, 148 army post offices were operating at 3 army headquarters, 9 corps headquarters, 42 divisional headquarters, 1 artillery headquarters and 93 permanently designated localities.

The organization of the Postal Express Service and the functions of the several divisions were substantially as follows:

1. *Headquarters:* This consisted of:

(*a*) An administrative section with the usual duties relative to correspondence, personnel, etc.

(*b*) An inspection section charged with investigation of all complaints concerning mail.

(*c*) A supply section, which procured and issued post office equipment and supplies.

2. *Post Office Division:* Charged with the operation of the fixed or stationary offices set up to serve an area where troops or establishments were permanently located. An important branch of the Division of Post Offices was the Troop Movement Bureau, which was charged with the duty of collecting information as to changes in location or organization and furnishing same to all offices concerned.

The Troop Movement Section was charged not only with the duty of noting changes of army units, but also the distribution of such information to army post offices through the medium of a monthly postal guide, with a supplementary daily postal memorandum. Information on troop movements was obtained from G. H. Q. troop movement sheets; G-4, S. O. S., troop movement sheets; G. H. Q. weekly supply lists and supplements; daily sheets from Statistical Branch, A. G. O., S. O. S.; reports from headquarters of the various services; reports of commanding officers of units, reports from hospitals.

It was the policy to send mail to headquarters of a unit, depending upon such to make the distribution.

3. *Transportation Division:* Exercised control over the movement of mail by railway and truck. The railway movement was accomplished by attaching mail cars to fast express trains. A guard or convoy accompanied each car. This division also operated the postal transfer stations established at regulating stations, at railroad junc-

tions, and at important distributing centers for the delivery of mail trucks.

When the Postal Express Service first assumed the responsibility of delivery, mail was shipped to regulating stations like Is-sur-Tille. This system proved a failure, since our regulating station was so far in rear of the front line. These trains could be diverted after leaving the regulating stations to any division which might be in urgent need.

This was naturally of advantage to the supply department, since supplies suitable for one division could be diverted to another, but it was impossible from the mail standpoint, since letters for individuals should be sent only to the person addressed.

With the establishment of the "rocade" railway mail lines, and the abandonment of the service of mail for divisional units from regulating stations, motor truck service was instituted to serve combat units in the front lines, using those stations on the railway mail service "rocade" which were most favorably situated for that purpose. These were in fact mail regulating stations, and from them truck service was organized direct to corps or divisional post-offices, or to such fixed advanced post-offices as were in a position suitable for delivery to corps or division trains. In order to keep these trucks in working order, the Postal Express Company had to arrange their own repair crews of experienced mechanics. These crews were dispatched from one postal regulating station to another.

4. *Central Post Office:* This establishment did not serve the area in which it was located, Bourges, but had the sole function of redirecting mail which could not be delivered as originally addressed. The files of the Central Records Office (A. G.) located at Bourges were the only source from which new addresses could be obtained. The volume of mail requiring re-directory service grew to huge proportions and the Central Post Office expanded proportionately. The headquarters was moved to Paris in October, 1918.

5. *Courier Service:*

(a) *Overseas Courier Service*, with officer couriers, operated between G. H. Q., Paris, and Washington.

(b) *Inland Courier Service:* Operated between G. H. Q., Hqrs. S. O. S., and Paris; between Hqrs. S. O. S., and base ports, Paris and London.

(c) *Motor Dispatch Service:* Organized in October, 1918, primarily to secure speedy and sure handling of official mail between G. H. Q. and nearby headquarters, army, corps, etc.

The Postal Express Service began to operate at the time when troop arrivals were at their maximum, over 300,000 per month. Moreover, some 1,000,000 men arriving between June and December,

1918, went to France in casual and replacement units which ceased to exist as soon as they joined the American E. F. These units were broken up and the men scattered throughout the Army. Each individual letter coming to these men required directory service and re-addressing. Active operations with the attendant casualties added untold thousands to the flood of letters pouring into the Central Post Office.

The amount of letter mail handled during the months preceding the Armistice is of interest.

Received from United States.			Dispatched to United States.	
Pouches.	Letters.		Pouches.	Letters.
5,233	14,700,000	August	4,129	13,200,000
8,750	24,000,000	September	3,564	11,400,000
11,891	33,300,000	October	5,598	17,900,000
10,943	30,600,000	November	5,336	17,100,000

The amount of second-class mail (merchandise, newspapers and periodicals) received during the same period was 175,187 pouches.

On November 1, 1918, the number of post offices, mobile and fixed, had increased to 130 and the personnel of the Postal Express Service comprised 89 officers, 2,041 enlisted men and 50 civilian (American) postal clerks.

However, neither the size of the establishment nor the volume of mail handled afford a true measure of the results accomplished. That the service was able to "carry on" in spite of the numerous and peculiar difficulties that confronted it from the start attest the soundness of its organization and the devotion of its personnel.

APPENDIX—CHAPTER XXVIII—SECTION V.

The following is a list of all Army Post Offices (A. P. O.) established:

A. P. O.	Location.	Established.
		1917
701	St. Nazaire (Loire Inf.)	July 10
702	Paris (Seine)	July 12
703	Gondrecourt (Meuse)	July 28
704	Le Valdahon (Doubs)	Aug. 20
705	Bordeaux (Gironde)	Aug. 11
		1918
705–A	Camp Génicart (Gironde)	Dec. 8
		1917
706	Chaumont (Hte. Marne)	Aug. 20
707	Mailly (Aube)	Sept. 12
708	Nevers (Nièvre)	Sept. 24
709	26th Division	Sept. 29
710	2d Division	Sept. 30
711	Coetquidan (Morbihan)	Oct. 13
712	Is-sur-Tille	Nov. 19
713	Gièvres (Loir-et-Cher)	Nov. 7
713–A	Romorantin (Loir-et-Cher)	July 29
714	Langres (Hte. Marne)	Nov. 11
715	42d Division	Nov. 15
716	Brest (Finistère)	Nov. 22
717	Tours (Indre-et-Loire)	Nov. 28
718	Saumur (Maine-et-Loire)	Dec. 3
719	Haussimont (Marne)	Dec. 8
720	Bourbonne-les-Bains (Hte. Marne)	Dec. 13
		1918
721	Dijon (Côte-d'Or)	Jan. 7
722	La Courtine (Creuse)	Jan. 17
723	Clermont-Ferrand (Puy-de-Dôme)	Jan. 8
723–A	Châtel-Guyon (Puy-de-Dôme)	Aug. 23
724	Issodun (Indre)	Jan. 10
725	St. Maixent (Deux-Sèvres)	Jan. 15
726	Blois (Loir-et-Cher)	Jan. 31
727	St. Aignan (Loir-et-Cher)	Jan. 28
728	Regulated via 712	Feb. 5
729	Mantes (Seine-et-Oise)	Feb. 6
730	Châtillon-sur-Seine (Côte d'Or)	Feb. 7
731	Neufchâteau (Vosges)	Feb. 11
731–A	Colombey-les-Belles (M. et M.)	May 6
732	Vittel (Vosges)	Feb. 11
733	Angers (Maine-et-Loire)	Feb. 20
734	32d Division	Mar. 16
734–A	32d Division, Champlitte (Haute-Saône)	Apr. 8
735	La Rochelle (Charente-Inférieure)	Mar. 18
735–A	Rochefort (Charente-Inf.)	Sept. 21
736	Aix-Les-Bains (Savoie)	Apr. 10
737	Cosne (Nièvre)	Do.
738	Châteauroux (Indre)	Do.
739	77th Division	Apr. 20
740	3d Division	
741	Mehun (Cher)	Apr. 30
742	82d Division	May 20
743	35th Division	Do.
744	28th Division	May 25
745	5th Division	Do.
746	4th Division	May 27
747	Commercy (Meuse)	May 26
748	27th Division, via 702	May 25
749	30th Division, B. E. F. via 702	May 26
750	33d Division, B. E. F. via 702	Do.

A. P. O.	Location.	Established.
		1918
751	Boulogne (Pas-de-Calais)	May 16
752	Marseille (Bouches-du-Rhône)	May 21
753	Limoges (Hte. Vienne)	May 22
754	3d Corps	May 31
755	78th Division, B. E. F. via 702	June 11
756	80th Division, B. E. F. via 702	Do.
757	Nogent-en-Bassigny (Hte-Marne)	Do.
758	Liffol-le-Grand (Vosges)	June 12
759	Mobile	June 21
760	Le Havre (Seine Inf.)	July 13
761	Mobile, 89th Division	Do.
762	Le Mans (Sarthe)	Do.
763	Mobile, 37th Division	July 5
764	Epinal (Vosges)	July 6
765	Mobile, 29th Division	July 8
766	Mobile, 92d Division	July 12
767	Nantes (Loire-Inf.)	July 16
768	Cherbourg (Manche) discontinued	July 23
769	Mobile, 5th Army Corps	July 13
770	Mobile, 90th Division	July 15
771	Mobile, 79th Division	July 24
772	Verneuil (Nièvre)	July 31
772–A	Decize (Nièvre)	Nov. 5
773	Mobile, 76th Division	July 30
774	1st Army Hqrs.: Regulated via Paris	Do.
	Regulated via A. P. O. 712	Aug. 14
775	4th Army Corps, regulated via Is-sur-Tille	July 30
776	Mobile, 91st Division	Do.
777	Mobile, 6th Division	Do.
778	Lacourneau (Gironde)	Aug. 15
779	Meucon (Morbihan)	Do.
780	Mars-sur-Allier (Nièvre)	Aug. 19
781	Vichy (Allier)	Aug. 22
782	Château-Thierry (Aisne)	Oct. 4
783	6th Army Corps, regulated via 712	Aug. 26
784	Toul (Meurthe-et-Moselle)	Aug 25
785	Allerey (Saône-et-Loire)	Do.
786	Clamecy (Nièvre)	Aug. 27
787	Azerailles (Meurthe-et-Moselle) Discontinued	Aug. 26 Dec. 31
788	Mobile, 40th Division	Aug. 29
789	Mobile, 85th Division	Aug. 31
790	Mobile, 2d Army Corps	Do.
791	Mobile, 81st Division	Do.
792	Mobile, 7th Army Corps	Aug. 26
793	Mobile, 7th Division	Aug. 19
794	Périgueux (Dordogne)	Aug. 22
795	Mobile, 88th Division	Aug. 26
796	Mobile, 36th Division	Aug. 30
797	Orléans (Loiret)	Aug. 23
798	Mesves-sur-Loire (Nièvre)	Do.
799	St. Malo (Ille-et-Vilaine)	Aug. 30
901	Milan, Italy	July 13
902	Bourges (Cher)	Aug. 1
903	Vitrey (Hte-Saône)	Sept. 5
904	Mobile, 39th Division	Sept. 6
905	Mobile, 84th Division	Sept. 12
906	Mobile, 87th Division	Do.
907	Bar-le-duc (Meuse)	Do.
908	Sougy (Nièvre)	Sept. 14
909	Beaune (Côte-d'Or)	Sept. 15

A. P. O.	Location.	Established.	A. P. O.	Location.	Established.
		1918			1918
910	Château-du-Loir (Sarthe)	Sept. 17	927	3d Army Hqrs., Mobile	Nov. 18
911	Libourne (Gironde)	Sept. 20	928	La Valbonne (Ain)	Do.
912	Mobile, 34th Division	Sept. 24	929	Joinville (Hte-Marne)	Nov. 22
913	Bar-sur-Aube (Aube)	Do.	930	Advanced G. H. Q., Trêves, Germany	Nov. 25
914	Heippes (Meuse)	Do.			
915	Nancy (Meurthe-et-Moselle)	Sept. 26	931	8th Army Corps, Mobile	Do.
916	Mobile, 86th Division	Oct. 19	932	9th Army Corps, Mobile	Do.
917	Châtenay-sur-Seine (Seine & M.)	Sept. 29	933	Nice (Alpes-Maritimes)	Nov. 9
918	2d Army Hqrs., Mobile	Oct. 6	934	Coblenz, Germany	Dec. 16
919	Rimaucourt (Hte-Marne)	Oct. 8	935	Vannes (Morbihan)	Dec. 19
920	Châlons-sur-Marne (Marne)	Oct. 9	936	Thionville (Lorraine)	Dec. 28
921	St. Dizier (Hte-Marne)	Do.	937	Pau (Basses-Pyrenées)	Dec. 29
922	Angoulême (Charente)	Oct. 16			
923	Grenoble (Isère)	Oct. 19	827	Mobile, 31st Division	Oct. 28
924	Le Blanc (Indre)	Do.	828	Mobile, 38th Division	Oct. 19
925	Cour-Cheverny (Loir-et-Cher)	Do.	831	Mobile, 8th Division	Nov. 19
926	Autun (Saône-et-Loire)	Nov. 5			

The following offices were established in December, but were not officially announced until late dates as shown below:

A. P. O.	Location.	Established.	A. P. O.	Location.	Established.
		1919			1919
705	Pauillac (Gironde)	Jan. 27	939	Savenay (Loire-Inf.)	Jan. 18
938	2d Depot Div	Jan. 11	940	Rennes (Ille-et-Villaine)	Jan. 31

A. P. O.	Location.	Established.	A. P. O.	Location.	Established.
		1918			1918
910	Château-du-Loir (Sarthe)	Sept. 17	927	3d Army Hqrs., Mobile	Nov. 18
911	Libourne (Gironde)	Sept. 20	928	La Valbonne (Ain)	Do.
912	Mobile, 34th Division	Sept. 24	929	Joinville (Hte-Marne)	Nov. 22
913	Bar-sur-Aube (Aube)	Do.	930	Advanced G. H. Q., Trèves, Germany	Nov. 25
914	Heippes (Meuse)	Do.			
915	Nancy (Meurthe-et-Moselle)	Sept. 26	931	8th Army Corps, Mobile	Do.
916	Mobile, 86th Division	Oct. 19	932	9th Army Corps, Mobile	Do.
917	Châtenay-sur-Seine (Seine & M.)	Sept. 29	933	Nice (Alpes-Maritimes)	Nov. 9
918	2d Army Hqrs., Mobile	Oct. 6	934	Coblenz, Germany	Dec. 16
919	Rimaucourt (Hte-Marne)	Oct. 8	935	Vannes (Morbihan)	Dec. 19
920	Châlons-sur-Marne (Marne)	Oct. 9	936	Thionville (Lorraine)	Dec. 28
921	St. Dizier (Hte-Marne)	Do.	937	Pau (Basses-Pyrenées)	Dec. 29
922	Angoulême (Charente)	Oct. 10			
923	Grenoble (Isère)	Oct. 19	827	Mobile, 31st Division	Oct. 28
924	Le Blanc (Indre)	Do.	828	Mobile, 38th Division	Oct. 19
925	Cour-Cheverny (Loir-et-Cher)	Do.	831	Mobile, 8th Division	Nov. 19
926	Autun (Saône-et-Loire)	Nov. 5			

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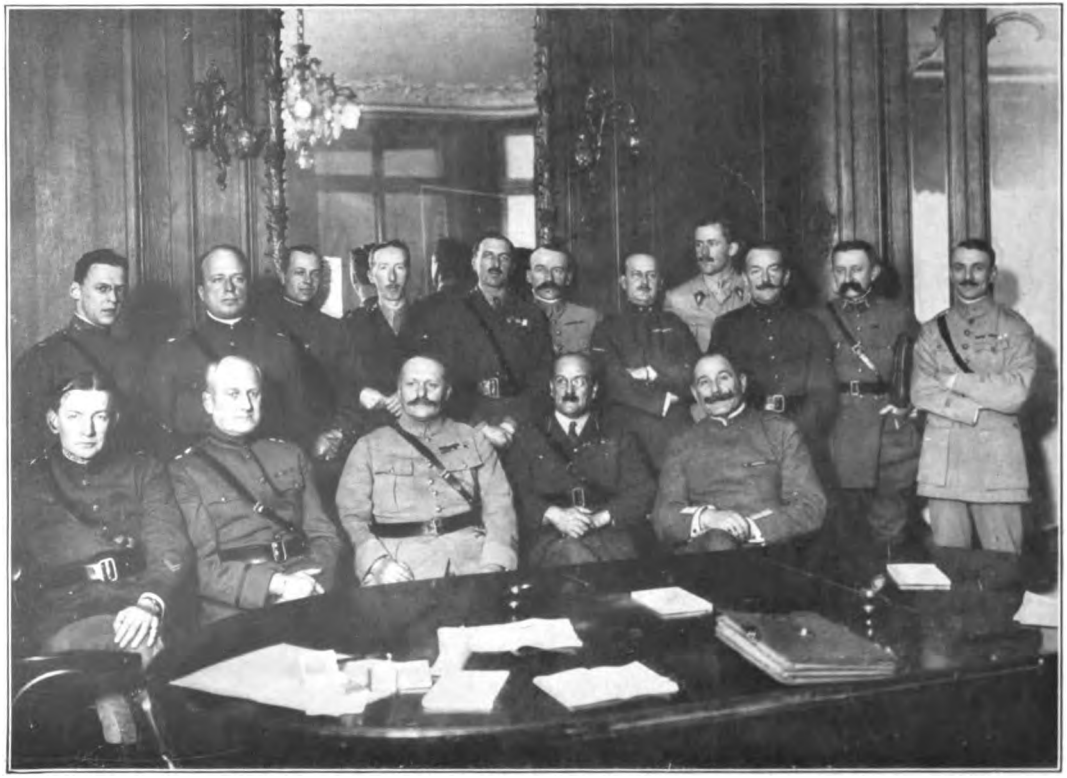
		1919			1919
706	Pauillac (Gironde)	Jan. 27	939	Savenay (Loire-Inf.)	Jan. 18
938	2d Depot Div	Jan. 11	940	Rennes (Ille-et-Villaine)	Jan. 31



THE MILITARY BOARD OF ALLIED SUPPLY

Left to right (sitting): Gen. Charles G. Dawes; Gen. James G. Harbord; Gen. Charles J. M. Payot; Gen. Reginald Ford; Gen. Errico Merrone. Left to right (standing): Maj. C. W. Adams; Col. Harry L. Hodges; Lieut. C. B. Gibson, jr.; Maj. N. L. Craig; Lieut. Col. Lord Pembroke and Montgomery; Commandant Lescannes; Capt. Fabio Mauroner; Lieut. Duc de Mouchy; Commandant de Renesse; Commandant F. de Wissocq; Lieut. H. de Siéyes.

CHAPTER XXIX.

SECTION I.

OPERATIONS OF PORTS (BRITISH).

In overseas expeditions prior to 1914, it had been the practice to use transit areas and transit sheds in the docks at overseas base ports as depots and warehouses for the supplies and munitions of the forces in the field. Accordingly, in the original arrangements for the British Expeditionary Force, it was provided that the French would allot at the ports of Boulogne, Havre and Rouen, covered and open storage spaces of stated numbers of square meters area for supply, ordnance, and other depots; these spaces were alongside the berths allotted for the use of the British forces and were calculated to suffice for a force of six infantry and one cavalry divisions, with certain army troops.

Military events very early in the war caused the temporary evacuation of these three ports but by the end of October, 1914, they were reoccupied. By this time the original six divisions had grown considerably; the original allotments of berths and storage spaces were already becoming insufficient and the anticipated increase in the size of the force would make them still more so. The use of another port was therefore desired. Calais was being used by the Belgians, so Dunkirk was suggested, the front was as yet too unstable to admit of the establishment of British installations at the latter. Eventually it was arranged that Calais should be used by both British and Belgians, and that port was opened as a British base port in June, 1915. By that time the available accommodation at all the ports used by the British was fairly fully employed and it was agreed by the French that certain kinds of stores, e. g., railway material, might be landed at Dunkirk for immediate despatch elsewhere provided no accumulation was allowed and no British installation established there.

The system under which the base ports other than Dunkirk were worked was as follows: Ships arriving with stores in bulk for some particular department were berthed alongside the supply, ordnance, or other depot as the case might be, and the goods discharged were received into the transit sheds and open areas which formed the depot. From the depot they were reloaded in detail into railway

wagons from which were made up the daily supply trains to the front. The stocks in the depots usually amounted to from twenty-one to twenty-eight days' supply for the force served by the depot, and as the force increased so did the stock held at the depot. The hangars became full, and where there was room for expansion the stacks on the open spaces extended further and further from the quayside. The removal of stores from alongside the ship to a stack took longer and longer as the distance from the quayside to the stack increased, and the rate of discharge from a ship could not exceed the rate at which space could be cleared on the quays within reach of the cranes and ship's derricks. Delays in loading, irregular sailings due to bad weather, the varying speeds of different vessels and the convoy system, resulted in irregular arrivals. Stores could only be unloaded at berths alongside the depot for any particular kind of store; if two or three ships with stores for any one depot came into port simultaneously, they had to take their turn. Not only was the off-loading of each ship delayed by the congestion on the quays, but vessels had often to wait some days before coming alongside at all. If a ship arrived with a cargo for two different depots it had to discharge part at one depot and then shift out and take its turn at another. Between October, 1915, and January, 1916, the average time spent in French ports by forage ships from Canada was seventeen days. Whereas under ordinary working conditions in peace time, the rate of discharge of steamers is in the neighborhood of 750 tons per day, the rate for British supply ships in French ports in the summer of 1916, did not exceed 300 tons per day, and even that figure would be considerably reduced if account were taken of time lost awaiting berths.

During 1916, various attempts were made to reduce the congestion. Additional cranes were installed, better use of the labor employed was sought, a beginning was made of the use of the ports for transit only by the establishment of inland depots, and steps were taken to insure more regular arrivals of ships and to improve the stowage of cargo on them. These steps, however, were merely palliatives and a detailed investigation into port working, made in the autumn of 1916, showed that they would be quite insufficient to enable the ports to deal with the greatly increased traffic to be expected when the Army reached its maximum strength and the munitions output was at its height. No great increase in the number of berths at the disposal of the British could be looked for because the French were making large imports through the same ports and the total volume of traffic passing through was already far greater than before the war. The average tonnage discharged per week at Le

Havre was 57,000 in 1913, and 115,000 in 1916; the figures for Rouen were 99,000 and 184,000. The investigation showed that:

	Tons.
(*a*) The average weekly discharge of British traffic at all base ports for the four weeks ending August 27, 1916 was	129,024
(*b*) The maximum in any one week (that ending August 20, 1916) was	138,987
(*c*) The estimated maximum possible discharge under existing conditions was	160,916
(*d*) The average discharge required in the near future was	198,662
(*e*) Allowing a margin for irregular arrivals and for contingencies the maximum weekly discharge to be provided for was	248,327

To meet the situation thus disclosed, a Directorate of Docks was established and assumed control on December 1st. Its function was to form a link in the chain of transportation operations between the Naval Transport Service on the one side and the Railway and Inland Waterway Services on the other. Its main objects were to economize in shipping by speeding up discharge and to pass through the bottleneck of the ports a much greater tonnage than was possible under the conditions then existing.

Among the factors in the problem to be solved were the following:

Geographical.—At the end of 1916, practically all the British Army was north of the Somme but the only ports of any size north of that river were Dunkirk, Calais and Boulogne. Dunkirk was now within easy reach of enemy aeroplanes and was subject to bombardment by long range artillery, so that for many classes of stores, e. g., ammunition, it was unsafe and comparatively little use could be made of it. Calais and Boulogne, the next nearest ports to the British front, were incapable of dealing with the amount to be imported, even if all the British installations which had grown up during the early part of the war round the southern ports could be abandoned, and even if military considerations had made it wise to do so.

Railway.—There was a great shortage of empty railway wagons for loading at the ports. The rotation of wagons loaded at northern ports was quicker than that of wagons loaded at southern ports, so that the supply of empties was easier in the north. The French therefore desired that the maximum amount of work should be got out of the northern ports and as little use as possible made of the southern ones. There was also the question of the train capacity of the French railways; during the early months of 1917, the railways were unable to remove from the ports of tonnages which it was desired to import and certain reserves had to be retained in England because the railways could not transport them from the ports to depots in France.

Shipping.—To shorten the turnaround of vessels and to save escorts, the Naval Transport authorities desired vessels plying between England and France to use the shortest routes and these routes led to the northern ports; vessels coming from across the Atlantic would on the other hand stop short at the southern ports.

As mentioned above the convoy system and other causes led to "bunching," and, to allow of minor fluctuations in the traffic, it was essential that each port should be capable of handling 10 per cent more traffic than the expected average. In December 1916, the accidental blockage of Boulogne for nearly three weeks, by the stranding in the channel of an incoming steamer, emphasized the necessity of surplus port accommodation. During the year 1918, while the accommodation allotted to the British at each port in turn might be fully occupied, the number of berths in use at any one time at all the ports taken together was only from 43 per cent to 57 per cent of the total. In other words, to allow for fluctuations of traffic and for "bunching," the number of berths required at the base ports overseas proved to be about double the number normally occupied.

The steps taken to realize the benefits anticipated from the new Directorate of Docks included the return of the hangars and quays to their proper use as transit sheds and areas. This involved the construction of new depots outside the dock areas and the transfer to them of the work previously done outside. In the first two and a half years of the war the installations inside the dock areas had grown to great dimensions and it was practically impossible to remove them all; some remained till the end of the war. But the use of the quays and adjacent sheds solely as transit areas gave much greater elasticity in the berthing of vessels; some berths were particularly suited for particular classes of traffic, e. g., coal, or the berth at Boulogne permanently occupied by a refrigerator ship as a floating cold meat store, but it was no longer essential for instance for a ship with ordnance stores to berth at the particular wharf opposite ordnance hangers, and in consequence better use could be made of the berths allotted to the British. The labor for discharging ships was also made more fluid and could be transferred at will from berth to berth as required; experts in dock working were employed to superintend it and labor saving machinery installed.

When the Docks Directorate was formed (Chart 1, Chapter XXX, Vol. I), the length of quay allotted for British use in French ports was 7,470 meters; estimates were made of the berths that would be required to handle the anticipated tonnage and the French, at considerable inconvenience to themselves, increased the length to 8,865

meters. At many of the berths there were insufficient cranes or none existed, but the Docks Directorate included a mechanical engineering branch which now undertook their provision, maintenance and working.

The following table shows the crane equipment of the berths allocated by the French for use by the British.

	Cranes.			Number of meters of quay frontage per crane.
	French.	British.	Total.	
December, 1916	92	29	121	62
December, 1918	99	215	314	26

Other measures were: An increased use of lighterage, performed by the Inland Water Transport Service; vessels were discharged to lighters for transfer to depots served by canals at the same time that they were being discharged to quay; experiments were made in continuous discharge throughout the 24 hours by working three shifts, lack of sufficient expert supervising personnel and attacks from the air during the hours of darkness prevented this proving altogether a success. The salient points of the system ultimately evolved were as follows:

Despatch from home ports.—Certain classes of traffic were allocated to the home ports most suitable for dealing with those traffics and a fleet of vessels sufficient (after allowing for withdrawals for necessary periodical overhauls and repairs,) to transport the average tonnage to be conveyed was detailed to those ports. When a vessel sailed, representatives of all the departments concerned met and agreed on the cablegram to be despatched to each and all the departments concerned overseas, thus eliminating correspondence and confusion overseas arising from the receipt, by the Departments of Docks and Railways, by consignees, and by any other authorities concerned, of notifications not entirely in accordance with one another.

Receipt overseas.—Each month the Director General of Transportation (D. G. T.) received from the Quartermaster General (Q. M. G.) a notification of the imports in tons required by each branch of the Army with their destinations. From this the Docks Directorate prepared a program showing the proposed distribution of the imports among the ports at which the British had been allotted accommodation, and the weekly tonnage to be handled at each. After approval by the Quartermaster General, the program was submitted to the authorities concerned at home, viz: the War

Office, the Naval Transport Department and the Ministry of Shipping, for their concurrence. The advantages of such a program were, that it gave the transportation authorities at home a clear and comprehensive idea of what the Army wanted, of the shipping that had to be provided, and the probable turnround of that shipping; it told the Docks Directorate overseas the tonnage it had to be prepared to handle at each port, and gave the directorates of other transportation services an idea of what they would have to do to effect clearance of the dock areas.

The distribution of imports among ports was based mainly on railway considerations. Two lines of communication ran from the group of ports north of the Somme and two from the group south of that river, and normally each group handled about half of the total imports, but the military situation caused variations in the proportion from time to time. In February, 1917, the northern group was handling 49 per cent of the total; in view of the possibility of the Arras offensive being successful the figure grew to 61 per cent in August, and, as the probability of a break through receded it fell again to 51 per cent in December. With the opening of the German offensive in 1918, bringing with it the possibility of a concentration of the British Army north of the Somme, imports through northern ports rapidly increased to 61 per cent in April, only to be reduced again in May, June, and July. Following the Allied offensive in August, with the prospect of an advance into Belgium, imports at northern ports again increased and by October amounted to 64 per cent. This percentage increased still further after the Armistice and by December reached 74 per cent.

The total tonnage landed each month was affected mainly by the munitions output and the strength of the force in France, reaching its maximum in the early summer of 1917. It is worth noting that a considerable return traffic of empty ammunition boxes, guns for repair, salvage and scrap, grew up amounting at times to over 10,000 tons a week.

It may not be out of place to give a few figures to show the savings in shipping and in labor obtainable by the establishment of a single authority to coordinate the dock working at overseas base ports. The figures given below do not show either the best or the worst results attained and are the averages of the six principal ports, dealing with different classes of traffic and different types of sea going vessels. The Docks Directorate began active operations on December 1, 1916, and February 1917, is the first month for which complete figures are available.

	February—	
	1917	1918
Number of ships discharged during the month	158	145
Hours lost each week by ships waiting berths	2,396	291
Average time in port in hours from time of arrival to completion of discharge	95	40
Average rate of discharge in tons per hour in port	10.7	20.3
Average rate of discharge in tons per working hour	35.9	48.9
Tonnage discharged per man per hour	0.53	0.64

It is also interesting to compare the actual work done, with the work the Docks Directorate was established to do, as shown by the figures on the third page of this section. For five months in 1917, the average discharge was over 200,000 tons a week; the maximum was nearly 240,000 tons in one week.

MEMORANDUM ON PORT CONSTRUCTION DEPARTMENT (BRITISH).[1]

1. The Ports Construction Department was authorized in March, 1917, to carry out all general construction work at, and additions to, ports in France required for the British Expeditionary Forces, including the French terminal berths for the cross channel ferry; and also for the purpose of undertaking the reconstruction of the Belgian ports of Bruges, Zebrugge and Ostend, etc., which at that time was anticipated might be in the hands of the Allies during the course of the year.

2. The authorized scale of establishment of the department provided for:

	Number.
18 Ports Construction Companies, British	1,864
18 Companies, non-British	4,500
Total	6,364

The British personnel to be all skilled tradesmen and the non-British partly skilled men, working under technical officers of wide experience on public works of all sorts.

Actually the average strength of the Department since its inception was:

Technical officers	23
Discipline officers	17
British skilled personnel	815
3 Chinese companies	1,400
Total	2,255

Arrangements were made, however, to increase the strength up to the authorized scale at short notice if required.

3. Belgian Ports.—For the purpose of the reconstruction of the Belgian ports a large amount of information as to their pre-war condition was collected, and the department was constantly advised by the Royal Naval Air Service (R. N. A. S.) as to the damage done from time to time, and many valuable photographs of them were also supplied. From the information thus available definite plans were made and schemes prepared for their reconstruction, and a large amount of plant and material, to the value of over half a

[1] Prepared by Lt. Col. Bradford Leslie, R. E., C. E. P. C., British General Headquarters.

million sterling, was obtained and stored at the department's depot at Les Forts, near Dunkirk.

4. Early in 1918, the military situation was such that orders were issued for the evacuation of the department's depot at Les Forts, and in consequence the whole of the plant obtained for the reconstruction of the Belgian ports, excepting that in actual use in other places, were despatched mostly by barge to Richborough and Zeneghem.

In October 1918, instructions were issued by the War Cabinet that repairs in Belgian ports should be carried out under the control of the Civil Engineer in Chief of the Admiralty. From that date considerable quantities of plant and material were placed at his disposal, also certain officers and men of this department.

5. Channel ferry.—The proposal to run a cross channel train ferry service was first put forward in December 1916, and the entire design and construction of the terminal berths on the French side were entrusted to the Chief Engineer, Ports Construction.

After detailed investigation of all the ports in northern France, Dunkirk, Calais, and Dieppe were finally selected for this purpose; Dunkirk and Calais to be served from Richborough, and Dieppe from Southampton.

A complete description of the ferry service with drawings of the terminus at Richborough, the steamers, adjusting bridges, hoisting gear, etc., will be found in "The Engineer" of the 17th January, 1919.

6. On the French side the steamer berths were all of different design, to suit local conditions at the selected ports; but were in general outline similar to the Richborough berth. At Dunkirk the steamer berth was alongside floating timber pontoons instead of against a fixed structure; at Calais alongside concrete piers with timber fenders, and at Dieppe alongside an existing viaduct to which suitable timber fendering was fixed. No particular engineering difficulties were encountered. The work was put in hand April–June, 1917, and was completed early in 1918, the inaugural service to Calais commenced on the 10th February, 1918, and that to Dieppe on 22d February, 1918. Owing to naval and military reasons the terminous at Dunkirk was but little used. The ferry steamers proved themselves good sea boats, able to cross in all but the severest weather.

7. The ferry service proved of great value for the importation of locomotives, railway wagons, tanks, and heavy artillery on railway mountings. A large number of motor lorries were also brought over on their own wheels, and the approaches at Calais and Dieppe were decked over for the reception of such traffic.

8. In addition to 12-inch guns on railway mountings and lesser artillery, on the 26th May, 1918, two 14-inch guns on railway mountings, each weighing 296 tons and measuring 87 feet in length over all, were brought over together and safely unloaded at Calais. On the English side, owing to the great weight involved it was found impossible to load these guns complete at Richborough. The railway mountings were therefore put on board at that port and the guns subsequently put in position at Chatham. A third gun of the same type and, in addition, two heavy locomotives and wagons of various types were unloaded at Calais on the 23d of September, 1918, in the presence of Mr. Poincaré, President of the French Republic. On this occasion the water level in dock was such as to give a down grade on the adjusting span 1 to 25, over which the gun and locomotive passed safely.

9. Channel train ferry, Cherbourg.—At the beginning of August instructions were received to prepare a berth at Cherbourg for the train-ferry steamer "Leonard," a vessel of different type to the others.

The "Leonard" had previously been plying across the St. Lawrence River at Quebec. The work was stated to be of the greatest urgency and the timber fendered berth, with reinforced concrete abutment to receive the adjusting girder on the steamer, was completed in three weeks. The vessel however did not make her first trip till ten weeks later.

10. D. G. T. Depot, Oissel.—In May 1918, a very important depot for the Stores and Chief Mechanical Engineers' Departments was commenced and brought into full use in October. The total area of buildings constructed aggregated 168,000 square feet, the principal being the stores 600 by 75 feet, ambulance painting shed 500 by 38 feet, and machine shop 300 by 60 feet. The work included the provision of complete water supply installations, extensive dug-outs, platforms and semi-permanent camps for personnel.

11. Locomotive shops, Rang-du-Fliers.—During the same period a large depot for locomotives was completed at Rang-du-Fliers including a locomotive erecting shop, built of "Winget" blocks, length 304 feet, width 40 feet, and height to eaves 35 feet. It was equipped with two 45-ton overhead travelling cranes, electrically driven. The total area of the buildings constructed was 105,000 square feet and complete water supply and semi-permanent camps were also provided.

12. General.—A very large number of minor works were also carried out by the department over a widely scattered area in northern France, including a considerable amount of work for the Admiralty at Dunkirk, but none of these works presented engineer-

ing features of special interest. The British personnel of the department did excellent work under, at times, rather trying conditions and were instrumental in training the three Chinese labor companies that were attached to them to a high state of efficiency. As far as this department was concerned, the employment of Chinese labor on all kinds of public works under skilled British supervision, proved eminently satisfactory. Under war conditions it is difficult to estimate the cost of works as there are many unknown factors.

CHAPTER XXIX.

SECTION II.

SERVICE FOR THE OPERATION OF MARITIME PORTS DURING THE WAR 1914–1918 (FRENCH).

I. FUNCTION OF THE SERVICE FOR THE OPERATION OF THE MARITIME PORTS.

The French ports and especially the large ports (such as Dunkerque, Calais, Le Havre, Rouen, Saint Nazaire, Bordeaux and Marseille) played an important part during the war. The unforeseen and continuous increase in imports of all knds—coal at first—then raw materials (steel, wood, etc.) and finally all supplies needed to satisfy the military requirements of the French and Allied Armies brought about such a development of traffic, that it became necessary to replace the unrestricted port traffic, which existed before the war, by a new system of operation. This was done with the idea of expediting the handling of this matériel. It became necessary also to organise means of forwarding these supplies to the interior of the country which would be commensurate with the importance of the imports.

This was the duty of the service for the operation of the maritime ports.

II. ORGANIZATION AND GENERAL FUNCTIONING OF THE SERVICE.

(Chart 6, Chapter XXX, Volume I.)

First.—A "Military Commission of Maritime Ports" (Commission Militaire des Ports Maritimes) was created in the Ministry of Public Works (Ministère des Travaux Publics) at the beginning of 1915. It was a directing headquarters and was composed of four commissioners (two military, one technical, one administrative) and of one naval officer.

The central commission was represented at the most important ports by "Port Commissions" (Commissions de Ports). These were local organs and were composed, as a general rule, of from seven to eight members (one president, two military, one naval, two technical). It was their duty to decide upon all matters relating to the use of the ports for military purposes alone.

A special section of the "Direction of the Rear" (Direction de l'Arrière) at General Headquarters, in conjunction with the "Military Commission of Paris" (Commission Militaire de Paris), handled all matters concerning the ports in the Zone of the Armies (Dunkerque, Calais, Boulogne, and later, Le Tréport, Diéppe, Fécamp, Le Havre and Rouen).

Second.—Towards the end of 1916, the service was reorganized along the following lines for the purpose of securing better coordination in the operation of the ports.

Under the authority of the Minister of Public Works (Under Secretary of State for Transportation) there was established a central service for the operation of the maritime ports (Service Central d'exploitation des Ports Maritimes), whose chief was located at Paris, and which was charged with both the military and commercial operation of maritime ports.

In each port there was a "Chief of Port Operations" (Chef d'exploitation du Port) who had authority over all of the port services and who regulated matters concerning labor and facilities, daily transportation schedules (plans de transport journaliers), the employment of port clearing means (railroads, waterways, etc.).

In the ports used by the Allied Armies as maritime bases (Belgian and British bases at Calais; British bases of Dunkerque, Boulogne, Rouen; American bases of Saint Nazaire, Bordeaux, etc.), the commandant of the base had to apply to the French "Chief of Port Operations" for the assignment of means of transportation (évacuation).

In the British and Belgian bases, at the ports located in the Zone of the Armies, French General Headquarters (Direction of the Rear) maintained representatives as follows:

At Calais, a "Regulating Commissioner of the northern Belgian and British bases" (Commissaire Régulateur des Bases Belges et Anglaises du Nord);

At Rouen, "Regulating Commissioner of the southern British bases and of Rouen" (Commissaire Régulateur des Bases Anglaises du Sud et de Rouen).

The principal duty of the Regulating Commissioners was to maintain liaison between the Chief of Port Operations and the commandant of the Allied base for the purpose of drawing up the "daily schedules of transportation" (plan de transport journalier) and to assure the execution of this transportation by rail and by water.

Whenever questions arose involving a principle or requiring the modification of existing installations, they were submitted simultaneously:

By the Regulating Commissioner of Calais, or of Rouen, to the Direction of the Rear.

By the Chief of the Operation Service to the Central Service for the Operation of Ports.

The Direction of Rear and the Central Service for the Operation of Ports, after agreement, promulgated the decision taken.

III. RESULTS OBTAINED AT THE PORTS.

The service for the operation of the ports accomplished a great deal in its work of improving port facilities, providing necessary labor (main-d'oeuvre), an assuring the removal therefrom of enormous amounts of tonnage, which represented needs in imports of the various ministries and of the Allied maritime bases.

Each large port was progressively equipped with extensive unloading facilities (cranes, grain elevators, etc.) as well as with a system of interior railways which were necessary to connect the various quays and other installations; about 350 kilometers of railways were constructed for this purpose.

Available labor, which consisted of a limited number of stevedores at the beginning of the war, was re-inforced by specialists who had been granted delays in joining the colors (including more than 6,000 crane operators, mechanics, electricians, motor truck drivers, etc.) and later by auxiliary laborers: Chinese, Moroccans, prisoners of war (more than 20,000 of the latter were engaged in this work).

The shipment (évacuation) towards the interior of the material and merchandise which had been unloaded at the ports was effected by combining all possible means of transportation:

By rail, generally.

By inland waterway, for ports connected by canals (such as Dunkerque and Calais) or located on navigable rivers (Le Havre and Rouen).

By road (motor transport).

By sea (coastal maritime services).

Such shipments as could not be forwarded immediately were stored on the spot.

The ports of France had a total storage capacity of 2,500,000 tons in 1917.

The tonnage unloaded in the ports increased from 31,000,000 tons in 1915, to 51,000,000 tons in 1916. As an example, the tonnage unloaded at Le Havre in August 1916, amounted to 626,000 tons, of which 575,000 tons were sent to the interior (375,000 tons by railroad and 200,000 via the Seine).

CHAPTER XXIX.

SECTION III.

OPERATION OF PORTS (BELGIAN).[1]

The "General Maritime Transport Bureau" (Bureau Général des Transports Maritimes—B. G. T. M.) was organized on January 7, 1917, under the Director of Communications (Ministry of War), for the purpose of coordinating all questions pertaining to transportation by sea and which up to that time had been handled by the Cabinet.

The function of the General Maritime Transport Bureau was to consolidate requests for cargo space and transportation and to transmit same to the Navy Department, as the latter had been delegated by the War Department to requisition available tonnage.

The B. G. T. M. studied the question of sea transportation thoroughly and made the necessary recommendations in connection therewith. The first matter considered was the choice of ports.

The ports used by the Belgian Army after the organization of the B. G. T. M., were St. Nazaire and La Pallice, in France. The disadvantage in connection with these ports, however, was that their employment necessitated lengthy railroad hauls to the front. The port of Calais was therefore chosen and the "Ouest" basin was placed at the disposal of the Belgian services by the French authorities.

Within a month, wharves were constructed, storehouses built, trackage laid, and all necessary facilities, such as cranes mounted on trucks, floating cranes, etc., installed, thereby permitting the docking of large steamers coming from America.

The B. G. T. M. took over the "Maritime Agency" at London, as well as the direction of the Belgian sea transportation services for ships coming from America via New York; until then, the latter had been centralized and placed under the orders of the Belgian consul in that city.

Later, the B. G. T. M. organized a "Maritime Agency" at Le Havre to direct sea transports arriving at the new Belgian base which had been established at that port.

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[1] Prepared for the Military Board of Allied Supply by Major Denis, of the Belgian Ministry of War, and reduced to the compass of this work by Lt. Col. Ellery Farmer, Inf., U. S. Army, of the American Section, M. B. A. S.

It was deemed inadvisable to maintain all the supplies of the Belgian Army in the Calais-Gravelines region, as the latter was too close to the front. The reserve stocks kept in this region, which was considered as an "intermediate supply zone" (zone des Stations-Magasins), were sufficient for one month's requirements, while a two months' supply was stored at Le Havre.

The quantity of these supplies was relatively greater than that maintained for the American and British Expeditionary Forces, but this was caused by:

1) The remoteness of America, which country was the source of practically all supplies of the Belgian Army.

2) The difficulty of maintaining relations with that country on account of the submarine warfare and of the small number of ships at the disposal of Belgium.

3) The difficulty of arranging contracts and the desirability of accepting those which presented themselves through chance opportunity.

It should be noted, however, that the quantities given above, i. e.: one and two months' supplies at Calais and at Le Havre, respectively, were really theoretical. As a matter of fact, the stocks of certain supplies at Calais were almost always exhausted.

Transports between the Belgian base at Le Havre and the intermediate supply zone (zone des Stations-Magasins) of Calais-Gravelines, were effected either by sea or by rail; in the latter case via Rouen-Abancourt-Abbeville. To economize transportation, shipments between Le Havre and Calais were reduced to a minimum.

The Calais-Gravelines intermediate supply depots (Stations Magasins) were directly supplied from overseas through Calais, to which port large steamers coming from America were generally directed.

Le Havre was, therefore, principally a storage center for non-perishable supplies and did not supply the intermediate depot at Calais unless the latter failed to receive supplies from overseas in due time. Le Havre was also the supply base for all of the Belgian military organizations located south of the Seine.

The following navigation lines were established during the war for the transport of general merchandise: Tilbury–Le Havre, New York–Calais, New York–Le Havre.

From various ports of the United States to Calais, for the transport of lumber, oats, steel, horses, and, from Lisbon and Oporto to Le Havre, for the transport of munitions, wooden ties, and general merchandise.

To provide against a possible shortage of rail transportation the B. G. T. M. established a service of transports by inland waterways.[2]

[2] See Chapter XXVI, Section III, Vol. II.

A barge and tow-boat service was organized on the French rivers, particularly on the Seine. The operation of this service greatly relieved the traffic on the French railroads and resulted in notable financial economies.

The B. G. T. M. was also charged with the armament of Belgian naval units, as it became indispensable, on account of the submarine warfare, to provide Belgian ships with defensive armament. A "Naval Depot" (Dépôt d'Equipages—D. E.) was therefore created by Ministerial Decree,[3] dated May 3, 1917, for the purpose of maintaining and developing armed units composed of Belgian sailors. This organization was subsequently enlarged in order to replace by Belgian ships, whom it was difficult to control or over whom it was practically impossible to exert a rigid discipline.

Another part of the program provided for the formation of naval gun crews for duty aboard merchantmen and thereafter the armament of the Belgian ships compared favorably with that of the merchant ships of the Allied fleets. Finally, studies were made and plans elaborated for the installation of wireless equipment aboard Belgian vessels.

[3] Ministerial Decree Bi-5197-4, May 3, 1917.

CHAPTER XXIX.

SECTION IV.

OPERATION OF PORTS (ITALIAN).

SUPPLIES BY SEA.

Maritime traffic assumed proportions and attained an importance which could not be foreseen as a result of the entry into the war of nearly all of the European nations and subsequent demands on neutral countries.

The national resources of the Allies were insufficient and consequently all overseas markets, especially those of North and South America, were called upon to supply the deficiencies. Sea transportation thus became of primary importance in the supply of both the armies and the civil population.

MARITIME TONNAGE.

At the time of Italy's entrance into the war, the shortage of maritime tonnage was already felt. The Allies depending upon the American markets for supplies, the necessity for maritime transport in Europe developed to an extraordinary degree, and, due to the scarcity of tonnage, excessive increases in freight rates resulted. These difficulties were further increased by the submarine warfare which, in addition to the losses caused, limited the routes (rotte) to be followed, as well as the nature of the cargoes to be carried.

In addition there occurred the upheaval of the Balkan States, which resulted in Greece withdrawing her ships from international commerce, still further reducing available tonnage. Subsequently the Greek mercantile marine sold a number of ships to foreign Governments, at very high prices, but the number was too limited to afford any great relief to the tonnage situation.

The constantly increasing need for maritime tonnage for the transport of supplies, as well as the ever increasing freight rates, necessitated the requisition of ships. It was impracticable, at first, to apply this policy to the whole merchant marine because a complete requisition would have eliminated the Italian mercantile fleet from the field of international competition. The result would have been that the foreign fleets, remaining masters of the markets, would have

elevated tariffs "ad libitum" and the damage to the Government administrations would have been out of all proportion to the advantages to be gained by a total requisition. Therefore, about one-third of the total tonnage remained in private commerce, and the administrations divided the requisitioned tonnage according to the requirements of the situation. Additional tonnage requirements were obtained by the use of national or foreign ships and by the maximum employment of sailing vessels.

Subsequently, the lack of tonnage and the increasing transportation difficulties (the principal ones being the intensification of the submarine warfare and the general congestion of the ports), together with the growing need for supplies from overseas, necessitated an almost complete requisitioning of national shipping, excluding only those ships which, while in commission for private individuals, carried cargoes interesting the State and the administrations, particularly the munitions services.

This situation was met by adopting the measures taken by the British Government, such as the issuing of navigation licenses, requisitions, and the freighting of tonnage on time charter for the Allies. Thereafter, all the Allies endeavored to clear the ports of discharge as speedily as possible by the rapid unloading of ships. However, these efforts were considerably minimized by the fact that the congestion of the American railways and ports of discharge caused the ships loading in America to lose a great deal of the time which they had gained when discharging cargoes in Europe.

Other steps taken were the utilization of neutral ships to better advantage (a British measure), the employment of interned German ships and the speeding up of construction in the shipyards. In spite of all this, on account of the great disparity between the amount of tonnage available and the actual requirements, the mercantile marine problem remained very grave throughout the war.

The importation of coal was closely connected with the transport problem and the coal question soon assumed a general character on account of the progressive absorption of available supplies by the various factories engaged in the manufacture of war material. The agitation among the English miners, the scarcity of neutral tonnage and, finally, the constantly increasing requirements of the national industries rapidly affected existing coal supplies and convoys.

On February 2d, 1917, the King's Deputy promulgated a decree (No. 113), under the terms of which a "General Coal Commissariat," under the control of a special committee of Ministers of the Crown, was created to purchase, transport, and distribute coal. This committee was authorized to employ the services of supply, the

State navigation and railway services (Navigazione Ferrovie dello Stato), as well as the special offices of the various Government administrations, in carrying out its functions.

ORGANIZATION OF THE PORTS

The unforeseen importance attained by maritime transports during the war (for the reasons already mentioned), had the effect of diminishing tonnage in proportion to requirements for same and another direct consequence of this sudden development was the unpreparedness of the ports to sustain the enormous increase in traffic.

From the beginning of the war the congestion of the ports presented a very serious problem and one which required careful attention in order to solve it. It will be sufficient here to state the condition which existed in the largest Italian port, that of Genoa, at the end of November 1915, to give an idea of the general situation. This was characterized by the sight of 470,000 tons of shipping (40 steamships and 6 sailing vessel) lying idle in the outer port awaiting to be discharged, and by the fact that the captain of that port had to issue orders that, in the future, vessels arriving at Genoa would no longer remain in the outer port, but that they would proceed to the docks to await their turn to unload their cargoes. However, by the adoption of appropriate measures, the problem was solved satisfactorily.

PORT OF GENOA.

The existing port services being unable to adequately assign railway facilities among the various services, particularly those for the transport of materials required by the various war industries, a special commission was created, similar to those operating in the British ports. This commission, working in conjunction with the local Military Railway Commission, consolidated the demands for railway equipment, determined urgency of transportation requests and established priorities. The result of this reorganization, which was essentially military in character, was a notable improvement in the general operation of the port services. The latter had, until then, been under the control of commercial interests which were opposed to military control and their attitude was largely responsible for the unsatisfactory conditions at that port.

Some of the more important measures adopted by the military authorities were: the organization of a system for unloading the ships rapidly, this was obtained by providing bonuses or rewards for speed in unloading; the storage on the spot of merchandise which could not be forwarded immediately by railway in order to quickly clear the docks of merchandise; the requisitioning of float-

ing bottoms for the purpose of increasing the working capacity of the ports; recommendations to the various administrations concerned in receiving material, with a view to eliminating difficulties or delays such as those caused, for example, by defective loading of vessels at ports of origin, etc.

Steps were also taken to relieve the pressure on the port of Genoa by diverting ships to Vado, Savona, Spezia and Leghorn, as well as to smaller ports. These measures soon showed results and by the end of March 1916, the situation was regarded as satisfactory. By that date most of the goods which had been lying on the docks had been forwarded to warehouses in the interior or to consignees, and only two steamships and five or six sailing vessels were awaiting to be unloaded, while the number of discharging berths at the coal docks which were still occupied had been reduced to sixteen, leaving twelve berths available for unloading purposes. Moreover, in accordance with contract stipulations, English freight steamers were being unloaded at an average rate of speed of 1,000 tons a day.

HARBOR OF VADO.

The harbor (roads) at Vado was improved to permit unloading of ships at that port, in order to lighten the traffic at Genoa. For this purpose, important works were undertaken between the three pontoon bridges (pontilli) and accessory installations. The number of floating bottoms was increased, unloading facilities, as well as depots and storehouses, were enlarged and railway equipment improved; finally, steps were also taken to assist the " Workmen's Association ". Vado was thus enabled, within a short time, to assist materially in reducing the traffic at the port of Genoa.

PORT OF SAVONA.

The port of Savona, thanks to the carefully planned measures adopted there, also operated satisfactorily despite its inadequate railway facilities. A special commission, similar to that at Genoa, was organized at Savona; the functions of the local military command were increased; closer relations with the Turin Division of the Railway Administration and with the Military Railway Commission were established; disembarkation offices were created; measures to insure the proper assignment of railroad transportation were instituted and all abuses were stopped. The port of Savona was thereby enabled to meet all requirements and soon equalled Genoa.

At the end of December 1915, that is to say, within one month, the quantity of supplies remaining at Savona had been reduced to

30,000 tons; coal, from 100,000 tons to 75,000 tons and cereals from 14,000 tons to 3,000 tons.

PORT OF SPEZIA.

Spezia was designated as the unloading point for explosives, grain, frozen meat and certain wood cargoes.

Railway plants were established at Valdellora and Migliorina from plans elaborated by the Maritime Railway Committee; a "traveling bridge", with necessary accessories, and warehouses and sheds were constructed; a new railroad line was built, and a signal mast was erected on the maritime landing place. The operation of the animal and motor transport hauling services was entrusted to reliable civilian firms. Finally, a special commission was established in this port to control the assignment of railway facilities and here, as elsewhere, it succeeded in overcoming prejudicial local conditions to the advantage of port operating services.

PORT OF LEGHORN.

This port had a very small capacity at the beginning of the war but, after a careful reorganization, it was enabled to relieve the port of Genoa in the handling of wheat and other cereals.

One of the important measures taken here was the forwarding of large quantities of merchandise, from Leghorn to Pisa, by way of the "Navicelli" canal. This, in conjunction with the efficient work of the special commission which had been established at Leghorn and of the "embarkation and disembarkation office" operating under the military railway commission of Firenze, as well as of the various local authorities, enabled this port to operate successfully.

OTHER PORTS.

There is nothing of particular interest to report in connection with the operation of the other Italian ports. They operated satisfactorily and in most cases their pre-war organization succeeded in expanding them so that they were enabled to handle the increased traffic resulting from the war. This was particularly true in the case of the ports of Naples, Torre Annunziata and Taranto, which were charged with the important service of supplying the troops in Albania and Macedonia.

PRINCIPAL ADMINISTRATIVE ORGANIZATIONS FOR MARITIME TRAFFIC.

The principal organizations charged with planning, organizing, and controlling matters concerning maritime transportation were:

The Maritime Railway Committee: For the solution of traffic problems in the ports, the creation of special port commissions, and all questions of general or particular interest concerning ports.

A Committee for the requisition of shipping: For all matters concerning the requisitioning of national shipping.

A Sub-Committee of the above mentioned Maritime Services: Which dealt with all questions pertaining to steamships of the State Navigation Company.

A Central Maritime Traffic Commission: This was a technical organization concerned with military maritime movements. It prepared legislative action affecting the mercantile marine and the employment of foreign vessels. Through its special mission in London, this commission apportioned available tonnage in accordance with the requirements of the various administrations and solved commercial importation and exportation problems. It also coordinated the port and railway services and regulated the shipment of merchandise toward the interior. The commission was suppressed upon the formation of the Ministry of Maritime and Railway Transportation.

The Delegation of the Transportation Administration: This was an agency fo the General Commissariat. It worked on conjunction with the above named organizations and was particularly charged with providing for the needs of the Army.

Upon Italy's entrance into the World War, the "Delegation of the Transportation Administration" organized a transport service for the importation from America of raw material requirements for the various industries engaged in the manufacture of arms and munitions. It was also charged with the control of vessels carrying wood, cereals and coal for the military administrations and for the transport of horses. In this connection, it organized disembarkation points at Genoa, Savona, Vado, Spezia and Leghorn.

In 1917, with the formation of various "Commissariats" (Cereals, Coal, Arms and Munitions, etc.), these transports were removed from the control of the "Delegation" and taken over by the Commissariat concerned.

Military Maritime Transport Office in New York: This office was organized for the particular purpose of directing transports interesting the Under Secretary for Arms and Munitions. The increased traffic of Italian ships to American ports could no longer be supervised without a local agency to enforce the technical and maritime regulations prescribed by the Italian Government for this class of transport. The creation of this office was further necessitated on account of the density of traffic on the American railroads and in the American ports, with the consequent need for the establishment of priority rules and careful planning of loading

operations in order to avoid useless and costly trips from one port to another and minimize delays.

MARITIME TRANSPORTS.

Supplies for overseas troops.—For the supply of Italian troops overseas, there were:

A Delegation of the Transportation Administration: The Transportation Section of the General Staff was mobilized and transformed into the Transportation Administration at the beginning of June 1913. As soon as the mobilization of the Italian Army was completed, the Transportation Administration established itself in the theater of operations, leaving only a "Delegation" in Rome. This delegation was responsible for all military sea transportation and also handled those matters which have been mentioned above, in conjunction with the various administrative agencies concerned with general maritime traffic.

Military Maritime Transport Offices and Military Embarkation and Disembarkation Offices: These were military maritime transport agencies under the orders of the Delegation of the Transportation Administration.

The first were technical administrative offices concerned with the operations and movements of the Royal Italian Navy and were composed of mixed elements from the Army and Navy. There were three of these offices: That of Naples, which existed before the war; that of Taranto, for the supply of the Italian troops operating in Albania and Macedonia, and that of Venice. The latter was established after the Armistice, as the result of the sudden and unforseen increase in maritime traffic in the Adriatic Sea.

The Military Embarkation and Disembarkation Offices were established in various ports and were under the control of the Military Transport Offices and of the Military Railway Commissions. The principal ones were located at Genoa, Savona, Spezia, Leghorn, Civitavecchia, Naples, Palermo, Messina, Syracuse and Taranto.

Supplies for the Colonies.—During the war, as in the past, the normal supplies for the troops in the colonies continued to be despatched from Naples for the ports of Tripolitania, Cirenaica, the Eastern Mediterranean, Eritrea and Somaliland.

Supplies for Albania and Macedonia (Chart 3, Chapter IV, Volume I).—The Italian Corps of Occupation in Albania increased gradually and the importance of the base at Taranto became proportionately greater, especially after the expedition of Italian troops to Macedonia.

The "A. M. Commissariat" (for Italian troops in Albania and Macedonia), with headquarters at Taranto, was responsible for the

supply of these troops, while the Military Transport Office at that port, with its subordinate embarkation and disembarkation offices, provided the necessary maritime transportation. In 1916, these transports had increased to such an extent that it became necessary to establish secondary bases at Brindisi and Gallipoli.

The principal transfer points were the ports of Valona and Salonica and, in both of these places, a branch office of the "A. M. Commissariat" was established, with embarkation and disembarkation offices attached. After the opening of the ordinary road through Southern Albania, the port of Santi Quaranta was also put in operation and a secondary base was established there for the Italian troops in Macedonia.

Toward the end of 1916, the congestion at Taranto necessitated the formation of an auxiliary service and the establishment of a branch office of the "A. M. Commissariat" at Naples. Storehouses were also established at Torre Annunziata and numerous vessels carrying supplies to Albania and Macedonia obtained their cargoes from that port, thus greatly relieving the situation at the base of Taranto.

CHAPTER XXIX.

SECTION V.

OPERATIONS OF PORTS AND ALLIED BASES (AMERICAN).[1]

At first it was thought that practically all supplies necessary for the equipment and maintenance of the American forces had to come from overseas, and the commencement of the supply system of the American Expeditionary Forces was, therefore, at the ports. An examination of the French ports was made immediately upon the arrival of the Commander in Chief and his staff in France, and it was found that in order not to interfere with the supply systems of the Allied Armies, the channel ports could not be used and it would be necessary for the American forces to use the southern ports, St. Nazaire, La Rochelle, Bordeaux, with a consideration of Marseille, which were allotted to the American Expeditionary Forces. The examination of these ports showed that extensive development would be necessary to provide adequate facilities to receive and unload with despatch the great fleet of ships which would be required to supply the American Expeditionary Forces. Delay in unloading meant a waste of tonnage, and shortening the turn-about of each ship was in effect increasing the tonnage. Construction was, therefore, started immediately on additional docks, machinery was installed for the rapid unloading of the ships, classification sheds were built for the checking and sorting of the cargoes and additional railway tracks were laid so that the docks and classification sheds could be cleared promptly. (Charts 4 and 5, Chapter XXX, Vol. I.)

In close vicinity to the ports and within the areas known as "Base Sections" were established general depots for all services, to which were sent all supplies and materials as unloaded from the ships, with the possible exception of coal, forage, frozen meat and commodities of this character which could be loaded directly, without sorting, into cars placed along the ship's side and forwarded in solid trains to the interior. These depots gave enormous storage capacity which could be used as a reservoir during the periods of shortage of railway equipment, when it was possible to forward only a limited amount of supplies to the intermediate and advance depots. The clearing of the docks was generally accomplished by

[1] Extracts from Report of Gen. Mosely, G–4, G. H. Q., to Commander in Chief.

shuttle trains which ran between the docks and the depot on regular schedules, making the unloading of the boats entirely independent of the railway systems.

It was not practicable to make shipments from the United States of balanced stocks, or to consign cargoes to particular ports, so that the stockages of the local base ports were neither complete nor balanced. Consequently, in the interior, at a distance of absolute safety from the front, there were established very large general depots where balanced stocks of all classes of materials were accumulated and kept in reserve to maintain the stockages of depots nearer the front from which the troops were supplied.

CONSTRUCTION.[2]

(Chart 3, Chapter XXX, Vol. I.)

PORTS AND DOCKS.

To provide adequate debarkation facilities for the American Expeditionary Forces, first estimated at 500,000 men, later at 2,000,000 men and finally announced as 4,000,000 men, the Engineer Department had recourse to two lines of action: the acquisition of existing French docks and the construction of new installations. Based on a per capita consumption by the American Expeditionary Forces of 50 pounds per day, it was necessary to make provisions for the discharge first of 12,500 tons, then of 50,000 tons, and finally of 100,000 tons.

The first installation at which actual construction was undertaken was a 10-berth pile dock at Bassens, on the Garonne River, 5 kilometers below Bordeaux; the second was a 2-berth pile dock in the Port du Commerce at Brest; and the third was an 8-berth pier in the Loire River at Montoir, near St. Nazaire.

BASSENS.

Proximity to an existing French dock, allowing the landing of material and equipment near the site of the proposed dock, accessibility to the main line of the Paris-Orléans Railway, from Bordeaux to Paris, and the possibility of installing storage facilities nearby, were controlling factors in the selection of Bassens as the site for the first and largest of the American dock installations.

The original design of the Bassens dock called for a structure that would sustain the load imposed by 5-ton and 10-ton Gantry cranes,

[2] Extracts from Report of Director of Construction and Forestry.

the heavier imposing a wheel load of 86,000 pounds; piling and heavy timbers had to be brought from the United States, at least until forestry troops, arriving late in September, were able to produce them in France. Long piling was needed and was obtained with difficulty and was slow in arriving from the United States.

All during the winter of 1917–18, work on the Bassens project was prosecuted with vigor. As a result, the Bassens docks were ready in April to receive the first vessel.

The dock consisted of 10 berths, each 410 feet long, with a four-track trestle approach at each end. These four tracks were connected with the depressed unloading tracks in the rear of the dock, which tracks connected at the south end with the receiving yard, and at the north end with the departure yard, both yards being about half a mile from the dock itself.

The dock proper was 86 feet wide. Eleven thousand and fifty piles, ranging in length from 50 to 100 feet, were used in the original construction and 4,500,000 feet board measure of lumber. The dock contained 3.53 miles of trackage. On the dock were classification sheds 66 feet wide, six of the eight sheds being 312 feet in length and the others 204 feet.

The construction of the departure yard, one-half mile northeast of the docks, required a fill of 271,593 cubic yards, the laying of 20 miles of track, and the placing of 104 switches and 4 double slips. The receiving yard, a quarter of a mile southeast of the docks, necessitated approximately 19,000 cubic yards of fill. There were laid 6.5 miles of trackage in this yard, as well as temporary engine facilities, 32 switches, and 2 double slips.

Other installations were made at the various ports assigned the American Expeditionary Forces, after careful study by section Engineers of possibilities for local port development. Some new installations were approved upon the reports of individual section Engineers, though, in the case of the largest projects, boards of Engineers usually went over the ground, making thorough investigations and submitting their reports, upon which future action was based.

IMPROVEMENT OF EXISTING FACILITIES.

In the rehabilitation of existing berths to meet American demands, more or less extensive improvements were made at Brest, St. Nazaire, Nantes, Bordeaux, Bassens, La Pallice, Marseille and Toulon by the installation of new trackage, erection of additional storage space, and the change in existing track layouts. Almost all berths acquired by the American Army were served by track layouts requiring the use of turntables for switching cars, a system which excluded the use of American rolling stock.

HISTORY OF PORT OPERATIONS.[3]

At the beginning, port commanders were responsible only for the sanitation, police and discipline of their areas and the several services were engaged separately in the development and operation of the port. Later this system was changed. All activities of the port were placed under the control of the port commander who organized a complete staff capable of co-ordinating the various services. As a result pressure was always being brought to bear upon the weakest point to bring it up to standard. Material and labor standing idle in one department were employed to speed up another. Transportation was pooled so as to be available for all. Unity of action and uniform development of all departments were thereby secured.

Territorial administrative sections were created and readjusted from time to time as necessity demanded. The commanding generals of sections had a great deal of business to transact with the French military regional commanders and, for this reason, in defining the limits of sections French regional lines were generally followed. General Orders No. 26, G. H. Q., August 28, 1917, charged the commanding officers of sections with the duty of Assistant Chiefs of Staff for the purpose of control and coordination. This system, however, was departed from, and the section commander, under the reorganization, though not an Assistant Chief of Staff, was the direct representative of the Commanding General, S. O. S., and his relations to the representatives of the various services in the section corresponded to the relation of the Commanding General, S. O. S., to the services at Headquarters, S. O. S. Section commanders were directly responsible for the proper attention to duty of all within their sections, discipline, supply and sanitation. They were not authorized to make changes in the approved projects of construction. Questions relating to priority of shipment were settled by them, and in this they had the assistance of a staff officer, who represented G-4 at these headquarters.

Section commanders coordinated, when the necessity arose, the assignment and employment of all labor, including casuals, combatant or noncombatant, and they were charged with the pooling of motor transportation within the limits of their sections. All correspondence, not technical and not relating to the routine work of departments, passed through their office. The decision in large questions of priority of shipment was reserved by Headquarters. S. O. S. In these cases the chief of the service concerned would apply directly to these headquarters, where the priority would be determined.

[3] Extracts from Gen. Mosely's Report to the Commander in Chief.

REVIEW OF BASE SECTIONS.[4]

Base Section No. 1, (Chart 2, Chapter XXX, Vol. I.) with headquarters at St. Nazaire was the first base section established, and developed from the port of St. Nazaire. It was at St. Nazaire that the first American convoy landed, on June 26, 1917.

St. Nazaire developed into the greatest freight port of the American Expeditionary Forces, 1,600,000 tons of cargo having been discharged there at the date of the Armistice. During 1918, 397 ships were handled there, remaining in port an average of 13.4 days. The great storage depot at Montoir was built near St. Nazaire. Another important port of this base section was Nantes, on the Loire River. Here there were French docks with eight berths, which were turned over to the Americans by the French, and these docks handled the third largest amount of freight, next to St. Nazaire and Bordeaux, of the ports used by the Americans, 639,000 tons being handled there up to the date of the Armistice. During 1918, this port handled 248 ships, with an average of 9.2 days per ship in port.

Base Section No. 2, included the ports in the River Gironde and the port of La Pallice and the territory in the zone surrounding these points. Later, La Pallice became part of Base Section No. 7. The headquarters were located at Bordeaux, which was the terminus of one of the main lines of communication used by the Americans. Bordeaux was one of the first ports selected for American use, because there were docks at French Bassens available for immediate use.

The handling of freight, hospitalization, and artillery training were the important activities of this section.

"Beginning in November, 1917, when two ships were the maximum which could be unloaded at one time, docks were built which by November, 1918, were capable of unloading 15 ocean steamships at one time. Three lines of standard gauge railway track ran on the dock along the shipsides, with traveling cranes to swing cargo direct from hold to car, and with sheds behind the tracks for classification and overflow. Great railway yards were built and standard gauge track laid to St. Sulpice, some 9 miles distant, where an immense storage depot or reservoir took up the slack in the incoming shipments, using constantly from 1,600 to 2,000 railway cars in the shuttle service, and making possible an even flow of daily shipments up-country to the maximum of the railway capacity. Where in November, 1917, only 26,056 tons were unloaded, November, 1918, saw 236,653 tons of cargo unloaded at this port—not to speak of 6,933 animals and 2,027 troops.

[4] Extracts from Report of Commanding General, Services of Supply, to Commander in Chief, A. E. F.

"Naturally, all this construction and operation required a large force, and with over 100,000 troops in this one base section the administration of the section and coordination of all its activities required a complete staff organization.[5]

Bordeaux was the second port in France for the reception of freight, having handled up to January 1, 1919, 1, 749,700 tons. During, 1918, 381 ships docked at Bordeaux. The amount of freight handled at this port was increasing at a greater rate than at any other port occupied by the Americans. Had the war been prolonged, Bordeaux would have been the first port in the amount of American freight handled.

Base Section No. 3. was established primarily for the care of American troops passing through England to France. These troops were landed at Liverpool, transported by rail to the British channel ports (Southampton and Dover), and sent across the English Channel to Havre, Cherbourg and Calais.

Base Section No. 4, was originally Base Section No. 3. It was established as the agency for receiving American troops and supplies arriving in France from England. The important points of American activities in this base section were Le Havre, Rouen, Calais, and Boulogne, which was the headquarters of the section, handled 735,668 troops up to the date of the Armistice, and during 1917–18 discharged 506,000 tons of freight. During 1918, a total of 185 ships docked there, remaining in port an average of 6.1 days. During the same period, Rouen handled 95 ships, discharging 186,433 tons of freight.

Due to a constant shortage of rail transportation supplies of all kinds not required immediately at their destination, were shipped by barges from Le Havre up the Seine to Paris for distribution.

Base Section No. 5.—Within this section, the important American activities outside the port of Brest were at Cherbourg, debarkation port; Rennes, the location of a locomotive terminal and repair shops; St. Malo, leave area; and Granville, a coal port.

The port of Brest was the most important port of disembarkation in France, as the only deep water port available to the American Expeditionary Forces.

The principal feature at the port of Breast was the rest and embarkation camp at Pontanezen, the largest American camp in France.

On January 1, 1919, 533,000 tons of cargo had been discharged at Brest, 7,125 tons at Cherbourg, and 26, 000 tons of coal at Granville. On January 1, 1919, 804,670 troops had landed at Brest. During 1918, Brest handled 394 ships, with an average of 3.5 days in port per ship.

On May 24, 1918, the port of Brest disembarked from a fleet of transports, 42,152 American troops within twenty-four hours.

[5] Extract from Gen. Moseley's Report to C. in C.

After the armistice, Brest was selected as the principal embarkation port.

Base Section No. 6, was established June 28, 1918. Its headquarters were at Marseille. This port was not used previously by the American Expeditionary Forces, due to the great submarine danger in the Mediterranean. No American troops were brought to France through this port and it was used only for freight. The French assigned docks with berths for nine ships. During 1918, a total of 62 ships, with an average of 17.1 days in port, were handled, and a total of 431,598 tons of cargo discharged.

A motor reception park was maintained at Marseille; also a labor camp.

Base Section No. 7.—The first headquarters of this base section was at La Pallice, but later moved to La Rochelle. Prior to June 28, 1918, this section formed part of Base Section No. 2.

It was at the ports of this section that a large part of the coal for the American Expeditionary Forces was received and here was the principal depot for the storage of oil and gasoline.

The principal points of American activities were: La Rochelle, the location of Camp Pullman, a car erection plant which erected nearly 20,000 American cars; La Pallice, port of entry of oil and gasoline storage depot: Aytre; Aigrefeuille, the location of storage and classification yards, which point was to be a general storage depot for La Rochelle and La Pallice; Rochefort, a port of entry for coal and general cargo; Tonnay-Charente and Marous, coal storage depots. Talmont was an approved site for a great deep water port, and work had begun which ceased at the Armistice. At Montagne, there was a cement plant.

The total tonnage at La Pallice for 1917–18 amounted to 788,809 tons; at Rochefort, 517,995 tons. At La Pallice, 141 ships were handled with an average turn-around of 14.37 days; and at Rochefort, 166 ships, with an 8.83 days' turn-around.

As an indication of the magnitude of its activities, the number of troops in the base sections on November 11, 1918, were as follows:

	Officers.	Men.	Nurses.	Total.
Base Section No. 1	4,628	93,119	502	98,249
Base Section No. 2	3,801	90,301	671	94,773
Base Section No. 3	1,505	27,580	.....	29,085
Base Section No. 4	219	3,944	.....	4,163
Base Section No. 5	718	15,211	.....	15,929
Base Section No. 6	380	8,870	.....	9,250
Base Section No. 7	375	11,559	.....	11,934
	11,426	250,584	1,173	263,383

The above figures do not include civilian personnel, of which there were in the entire S. O. S., 23,772.

APPENDIX TO VOLUME II.

SECTION I.

ABBREVIATIONS (BRITISH ARMY).

"A"	Adjutant-General's Branch.
A	Acting.
A. A	Army Act.
A. A	Anti-Aircraft.
A. A. & Q. M. G	Assistant Adjutant and Quartermaster General.
A. A. S. L. S	Anti-Aircraft Searchlight Section.
A. and S	Ammunition and Stores.
A. B	Army Book.
Ac	Cross Channel (barges).
A. C	Alternating current.
A. C. B. A. S	Administrative Commandant Back Areas South.
A. C. I	Army Council Instruction.
A. C. L	Assistant Controller of Labour.
A. C. of S	Assistant Controller of Salvage.
A. D	Assistant Director.
A. D. C	Aide-de-Camp.
A. D. L	Assistant Director of Labour (later A. C. L.).
Admn	Administration.
A. D. P. S	Assistant Director of Postal Service.
A. D. M. S	Assistant Director of Medical Services.
A. D. U. S	Australian Depot Unit of Supply.
A. D. Sigs	Assistant Director of Signals.
Adv. Gd	Advanced Guard.
A. E. Coy	Area Employment Company.
A. F	Army Form.
A. F. C	Air Force Cross.
A. F. B	Army Filtration Barges.
A. F. M	Air Force Medal.
A. F. S	Assistant Financial Secretary.
A. H. Q	Army Headquarters.
A. H. T. D	Advanced Horse Transport Depot.
A. I. F	Australian Imperial Forces.
A. L. C	Army Labour Commandant. Assistant Labour Commandant.
A. M	Albert Medal.
Amm	Ammunition.
A. M. R	Aerial Musketry Range.
A. M. T. D	Advanced Mechanical Transport Depot.
A. O	Army Order.
A. O. C	See R. A. O. C.
A. P. C	Army Pay Corps. Auxiliary Petrol Company.

A. P. Coy	Advanced Park Company R. E.
A. P. D	Army Pay Department.
A. P. M	Assistant Provost-Marshal.
A. P. O	Army Post Office.
A. P. O. C	Army Post Office Corps.
A. P. S	Army Postal Service.
A. P. S. S	Army Printing and Stationery Services.
A. Q. M. G	Assistant Quartermaster General.
A. R. D	Army Remount Department.
	Advanced Railway Depot.
	Advanced Remount Depot.
A. R. I	Army Regulations India.
A. R. O	Army Roads Officer.
A. R. P	Ammunition Refilling Point.
A. R. R. C	Associate of the Royal Red Cross.
Art	Artillery.
Asst. C. R. E	Asst. Commanding Royal Engineers.
A. S. D	Advanced Supply Depot.
	Aeroplane Supply Depot.
	Area Signal Detachment.
A. T. C	Army Troops Company.
	Australian Tunnelling Company.
A. T. S	Ambulance Train Section.
A. V. C	See R. A. V. C.
B. A. F. & F	British Armies in France and Flanders.
Batt	Battery.
B. C	Battery Commander.
Bde	Brigade.
Bde. Comdr	Officer Commanding a Brigade.
B. E. F	British Expeditionary Force.
B. G	Brigadier General.
	Broad Gauge (railways).
B. G. R. O. D	Broad Gauge Railway Operation Division.
B. H. P	Brake Horse Power.
B. M	Brigade-Major.
B. M. T. D	Base Mechanical Transport Depot.
Bn	Battalion.
B. O	Brigade Order.
Br	Bombardier.
	Bugler.
B. R. C. S	British Red Cross Society.
B. S. D	Base Supply Depot.
B. S. O	Brigadier Supply Officer.
B. W. I. Rgt	British West India Regiment.
B. W. R. H	Black Watch Royal Highlanders.
Capt	Captain.
C. A. S. C	Canadian Army Service Corps.
Cav	Cavalry.
C. A. V. C	Canadian Army Veterinary Corps.
C. B	Companion of the Order of the Bath.
	Confinement to barracks.
C. B. E	Commander of the Order of the British Empire.
C. C. B. A. P	Canadian Cavalry Brigade Ammunition Park.

C. C. D	Central Correspondence Department (A. M. T. D.).
	Commander of Coast Defense.
C. C. L. Bn	Cape Coloured Labour Battalion.
C. C. S	Casualty Clearing Station.
C. D. U. S	Canadian Depot Unit of Supply.
C. E	Chief Engineer.
C. E. P. C	Chief Engineer Port Construction.
C. F. A	Canadian Field Ambulance.
	Canadian Field Artillery.
C. F. C	Canadian Forestry Corps.
	Chief Field Censor.
C. G. S	Chief of General Staff in the Field.
C. H	Member of the Order of the Companions of Honor.
C. H. D	Convalescent Horse Depot.
C. I	Lady of the Imperial Order of the Crown of India.
C. I. D	Central Investigation Department (Supplies Directorate).
C. I. E	Companion of the Order of the Indian Empire.
C. I. G. S	Chief of the Imperial General Staff (W. O.).
C. I. M. T	Chief Inspector Mechanical Transport.
C.-in-C	Commander-in-Chief.
C. I. O. M	Chief Inspector of Ordnance Machinery (later P. I. O. M.).
C. I. O. O	Chief Inspecting Ordnance Officer.
C. L	Controller of Labour.
C. L. C	Chinese Labour Corps.
C. L. O	Chief Labour Officer.
C. L. R. O	Corps Light Railway Officer.
C. L. R. W	Central Light Railway Workshop.
C. M. A	Controller of Military Accounts.
C. M. E	Chief Mechanical Engineer.
C. M. E. (E. L.)	Chief Mechanical Engineer, Electrical Branch.
C. M. G	Companion of the Order of St. Michael and St. George.
C. O	Commanding Officer.
Co	Company.
C. of S	Controller of Salvage.
Col	Colonel.
Coln	Column.
Commdng	Commanding.
Commdt	Commandant.
Commdr	Commander.
C. O. O	Chief Ordnance Officer.
C. O. R. C. C	Canadian Overseas Railway Construction Corps.
C. P. B	Central Purchase Board.
Cpl	Corporal.
C. P. S	Central Packing Shed (B. M. T. D.).
C. Q. M. S	Company Quartermaster Sergeant.
C. R. A	Officer Commanding Royal Artillery.
C. R. C	Civilian Railway Company.
	Corps Rest Camp.
C. R. C. E	Chief Railway Construction Engineer.
C. R. E	Officer Commanding Royal Engineers.
C. R. E. S. O	Chief Royal Engineer Stores Officer (two–N. & S.).
Cr. Sgt	Colour Sergeant.

C. R. T.	Canadian Railway Troops.
C. S. I.	Companion of the Order of the Star of India.
C. S. K. P.	Chief Storekeeper (railway).
C. S. M.	Company Sergeant Major.
C. S. O.	Chief Stores Officer (No. 2, B. M. T. D.).
	Correspondence Section Officer (No. 1, B. M. T. D.).
C. S. & T. O.	Chief Supply and Transport Officer.
C. T.	Corps Troops.
C. T. C.	Central Traffic Control.
C. V. D.	Central Voucher Department (A. M. T. D.).
C. V. O.	Commander of the Royal Victorian Order.
D.	Director or Deputy.
D. A.	Director of Artillery (W. O.).
	Divisional Art.
D. A. A. G.	Deputy Assistant Adjutant General.
D. A. B.	Disposal of Animals Branch (Veterinary Directorate).
D. A. C.	Director of Army Contracts (W. O.).
	Divisional Ammunition Column.
D. A. D.	Deputy Assistant Director.
D. A. G.	Deputy Adjutant General.
D. A. P.	Director of Army Priority (W. O.).
D. A. P. S.	Director of Army Postal Services.
D. A. Q. M. G.	Deputy Assistant Quartermaster General.
D. A. S.	Director of Army Signals.
D. B. E.	Dame Commander of the Order of the British Empire.
D. C.	Direct current.
	District Control (traffic).
D. C. D.	Dripping Collecting Depot.
D. C. L.	Deputy Controller of Labour.
D. C. M.	Distinguished Conduct Medal.
	District Court Martial.
D. C. of S.	Deputy Controller of Salvage.
D. D.	Deputy Director.
	Director of Docks.
	Docks Directorate.
D. D. M. S.	Deputy Director of Medical Services.
D. D. O. S.	Deputy Director of Ordnance Stores (Woolwich Arsenal)
D. D. P. S.	Deputy Director of Postal Services.
D. D. Rlys.	Deputy Director of Railways (W. O.).
D. D. S. & T.	Deputy Director of Supply & Transport (with Armies).
D. E. O. S.	Director of Equipment and Ordnance Stores (W. O.).
Dept.	Department.
D. E. S.	Director of Engineering Stores.
Det.	Detachment.
D. F. C.	Distinguished Flying Cross.
D. F. M.	Distinguished Flying Medal.
D. F. W.	Director of Fortifications and Works (W. O.).
D. G.	Dragoon Guard.
D. G. A. M. S.	Director-General, Army Medical Services (W. O.).
D. G. A. V. S.	Director-General, Army Veterinary Service (W. O.).
D. G. G. R. & E.	Director General of Graves Registration and Enquiries (W. O.).
D. G. Mob.	Director-General of Mobilization and Recruiting (W. O).

D. G. M. R. ..... Director-General of Movements and Railways (W. O.). Later D. Mov. and A. D. Railways.
D. G. M. S. ..... Director-General of Medical Services.
D. G. T. ..... Director-General of Transportation.
D. G. T. C. ..... Director-General Tank Corps (W. O.).
D. G. T. V. F. ..... Director-General of the Territorial and Volunteer Forces (W. O.).
D. H. ..... Director of Hygiene (W. O.).
D. of H. ..... Degree of Honor.
D. I. S. ..... Detail Issue Store (Supplies).
Dist. ..... District.
Div. ..... Division.
Divl. Comdr. ..... Divisional Commander.
D. I. W. T. ..... Director of Inland Water Transport.
D. J. A. G. ..... Deputy Judge-Advocate General.
D. L. ..... Director of Labour (Later C. L.).
D. L. R. ..... Director of Light Railways.
D. L. R. R. ..... Director of Light Railways and Roads (later two Directorates).
D. M. I. ..... Director of Military Intelligence (W. O.).
D. M. O. ..... Director of Military Operations (W. O.).
D. Mov. ..... Director of Movements (W. O.).
D. M. S. ..... Director of Medical Services.
Dn. ..... Dragoon.
D. N. T. O. ..... Deputy Naval Transport Officer.
D. O. ..... Director of Organization (W. O.).
Divisional Order.
D. of F. ..... Director of Forestry.
D. of T. ..... Director of Transport.
D. O. S. ..... Director of Ordnance Services.
D. P. ..... Director of Pathology (W. O.).
D. P. S. ..... Director of Personal Services (W. O.).
D. Post. ..... Director of Postal Services.
D. P. W. ..... Director of Prisoners of War (W. O.).
D. Q. M. G. ..... Deputy Quartermaster General.
Dr. ..... Driver.
Drummer.
D. R. ..... Director of Remounts.
D. Rem. ..... Director of Remounts (W. O.).
D. Remounts. ..... Director of Remounts.
D. R. L. S. ..... Despatch Rider Letter Service.
D. R. M. ..... Director of Raw Materials (W. O.).
D. R. T. ..... Director of Railway Transport.
D. S. ..... Director of Supplies.
D. S. C. ..... Distinguished Service Cross.
Division Supply Column.
D. S. D. ..... Director of Staff Duties (W. O.).
D. Sigs. ..... Director of Army Signals.
D. S. O. ..... Companion of the Distinguished Service Order.
D. S. T. ..... Director of Sea Transport.
D. S. T. ..... Director of Supplies and Transport (W. O.).
D. T. ..... Director of Transport.
D. T. M. ..... Director of Transportation (Later D. R. T.).
D. U. S. ..... Depot Unit of Supply.

D. V. S.	Director of Veterinary Services.
D. W.	Deadweight.
	Director of Works.
	Director of Wool and Textile Production (W. O.).
E. E.	Electrical Engineer.
E. F. C.	Expeditionary Force Canteens.
E. in C.	Engineer in Chief.
E. L. C.	Egyptian Labour Corps.
E. P.	Engineer Pay.
E. S.	Electrical Section.
	Engineering Stores.
E. S. D.	Engineer Stores Depot.
Est.	Establishment.
F. A.	Financial Adviser.
F. Amb.	Field Ambulance.
F. A. O.	Forward Area Officer (light railways).
F. C.	Field Commander.
F. C. M. A.	Field Controller of Military Accounts.
F. Co.	Field Company of Engineers.
F. C. P.	Fat Collecting Plant.
F. G. C. M.	Field General Court Martial.
F. Imp.	Field Imprisonment.
F. M.	Field Marshal.
	Finance Member (W. O.).
F. O.	Field Officer.
fob.	Free on Board.
F. P.	Field Punishment.
F. P. O.	Field Post Office.
f. s.	Feet per second.
F. S.	Financial Secretary (W. O.).
F. S. D.	Field Supply Depot.
	Field Survey Detachment.
F. S. M.	Field Service Manual.
F. S. R.	Field Service Regulations.
"G"	General Staff Branch.
G. B. E.	Knight (or Dame) Grand Cross of the Order of the British Empire.
G. C.	Gun Captain.
G. C. B.	Knight Grand Cross of the Order of the Bath.
G. C. I. E.	Knight Grand Commander of the Order of the Indian Empire.
G. C. M.	General Court Martial.
G. C. M. G.	Knight Grand Cross of the Order of St. Michael and St. George.
G. C. S. I.	Knight Grand Commander of the Order of the Star of India.
G. C. V. O.	Knight Grand Cross of the Royal Victorian Order.
Gd.	Guard.
G. D. A. C.	Guards Division Ammunition Column.
G. G. C.	Gun Group Commander.
G. H. Q.	General Headquarters.
G. O. C.	General Officer Commanding.
G. P. O.	General Post Office (London).
Gr.	Gunner.

G. R. O.	General Routine Order.
G. S.	General Service.
	General Staff.
G. S. O.	General Staff Officer.
H. A. M. T.	Heavy Artillery Mechanical Transport.
H. D.	Heavy Draught.
Hds.	Hands.
H. E.	High Explosive.
	Horizontal equivalent.
	His Excellency.
H. H.	His Highness.
H. M.	His Majesty.
H. M. T. D.	Home Mechanical Transport Depot.
Hosp.	Hospital.
Howr.	Howitzer.
H. P.	High pressure.
	High proficiency.
H. Q.	Headquarters.
Hr.	Hussar.
H. R. H.	His Royal Highness.
H. R. S.	Heavy Repair Shop.
H. S.	Higher Standard.
H. T.	High Tension.
	Horse Transport.
I. A.	Indian Army.
I. A. A.	Indian Army Act.
I. A. F.	Independent Air Force.
	Indian Army Form.
I. A. O.	Indian Army Order.
I. B. D.	Infantry Base Depot.
i/c	In charge of.
I. C. E.	Internal Combustion Engine.
I. D.	Investigation Department, Supplies Directorate (Also C. I. D.).
I. E. F.	Indian Expeditionary Force.
	Italian Expeditionary Force.
I. F., R. A. F.	Independent Force, Royal Air Force (also I. A. F.).
I. G. C.	Inspector-General of Communications (discontinued).
I. L. C.	Indian Labour Corps.
I. M. S.	Inspector of Medical Services.
Inf.	Infantry.
Inspr. S. & T.	Inspector of Supply and Transport.
I. O. C.	Instructions for Officers Commanding E. S.
I. of A.	Instructor of Artillery.
I. of M.	Regimental Instructor of Musketry.
I. O. M.	Inspector of Ordnance Machinery.
I. O. O.	Inspecting Ordnance Officers.
I. Q. M. G. S. (H. F. & E.)	Inspector of Quartermaster General's Services (Horse Feeding and Economies).
I. Q. M. G. S. (M. & E.)	Inspector of Quartermaster General's Services (Messing and Economies).
I. R. S. (A. T.)	Inspector of Rolling Stock (Ambulance Trains).
I. S.	Inland Section (Postal London).

I. S. O.	Companion of the Imperial Service Order.
I. V.	Issue Voucher.
I. W. & D.	Inland Waterways and Docks (Home).
I. W. T.	Inland Water Transport, B. E. F.
J. A. G.	Judge-Advocate-General..
K. B. E.	Knight Commander of the Order of the British Empire.
K. B. S.	Kite Balloon Section.
K. C. B.	Knight Commander of the Order of the Bath.
K. C. I. E.	Knight Commander of the Order of the Indian Empire.
K. C. M. G.	Knight Commander of the Order of St. Michael and St. George.
K. C. S. I.	Knight Commander of the Order of the Star of India.
K. C. V. O.	Knight Commander of the Royal Victorian Order.
K. G.	Knight of the Order of the Garter.
K. H. C.	Honorary Chaplain to the King.
K. H. P.	Honorary Physician to the King.
K. H. S.	Honorary Surgeon to the King.
K. M.	King's Messenger.
K. P.	Knight of the Order of St. Patrick.
K. R.	King's Regulations.
K. S.	Headquarters.
K. T.	Knight of the Order of the Thistle.
K. W.	Kilowatt.
L/C or L/Cpl.	Lance Corporal.
L. D.	Light Draught.
L. G. O. C.	London General Omnibus Company.
L. of C.	Lines of Communication.
L. P. O.	Local Purchasing Officer.
L. P.	Low Pressure.
Lr.	Lancer.
L. R.	Light Railways. Long Range.
L. R. C. E.	Light Railway Construction Engineer.
L. R. S. C.	Light Railway Superintendent, Construction.
L. R. S. M. & O.	Light Railway Superintendent, Mechanical and Operating.
L. R. S. S.	Light Railway Signal Section.
L/Sgt.	Lance Sergeant.
Lt. or Lieut.	Lieutenant.
Lt. Col.	Lieutenant-Colonel.
Lt. Gen.	Lieutenant-General.
L. T. O.	Local Transport Officer.
M. A. L. S.	Motor Airline Section.
M & V.	Meat and Vegetable (tinned ration).
M. B. E.	Member of the Order of the British Empire.
M. B. O.	Mineral Burning Oil.
M. C.	Medical Certificate. Military Cross.
Med.	Medical.
M. F. D.	Military Forwarding Department.
M. F. E.	Manual of Field Engineering. Military Forwarding Establishment.
M. F. O.	Military Forwarding Officer.
M. F. P.	Military Foot Police.

M. G.	Machine Gun.
	Major-General.
	Metre gauge (railways).
M. G. O.	Master-General of the Ordnance (W. O.).
M. I.	Mounted Infantry (Signal Service).
M. L. O.	Military Landing Officer.
M. M.	Military Medal.
M. M. P.	Military Mounted Police.
M. O.	Medical Officer.
M. P.	Military Police.
M. P. H.	Miles per hour.
M. P. S.	Mobile Power Station.
M. R. U.	Mobile Repair Unit.
M. S.	Military Secretary to the S. of S. (W. O.).
M. S. M.	Meritorious Service Medal.
M. T.	Mechanical Transport.
Mtd.	Mounted.
M. T. W. T. C.	Mechanical Transport Water Tank Company.
M. V.	Muzzle velocity.
M. V. O.	Member of the Royal Victorian Order.
N. A. C. B.	Navy and Army Canteen Board.
N. C. C.	Non-combatant Corps.
N. C. O.	Non-Commissioned Officer.
N. I. V.	Not in Vocabulary.
N. T. O.	Naval Transport Officer.
N. W. L.	Normal Water Level.
N. Z.	New Zealand.
N. Z. A. S. C.	New Zealand Army Service Corps.
O. B. E.	Officer of the Order of the British Empire.
O. C.	Officer Commanding.
O. C. & E.	Officers' Clothing and Equipment.
Offr.	Officer.
O. H. M. S.	On His Majesty's Service.
O. i/c	Officer in charge of.
O. M.	Member of the Order of Merit.
O. M. W.	Ordnance Mobile Workshop.
O. O.	Ordnance Officer.
O. R.	Other ranks.
Ord.	Ordnance.
O. R. S.	Orderly Room Sergeant.
P. D.	Provision and Demand Office (B. M. T. D.).
Para.	Paragraph.
P. B.	Permanent Base (personnel).
P. C.	Principal Chaplain.
P. C. C.	Port Construction Company.
P. E. F.	Portuguese Expeditionary Force.
P.-in-C.	Paymaster-in-Chief.
P. I. O. M.	Principal Inspector of Ordnance Machinery.
P. M.	Provost-Marshal.
P. M. G.	Postmaster General (London).
Pmr.	Paymaster.
P. N. T. O.	Principal Naval Transport Officer.
P. O.	Post Office.
P. of W.	Prisoners of War.

P. O. O.	Principal Ordnance Officer.
P. S.	Postal Section.
P. S. A.	Provision Supply Account.
p. s. c.	Staff College Graduate.
Pt.	Platoon.
Pte.	Private.
P. U.	Permanently Unfit (personnel).
P. W.	Permanent Way (railways).
	Royal Pay Warrant.
"Q"	Quartermaster-General's Branch.
Q. F.	Quickfiring.
Q. M.	Quartermaster.
Q. M. A. A. C.	Queen Mary's Army Auxiliary Corps.
Q. M. G.	Quartermaster-General.
Q. M. S.	Quartermaster-Sergeant.
R. A.	Royal Artillery.
R. A. F.	Royal Air Force.
R. A. M. C.	Royal Army Medical Corps.
R. & F.	Rank and File.
R. A. O. C.	Royal Army Ordnance Corps.
R. A. R. E.	Royal Anglesey Royal Engineers.
R. A. S. C.	Royal Army Service Corps.
R. A. V. C.	Royal Army Veterinary Corps.
R. C. E.	Railway Construction Engineer.
R. C. M.	Regimental Court Martial.
R. E.	Royal Engineers.
R. E. C.	Railway Executive Committee.
R. E. P. S.	Royal Engineers Postal Section.
R. E. S. O.	Royal Engineers Stores Officer.
R. E. S. R.	Royal Engineers, Special Reserve.
R. E. T. C.	Royal Engineers Train Crew.
R. F.	Representative Fraction.
R. F. A.	Royal Field Artillery.
R. F. C.	Royal Flying Corps (later R. A. F.).
R. G. A.	Royal Garrison Artillery.
Rgt.	Regiment.
R. H. A.	Royal Horse Artillery.
R. H. S. D.	Railhead Supply Detachment.
R. I. M.	Royal Indian Marine.
R. L. O., H. D.	Returned Letter Office, Home Depot.
R. L. S.	Registered Letter System.
	Returned Letter Section (London).
R. M.	Riding Master.
R. M. A.	Royal Marine Artillery.
R. M. L. C.	Royal Marine Labour Corps.
R. N. A. S.	Royal Naval Aircraft Section.
R. O.	Routine Order.
R. O. D.	Railway Operating Division.
R. P.	Regimental Police.
	Reply paid.
	Rules of Procedure.
R. P. M.	Revolutions per minute.
R. R. C.	Member of the Royal Red Cross.
R. S.	Regulating Station.

R. S. M.	Regimental Sergeant Major.
R. S. O.	Railhead Supply Officer.
R. T. E.	Railway Transport Establishment.
R. T. O.	Railway Transport Officer (later Ry. Traffic Officer).
R. V.	Receipt Voucher.
R. V. P.	Reserve Vehicle Park.
S. A. A.	Small arm ammunition.
S. A. A. S.	Small Arms Ammunition Section.
S. & T. C.	Supply and Transport Corps (Indian Army).
S. A. N. L. C.	South African Native Labour Corps.
S. A. R. T.	South African Railway Troops.
S. C.	Staff Captain.
S. D.	Supply Depot.
Sec.	Section.
S. G.	Standard gauge (railways).
S. G. S.	Surveyor-General of Supply (W. O.).
Sgt.	Sergeant.
Sig. Co. A.	Signal Company Air Line.
Sig. Co. C.	Signal Company Cable.
Sig. Co. D.	Signal Company with Division.
Sig. Co. W.	Signal Company Wireless.
Sig. O.	Signal Officer.
Sig. Sqn.	Signal Squadron.
Sig. Tp.	Signal Troops.
S. I. O. M.	Section Inspector of Ordnance Machinery.
S. L. R.	Superintendent of Light Railways.
S. M.	Sergeant Major.
S. M. O.	Senior Medical Officer.
S. M. T. O.	Senior Mechanical Transport Officer.
S. O.	Staff Officer.
S. O.	Supply Officer.
S. of S.	Secretary of State for War (W. O.).
S. P. D.	Supplies Purchase Department.
Sqn.	Squadron.
S. R.	Short Range.
S. R. T. O.	Supply Railway Transport Office.
S. S.	Staff Sergeant.
	Stationery Service publication on No.
S. S. M.	Staff Sergeant Major.
S. S. O.	Senior Supply Officer (with division).
	Station Staff Officer.
S. R. T. O.	Supply Train Regulating Officer.
S. W. P.	Special Works Park.
T.	Temporary.
T. and S.	Transport and Supply.
T. C. P.	Telegraph Construction Party.
T. D.	Tent Detachment, R. A. F.
	Territorial Decoration.
Tel.	Telegraph.
T. F.	Territorial Force.
	Train Ferry.
T. L. O.	Train Loading Officer.
T. M.	Trench Mortar.
	Trench Munitions.

T. O	Transport Officer.
Tp	Troop.
T. P. O	Traveling Post Offices.
Tpr	Trooper.
T. T. D	Transportation Troops Depot.
U. K	United Kingdom.
U. S. of S	Un 'er Secretary of State for War (W. O.).
V. A. D	Voluntary Aid Detachment.
V. B	Volunteer Battalion.
V. C	Victoria Cross.
V. D	Volunteer Decoration.
V. E. S	Veterinary Evacuation Station.
Vet	Veterinary.
V. I	Vertical interval.
V. R. C	Volunteer Rifle Corps.
W. A. A. C	Women's Army Auxiliary Corps (later Q. M. A. A. C.).
W. D	War Department.
W. E	War establishments.
W. O	War Office.
	Warrant Officer.
W. O. E. & M	Works Officer, Electrical and Mechanical.
Y. M. M. G	Yukon Motor Machine Guns.

NOTE.—In referring to the various grades of administrative staff and service appointments, the following are the usual prefixes:

D	Director.
D. D	Deputy Director.
A. D	Assistant Director.
D. A. D	Deputy Assistant Director.

The same prefixes apply to the staff of the "A" and "Q" branches.

APPENDIX TO VOLUME II.

SECTION II.

ABBREVIATIONS (FRENCH ARMY).

Extract.—"The following is a compilation of the greater part of the abbreviations used in the French Army. To the knowledge of the compiler it is the only available list approaching completeness, eighty-seven abbreviations only being comprised in the latest official lists. There are several hundred abbreviations in current use in official French correspondence which are universally understood but which have never received official sanction. Most of these have sprung into use during the war.

"In addition to the approved or usual forms, the more common variations are given as well. In the case of more than one form occurring for a single abbreviation, the *usual* form is indicated by the letter 'U', and the *approved* form by the letter 'A,' if it does not happen to be at the same time the more usual form. Abbreviations followed by 'O' are those decreed *official* by "Circulaires Ministérielles" of October 4, 1913, and June 19, 1914 (the latest official lists)."

NOTE.—English in parenthesis when necessary.

A.

Abbrev.	Designation in full.	Class of Abbrev.
A	attelée (harnessed, mounted)	
A. A. A	artillerie anti-aérienne (anti-aircraft artillery)	
A. C.	artillerie de campagne	U
	artillerie de Corps (usually followed by number)	
A. C. 7e	artillerie 7me Corps	O
A. C. D	artillerie de campagne divisionnaire	
A. D	artillerie divisionnaire	
A. D. 20e	artillerie de la 20me Division	O
A. D. C	artillerie divisionnaire, Cavalerie	
adjt adjt	adjoint *or* adjutant (usual form for both, but preferably used for "adjoint" only).	
adjudt	adjudant	A
ADon, ADMon	administration, latter form usual	
A. G	avant-garde	O
A. G. F. A	Affaires de Guerre Franco-Américaines	
A. L	artillerie lourde (heavy artillery)	O
A. L. C	artillerie lourde courte (heavy artillery, short)	
A. L. A	artillerie lourde de l'Armée	
A. L. C. A	artillerie lourde de Corps d'Armée	
A. L. G. P	artillerie lourde à grande puissance (large heavy caliber artillery)	

Abbrev.	Designation in full.	Class of Abbrev.
A. L. H.	artillerie lourde hippomobile (horse-drawn heavy artillery)	
A. L. L.	artillerie lourde longue	
A. L. T.	artillerie lourde à tracteurs	O
A. L. V. F.	artillerie lourde sur voie ferrée (heavy artillery on railway trucks)	
A. M.	auto-mitrailleuse (motorized M. G.)	
Amb.	ambulance	O
A. P.	avant-poste (outpost)	O
Appt.	approvisionnement (supply)	O
AR.	arrière (rear)	
Arr. G.	arrière-garde (rear guard)	O
Art.	artillerie	O
ARTie.	artillerie	O
Art. C.	artillerie de corps	
Art. T.	artillerie territoriale	
a/s.	au sujet de (in re. to)	
A. S.	artillerie d'assaut (tanks)	
A. T.	artillerie de tranchée	
att.	attaché (assigned to)	
att. Intc.	attaché d'Intendance (Q. M.)	
AV.	avant (advance front)	
Bat.	Bataillon	
Batt.	Batterie	
B. C. M.	Bureau Central Militaire	
B. C. P.	bataillon de Chasseurs à pied (battalion of light infantry)	
Bde.	brigade	O
bdr.	brigadier (Sgt. mounted troops)	
B. I.	bataillon d'instruction (training bn.)	
B. I. T.	bataillon d'infanterie territoriale	
Bie.	batterie	O
Biv.	bivouac	
B. O.	Bulletin Officiel	
B. O. A.	boulangerie d'Armée (Army bakery)	O
B. O. C.	boulangerie de campagne (field bakery)	
B. O., P. R.	Bulletin Officiel, partie réglementaire	
B. O., P. S.	Bulletin Officiel, partie supplémentaire	
Bon., bon.	bataillon	
B. N. C.	Bureau National des Charbons (Nat'l. Coal Administration)	
B. R.	Bulletin de renseignements (Intelligence summary)	
Br.	brigade	
Brac. C.	Groupe de brancardiers de Corps (Corps litter-bearers)	O
Branc. D1.	Division de brancardiers, 1ère Division	O
Brig.	brigade	
B. S. P.	blanche siège place	Ordnance terms not in Wilcox.
B. S. 5.	blanche siège 5	
Btn.	bataillon	
B. T. S.	bataillon de tirailleurs Sénégalais (bn. of Senegalese riflemen)	O

C.

Abbrev.	Designation in full.	Class of Abbrev.
Bv	bivouac	O
C. A	Corps d'Armée	O
C/A	contre-attaque	
C. A. A	Centre d'Armes Automatiques (automatic arms center)	
C. A. C	Corps d'Armée Coloniale	
Cal	calibre	
cal	caporal	
Cant	cantonnement	O
Cap	Capitaine	O
Capit	Capitaine	
CAPne	Capitaine	
C. AR	central arrière (telephone central in rear)	O
Cav	Cavalerie	
C. AV	central avant (advanced telephone central)	
Cav. T	Cavalerie territoriale	
c. c	copie conforme (true copy)	
C. C	Corps de Cavalerie	O
Cdt	Commandant	
Cel *Cel*	Colonel	O U
C. E. P	Corps Expéditionnaire Portugais (Portugese E. F.)	
C. G. des A. G. F. A	Commissariat des affaires de guerre Franco-Américaines	O
Ch Chx	chevaux (horses)	
C. H. R	Compagnie hors rangs (Hdqrs. and supply companies)	
Ch. d. f CHin. d. f	chemin de fer (R. R.)	U
C. I	Centre d'instruction	
C. I. B	Centre d'instruction de brigade	
C. I. B. G	Comité Interallié des Bois de Guerre (Interallied Wood Committee)	
C. I. D	Centre d'instruction divisionnaire	
Cie	compagnie	O
C*ions*	communications	
C. I. R	Comité Interallié des Ravitaillements (Military Board of Allied Supply)	A
Cit	Citation	
C. J. M	Code de justice militaire	
C. M	Commissaire militaire	
C. M	compagnie de mitrailleuses (M. G. company)	
C. M. I	compagnie de mitrailleuses, infanterie	
Cm	centi mètre	
Cm.^{2}	centi mètre carré (square centimeter)	
Cm.^{3}	centi mètre cube (cubic centimeter)	
C*ne*	Capitaine Commune (township, community)	U
C. O. A	Commis et ouvriers d'Administration (Q. M. C. personnel)	O

Abbrev.	Designation in full.	Class of Abbrev.
Commt	Commandant	
Comt		
Compre	complémentaire	
Comre	Commissaire	U
con	clairon (bugler)	
C. P. O	contre-préparation offensive	
C. R	à charge réduite	
	(with reduced charge—Ordnance term not in Wilcox)	
C. R	compte rendu (statement)	
	centre de renseignements (Intelligence center)	
	centre de resistance	
C. R. A	Centre de Réserve de l'Armée	
	Commission Régulatrice Automobile	
C. R. C	Centre de Réserve de Corps	
Cre	circulaire	
155 C. S	155 mm. court Schneider (155 mm. Schneider howitzer-short)	
C. T. R	court tir rapide	
C. V	Capitaine de vaisseau	
CV. A	convoi automobile	O
CV. AD	convoi administrative (d'Armée)	O
CV. auto	convoi automobile	
CV. AX	convoi auxiliaire	O
D	Direction	
D. A	Directeur de l'Arrière (Director of the Rear)	O
	Direction de l'Arrière (Direction of the Rear)	U
D. C	division de Cavalerie	O
D. C. A	défense contre aéronefs (A. A. A.)	
D. C. F	Direction des Chimins de Fer (Direction of R. R.)	U
	Directeur des Chemins de Fer (Director of R. R.)	O
D. C. F. C	Direction des Chemins de Fer de Campagne (Direction of the Field Railways)	
Dcm	Décimètre	
D. E	Direction des Etapes (Direction of L. of C.)	
D. E. S	Direction des Etapes et Services (Direction of L. of C. and Services, obs., now: 4me. Bureau)	O
Dépt	Département	U
D. E. Z. U. S	Direction des Etapes, Zône des Etats-Unis (Direction of L. of C.—American zone)	
D. G. C. R. A	Directeur Général des Communications et des Ravitaillements aux Armées	
	Direction Générale des Communications et des Ravitaillements aux Armées	
	(Director-General or General Direction of Communications and Supplies to the Armies)	
Dett	Détachement	
D. G. E	Direction du Génie des étapes (Direction of L. of C. Engineers)	
D. G. T. M	Directeur Général des Transports Militaires (Director-General of Military Transports)	
D. I	division d'infanterie	O

Abbrev.	Designation in full.	Class of Abbrev.
D. I. C.	division d'infanterie coloniale	
Dion	direction	
	division	U
Divion	division	
D. M.	Décret militaire	
D. M. G.	Direction du matériel du Génie (Direction of Engineer material)	
D. M. R.	dépôt mobile de remontes	
D. O. L.	détachement d'observation et de liaison	
Don	direction	
	division	
Dp. E.	dépôt d'éclopés (depot disabled men)	O
Dr	Directeur	
D. R.	division de réserve	O
D. S. A.	Directeur du Service Automobile	
	Direction du Service Automobile	
D. T. M. A.	Direction des Transports Militaires aux Armées (Direction of military transports of the Armies)	
D. T. M. I.	Direction des Transports Militaires à l'Intérieur (Direction of military transports in the interior)	

E.

E. C. M. A.	Ecole Centrale Militaire d'Aviation	
E. C. M. S.	Etablissement Central Matériel Spécial (Central establishment for special (electrical) material)	
E. C. P.	Ecole Centrale de Pyrotechnie	
E. M.	Etat-Major (Staff)	O
E. M. A.	Etat-Major de l'Armée (General Staff)	
E. M. A. A.	Etat-Major de l'Artillerie d'une Armée (Artillery staff of an Army)	
E. M. A. C.	Etat-Major de Corps d'Armée—Artillerie (Staff of Army Corps Artillery)	
E. M. C. A.	Etat-Major de Corps d'Armée (Staff of Army Corps)	
E. M. D. I.	Etat-Major de division d'infanterie	
E. M. D. C.	Etat-Major de division de cavalerie	
E. M. G.	Etat-Major Général (General Staff of the Army)	O
E. M. G. A.	Etat-Major du Génie d'une Armée (Engineer staff of an Army)	
E. M. G. C.	Etat-Major du Génie d'un Corps d'Armée (Engineer staff of an Army Corps)	
E. M. R.	Etat-Major de recrutement	
	équipe mobile de réparation	
E. N. E.	éléments non-endivisionnés (Army troops; unassigned units.)	O
E. Pont	équipages de pont (bridge train)	O
E. R. D.	équipe de récupération divisionnaire (Divisional salvage squad)	
Esc.	escadron	O
Esc. A.	escadrille d'avions (Air squadron)	O
esde	escouade (squad)	

F.

Abbrev.	Designation in full.	Class of Abbrev.
F. de R	Feuille de recensement (Census sheet)	
F. E. A	Forces Expéditionnaires Américaines (American E. F.)	
f. f f. fons	faisant fonctions de (acting as)	
F. M	fusil mitrailleur (automatic rifle)	
	franchise militaire (mail frank)	
F. R	Feuille de recensement	
Ft. *fons*, de	faisant fonctions de	
Fl. G	flanc-garde (flank guards)	
four	fourrier (Q. M.)	

G.

G. A	Groupe d'Armées (Group of Armies)	
G. A. C	Groupe d'Armées du Centre	
G. A. E	Groupe d'Armées de l'Est	
G. A. F	Groupe d'Armées françaises	
Gal Gal	Général	O U
G. A. N	Groupe d'Armées du Nord	
G. A. R	Groupe d'Armées de réserve	
Gaux Gaux	Généraux (generals)	
G. B. C	Groupe de brancardiers de Corps	
G. B. D	Groupe de brancardiers divisionnaires	
G. C	groupe de combat	
G. C. T. A	groupe de canevas de tir d'Armée (Re. Army targets)	
G. D	Génie divisionnaire (Divisional Engineers)	
G. M. P	Gouvernement Militaire de Paris	
G. M. R	groupe mobile de remontes	
Gén	Génie (Engineers)	O
Gend	Gendarmerie	O
Gen. T	Génie territorial	
G. O. E	Gare origine d'étapes	O
G. P. A	Grand Parc d'Armée (rarely used)	
	Grand Parc d'Artillerie	O
G. P. F	Grande Puissance Filloux (large caliber "Filloux" artillery matériel)	
G. Q. G	Grand Quartier Général (G. H. Q.)	O
G. Q. G. A	Grand Quartier Général des Armées (G. H. Q.)	
Gr	groupe	O
G. R	gare régulatrice (regulating station)	O
G. Rav	gare de ravitaillement (railhead)	O
G. V. C	garde des voies et communications (Guard railroad lines and lines of communication)	

H.

h	heure(s) (hour or hours)	
H	hommes (men)	O

Abbrev.	Designation in full.	Class of Abbrev.
Hal	hôpital	
H. C	hors cadre	
H. O. E	hôpital d'évacuation	O
H. S	hors service	
H. V	hôpital vétérinaire	
H. V. A	hôpital vétérinaire auxiliaire	

I.

I. A. A	Inspection des Armes Automatiques	
I. A. L	instantanée allongée Lefèvre (Ordnance term not in Wilcox)	
I. D	infanterie divisionnaire	
I. G. A	Inspecteur Général de l'Artillerie	
Inf Inf*ie*	infanterie	O
Inf. T	infanterie territoriale	
Int	Intendant	O
Int*c. mre*	Intendance militaire (military supply: Q. M. approximately)	
Int. m*re*	Intendant militaire	
Insp*on*	Inspection	

J.

J. M	Justice militaire	

K.

K Kg Kgs Kilo(s)	kilogramme(s)	
Km Kms.	kilomètre(s)	
Km.² Kms.²	kilomètre(s) carré(s) (square kilometer(s)	

L.

Lieut *t* Lieut Lt	Lieutenant	O A
Lieut. Col Lt. Col	Lieutenant Colonel	U

M.

m	mètre	U
M	Monsieur modèle mitrailleurs	U
Mal	Maréchal	
Mal. des log	maréchal des logis (Sgt. mounted troops)	
Maj Majr	Major (administrative officer—medical officer)	

Abbrev.	Designation in full.	Class of Abbrev.
m. c	mètre cube	
Mcin	médecin (surgeon)	O
Mcin		U
M. D	compagnies "M. D." (main-d'oeuvre) du Génie (Engineer labor companies)	
Mc	militaire	
Melle	Ministérielle	
mm	millimètre(s)	
Mle	modèle	U
mm²	millimètre(s) carré(s)	
Mre	militaire	U
M. W	Minnenwerfer	

N.

N. de S	Note de service (memo. re. executive duty)	
No. Mle	numéro matricule (identification number)	
N. T	non transformé	

O.

O. A	Ondes amorties (wireless term: intermittent waves)	
	Obus allongé (Ordnance term not in Wilcox: "lengthened shell")	
O. B	Obus à balles (Ordnance term not in Wilcox: "ball projectiles")	
Obs. Ter	Observatoire terrestre	
O. E	Ondes entretenues (wireless term: sustained waves)	
	Obus explosif (Ordnance term not in Wilcox: "explosive shell")	
O. E. M	Officier d'Etat-Major (Staff Officer)	
O. F. A	Obus fonte acierée (Ordnance term not in Wilcox: "steel jacketed projectile")	
Off	officier	
	officiel (seldom used)	
Offer	Officier	
O. G	Ordre général (General Order)	
%	ordres (e. g. % de transport)	

P.

p	pour (for)	
P		
P/		
P. A	pour amplification / point d'appui / parc d'artillerie (depending on context)	
P. A. D	Parc d'artillerie divisionnaire	
pal	parc d'artillerie lourde	
pale		
P. A. L	parc d'artillerie de place	
P. A. P	parc d'artillerie	

Abbrev.	Designation in full.	Class of Abbrev.
P. Art	parc d'artillerie	
P. C	point de contact poste de commandement	O
P. C. A	Parc de Corps d'Armée	
P. C. A. D	poste de commandement d'artillerie divisionnaire	
P. C. C p. c. c	pour copie conforme (true copy)	U
P. C. C. A	poste de commandement de Corps d'Armée	
P. C. D. I	poste de commandement de division d'infanterie	
P. E	poste d'écoute (listening-post)	
Pel	peloton (platoon)	O
P. et CV	parcs et convois	O
P. E. S	poste d'écoute spécial (special listening-post)	
P. G	prisonnier de guerre (prisoner of war)	
P. Gen	parc du Génie (Engineer park)	O
P. Gen. A	parc du Génie d'Armée (Army Engineer park)	O
P. H. R	peloton hors rang	
p. i	par interim	
P. I	point initial position d'infanterie	O
P. J	poste de jonction	O
P. N	passage à niveau (grade crossing)	
p. o	par ordre (by order of)	U
P. O	par ordre (by order of) poste d'observation permis officiel (depending on context)	
P. O. C	poste officier de cantonnement	
P. O. L	poste d'observation et de liaison	
P. P	petite poste par prescription (unusual)	
P. Pon	par prescription (according to regulations)	U
P. R. A	parc de réparation d'artillerie	
P. Racc	point de raccordement (junction point)	O
P. S	poste de secours (dressing station)	O
P. T. A	poste téléphonique d'artillerie	
P. T. I	poste téléphonique d'infanterie	
P. V	procès-verbal (official report or minutes) pigeon voyageur (rare)	

Q.

Q. G	Quartier Général (General Headquarters)	O
Q. G. A	Quartier général d'Armée	
Q. G. B	Quartier général de Brigade	
Q. G. C. A	Quartier général de Corps d'Armée	
Q. G. D. I	Quartier général de division d'infanterie	
Q. G. G	Quartier général de Groupe d'Armées	

R.

R. A	Régiment d'artillerie	
R. A. C	Régiment d'artillerie de campagne	
R. A. L	Régiment d'artillerie lourde	

Abbrev.	Designation in full.	Class of Abbrev.
R. A. M	Régiment d'artillerie de montagne (mountain artillery)	
R. A. S	rien à signaler (nothing to report)	
R. A. T	Réserve de l'Armée Territoriale	
Ravt	ravitaillement (supply)	O
Ravt. mat	ravitaillement matériel	
Regl	régional	
Reg Regt Regt	Régiment	U
R. I. C	Régiment infanterie coloniale	
Rensgts	renseignements (information)	
R. G. A	Réserve Générale Aéronautique (General Aviation Reserve) Réserve Générale Automobile (General Motor Transport Reserve)	U
R. G. A. L	Réserve générale d'artillerie lourde (General reserve of heavy artillery)	
Rgt	Régiment	O
R. I	Régiment d'infanterie	
R. I. T	Régiment d'infanterie territoriale	
R. Q	ravitaillement quotidien (daily supply)	O
R. S. M	réserve station-magasin (depot supply reserve)	
R. V. F	ravitaillement viande fraiche (fresh meat supply)	
S. A	Service Automobile service auxiliaire	
Sce	service	
s/c	sous couvert de (under cover of, re. documents)	
S. C	Section de courrier	O
S/chef	sous-chef (assistant chief)	
S1. CV. AD	Section 1 du convoi administratif	
Sct	section	O
S. Dist	section de distribution	
S. E	section des effectifs (personnel section)	
Sec	section	
S. E. G. A	Services des entrepôts généraux de l'Aviation	
Sergt	Sergent	U
S. F. A	Section Franco-Américaine	
Sgt	Sergent	A
Sgt. four	Sergent fourrier (Q. M. sgt.)	
S. Hos	section d'hospitalisation	O
Sion	section	
S/Int	Sous-Intendant	
S/lt S. Lt	Sous-Lieutenant	U
S. M	service militaire station-magasin (supply depot) section de mitrailleurs (seldom used)	O
S. M. A	section de munitions d'artillerie	O
S. M. I	section de munitions d'infanterie	O
S. Mitr	section de mitrailleuses (M. G. section)	O
Sn	section (seldom used)	
S/Off	sous-officer (non-commissioned officer)	

Abbrev.	Designation in full.	Class of Abbrev.
Son	section	
S. P	section de parc de campagne (section field park)	O
S. P	Secteur Postal (postal sector)	U
S. P. A	Service de la Poste aux Armées (military postal service)	
S. P. C	section de parc de campagne	U
S. P. G	section de parc du Génie (section of Engineer park)	
S. R	service de renseignements (Intelligence or information service)	
S. R. A	service de renseignements d'artillerie (Artillery intelligence section)	
S. R. Aéro	section de renseignements d'Aéronautique (Air Service intelligence section)	
S. Ravt	section de ravitaillement (supply section)	O
S. Res	section de réserve	O
S. R. L	section de répérage par les lueures (flash range-finding section)	
S. R. O. T	service de renseignements par observation terrestre (terrestrial observation intelligence service)	
S. R. S	section de répérage par le son (sound range-finding section)	
S. R. T	section de répérage par la terre (ground range-finding section)	
S. S	Service de Santé (Medical Service)	
S. S. A	Section sanitaire automobile (motorized medical section)	
S. T. Aé	section technique aéronautique	
S. T. A	section technique aéronautique	U
S. T	Service Télégraphique	
S. T. C. A	section topographique de Corps d'Armée	
S. T. D. I	section topographique de division d'infanterie	

T.

T	à tracteur	
T	territorial(e)	U
T. A	télégraphie acoustique	
T. B. A	troupeau de bétail d'Armée (Army cattle park)	
T. C	telegramme collationné	O
	train de combat	A
	travailleurs coloniaux (seldom used)	
T. D	titre définitif	
T. E	Train des équipages (seldom used)	
	tête d'étapes	O
T. E. M	tête d'étapes de manoeuvre (seldom used)	
	Train des équipages militaires	U
Tirs	tirailleurs	
T. L	train lourd	
T. M	transport de matériel	
	télégraphie militaire	U

Abbrev.	Designation in full.	Class of Abbrev.
T. M. R.	travailleurs militaires russes (Russian military laborers)	
T. O.	télégramme ordinaire	O
	télégraphie optique (visual signalling)	
T. P.	tir de place (seldom used)	
	transport de personnel	U
T. P. S.	télégraphie par le sol (ground telegraphy)	
T. R.	Train régimentaire	O
	tir rapid (seldom used)	
T. Comb.	train de combat (seldom used)	
T. Rav.	train de ravitaillement (supply train)	
Tr. Reg.	Train régimentaire (seldom used)	
T. S. F.	télégraphie sans fil (wireless—radio)	
T. S. V. P.	" tournez s'il-vous-plait " ("turn if you please"—to the next page, etc.)	
T. T.	titre temporaire	
T. U.	télégramme très urgent (very urgent telegram)	

V.

V. B.	Viven-Bessières (Ordnance term)	
VV.	Viandes-vivres (meat supply)	

W.

W.	Vivres-viandes	

X.

X*bre*.	Décembre	

Z.

Z.	Gaz (Compagnies " Z " du Génie) (Gas—" Z " Engineer companies—)	
Z. U. S.	Zône des Etats-Unis (U. S. zone—American zone)	

APPENDIX TO VOLUME II.
SECTION III.

ABBREVIATIONS (BELGIAN ARMY).

NOTE.—These abbreviations have been prepared by Adjt. A. Van den Cruyce, of the Belgian Military Mission at G. H. Q. of the American Expeditionary Forces. First the abbreviation is given, then the designation in full, followed by the English equivalent (as close as possible).

A.

A	Régiment d'artillerie. (Artillery regiment.)
ab/G. Q. G	Escadrille d'auto-mitrailleuses blindés du Grand Quartier Général. (Squadron of armored auto-machine guns of General Headquarters.)
ab/D. A	Auto-mitrailleuses blindés de la ____Division d'Armée. (Armored auto-machine guns of the _____Army Division.)
ab/I. D. C	Groupe auto-mitrailleuses blindés de la 1ère division de cavalerie. (Group of armored auto-machine guns of the 1st. Cavalry Division.)
A. C. A	Ateliers de construction automobile. (Automobile construction workshops.)
A. C. C. H	Ateliers de construction du charroi hippomobile. (Construction workshops for animal-drawn vehicles.)
A. C. M. A	Ateliers de construction de matériel artillerie. (Construction workshops for artillery matériel.)
A. E. M	Adjoint d'Etat-Major. (Assistant Staff Officer.)
Aé. M	Aérostation militaire. (Military ballooning.)
A. D. C	Groupe d'artillerie à cheval de la D. C. (Group of Horse Artillery of the Cavalry Division.)
A. F	Atelier de fonderie. (Foundry workshop.)
A. F. M	Atelier de fabrication de munitions. (Ammunition manufacturing plant.)
Amb	Ambulance.
A. P	Ateliers de précision. (Precision workshops.)
A. R. C. H	Ateliers de réparation du charroi hippomobile. (Repair shops for animal-drawn vehicles.)
A. R. M	Ateliers de réparation de matériel. (Repair shops for matériel.)
A. S	Ateliers de sellerie. (Saddlery shops)
5e Acc	5e batterie d'accompagnement. (Fifth battery of accompaniment.)
A. R. A	Ateliers de réparation d'Armée. (Army repair shops)
A. R. A. T	Ateliers de réparation du matériel d'artillerie de tranchée. (Shops for the repair of trench artillery matériel.)

A. R. B. A. F_____ Ateliers de réparation des bouches à feu au front. (Establishments for the repair of guns at the front.)
A. R. C. A_____ Ateliers de réparation du charroi automobile. (Repair shops for Motor Transport.)
A. R. C. C_____ Ateliers de réparation de cuisines et de caissons. (Repair shops for rolling kitchens and caissons.)
A. T_____ Artillerie de tranchée. (Trench artillery.)
Av. M_____ Aviation militaire. (Military Aviation.)
1/1 A_____ 1er groupe du 1er. régiment d'artillerie. (1st. group of the 1st. Artillery regiment.)
12/1/1 A_____ 12ème. batterie montée du 1/1 A. (12th. mounted battery of the 1st. Artillery regt.)

B.

B. A_____ Boucherie automobile. (Automobile butcher shops.)
B. A. L_____ Brigade d'artillerie lourde. (Heavy Artillery Brigade.)
B. C. F_____ Bataillon de chemin de fer. (Battalion of railway Engineers.)
Br. C_____ Brigade de Cavalerie. (Cavalry Brigade.)
Br. A_____ Brigade d'Artillerie. (Artillery Brigade.)
Br. I_____ Brigade d'Infanterie. (Infantry Brigade.)

C.

C_____ Régiment de Carabiniers. (Regiment of Carbineers.)
C. A_____ Compagnie d'alimentation. (Food supply company.)
C. A_____ Colonne d'Ambulances. (Ambulance Column.)
C. B. R_____ Commission Belge de ravitaillement (Londres). (Belgian Supply Commission—London.)
C. C. C. C_____ Cours de candidats comptables de compagnie. (Course for candidates for Company Accountants.)
C. C. S. E. M_____ Cours de préparation aux fonctions de secrétaire d'Etat-Major des places. (Preparatory course for garrison Staff Secretaries.)
C. D. D_____ Compagnie de Discipline. (Disciplinary company.)
C. I_____ Centre d'Instruction. (Training center.)
C. I. A_____ Centre d'Instruction d'artillerie. (Artillery training center.)
C. I. A. M_____ Centre d'Instruction d'anciens militaires. (Training center for former soldiers.)
C. I. A. T_____ Centre d'Instruction d'artillerie de tranchée. (Training center for trench artillery.)
C. I. A. X_____ Centre d'Instruction des auxiliaires. (Training center for auxiliary troops.)
C. I. B. I_____ Centre d'Instruction des brancardiers-infirmiers. (Training center for litter-bearers.)
C. I. C_____ Centre d'Instruction de cavalerie. (Cavalry training center.)
C. I. Gn_____ Centre d'Instruction du Génie. (Engineer training center.)
C. I. G. C_____ Centre d'Instruction des gardes de communications. (Training center for troops guarding communications.)
C. I. M_____ Centre d'Instruction des mitrailleurs. (Machine gun training center.)

C. I. S. L. A. A_____ Centre d'Instruction de Sous-Lieutenants auxiliaires d'artillerie. (Training center for auxiliary 2nd Lieutenants of Artillery.)

C. I. S. L. A. Gn_____ Centre d'Instruction de Sous-Lieutenants auxiliaires du Génie. (Training center for auxiliary 2nd Lieutenants of Engineers.)

C. I. S. L. A. C_____ Centre d'Instruction de Sous-Lieutenants auxiliaires de cavalerie. (Training center for auxiliary 2nd Lieutenants of Cavalry.)

C. I. S. O. I_____ Centre d'Instruction des Sous-Officiers d'infanterie. (Training center for Infantry non-commissioned officers.)

C. R. H_____ Compagnie de réhabilitation. (Rehabilitation company.)

C. S. B. C_____ Commandant Supérieur de la Base de Calais. (Commanding officer of the Calais base.)

C. T. A. M_____ Centre de triage des anciens militaires. (Classification center for former soldiers.)

C. T_____ Corps des Transports. (Transport Corps.)

C. A. Au_____ Colonne Automobile auxiliaire. (Auxiliary motor transport column.)

C. A./D. A_____ Commandement d'artillerie de la D. A. (Artillery Command of the Army Division.)

C. A./D. I_____ Commandement de l'artillerie de la D. I. (Artillery Command of the Infantry Division.)

C. A./S_____ Commandement de l'artillerie de secteur. (Command of sector Artillery.)

C. A. T_____ Centre d'artillerie de tranchée. (Trench artillery center.)

C. C. R. O_____ Centre de cavalerie et de remontes pour officiers. (Cavalry center and remount station for officers.)

C. D. A. F_____ Commandant de la défense aérienne du Front. (Commander of the aerial defense of the front.)

C. E. A. T_____ Centre d'études d'artillerie de tranchée. (Center of trench artillery studies.)

C. Gn./D. A_____ Commandant du Génie de la D. A. (Commander of Engineers of the Army Division.)

C. I./7D. I_____ Commandant de l'infanterie de la 7ème. D. I. (Infantry commander of the 7th Infantry Division.)

C. R. A_____ Commission Régulatrice d'Adinkerke. (Regulating Commission at Adinkerke.)

C. R. C. F. C_____ Coccission de réreau des chemins de fer de campagne. (Commission of the field railway systems.)

C. S. F. O_____ Compagnie des subsistants de la Flandre Occidentale. (Company for supplying Western Flanders.)

C. T. A. G_____ Corps des troupes auxiliaries du Génie. (Corps of Auxiliary Engineer troops.)

C. T./A. G_____ Corps des Transports du C. T. A. G. (Transport Corps of the C. T. A. G.)

C. T./A. L_____ Corps des Transports de la B. A. L. (Transport Corps of the Heavy Artillery Brigade.)

C. T. P./A. G_____ Compagnie des transports de pont du C. T. A. G. (Bridge transport company of the C. T. A. G.)

C. T./T. A_____ Corps des Transports du G. A. T. A. (Transport Corps of the Administrative Grouping of Army Troops.)

C. T./1D. A_____ Corps des Transports de la 1ère. D. A. (Transport Corps of the 1st. Army Division.)

C. T./8 D. I_____ Corps des Transports de la 8ème. D. I. (Transport Corps of the 8th Infantry Division.)

Ct_____ Cyclistes. (Cyclists.)

Cy. R. I./D. C_____ Compagnie de carabiniers cyclists de renfort et d'instruction. (Company of cyclist carbineers for reinforcement and training purposes.)

C. A. A. B_____ Colonne automobile d'ambulances et de brancards. (Motor transport column of ambulances and stretchers.)

C. A. M. A_____ Colonne automobile de munitions d'artillerie. (Motor transport column of artillery munitions.)

C. A. M. I_____ Colonne automobile de munitions d'infanterie. (Motor transport column of infantry munitions.)

C. A. V_____ Colonne automobile de vivres. (Motor transport food-supply column.)

C. A. V./A. G_____ Colonne automobile de vivres du C. T. A. G. (Motor transport food-supply column of the C. T. A. G.)

C. A. V./T. A_____ Colonne automobile de vivres du G. A. T. A. (Motor transport food-supply column of the G. A. T. A.)

C. I. D_____ Centre d'Instruction divisionnaire. (Divisional training center.)

C. M. A_____ Colonne de munitions d'artillerie. (Artillery ammunition column.)

C. M. I_____ Colonne de munitions d'infanterie. (Infantry ammunition column.)

C. M. M_____ Colonne de munitions des mitrailleuses. (Machine gun ammunition column.)

C. M. O_____ Colonne de munitions pour obusiers. (Howitzer ammunition column.)

C. V. R_____ Colonne de vivres de réserve. (Column of reserve food supplies.)

C. V. R./T. A_____ Colonne de vivres du G. A. T. A. (Column of food supplies of the G. A. T. A.)

Cy/1 D. A_____ Compagnie cycliste divisionnaire de la 1ère. D. A. (Divisional cyclist company of the 1st. Army Division.)

C. I. C. F. C_____ Commssion Interalliée des chemins de fer de campagne. (Interallied Field Railway Commission.)

Ch_____ Régiment de Chasseurs à pied. (Light Infantry regiment.)

Ch. ch_____ Régiment de Chasseurs à cheval. (Light Cavalry regiment.)

C. Cy_____ Bataillon des carabiniers cyclistes. (Battalion of cyclist carbineers.)

1C105L/1A_____ Batterie de canons de 105 long du 1er Art. (Battery of 105s of the 1st. Artillery.)

D. A_____ Division d'Armée. (Army Division.)

D. C_____ Division de cavalerie. (Cavalry division.)

D. C. G_____ Dépôt central du Génie. (Central Engineer depot.)

D. D_____ Dépôt divisionnaire. (Divisional depot.)

D. E. A_____ Direction (ou Directeur) des Etablissements d'Artillerie. (Direction (or Director) of the Artillery Establishments.)

D. S. ..... Dépôt de secteur. (Sector depot.)
D. S. A. ..... Direction des services de l'Arrière. (Direction of the Services of the Rear.)
D. S. M. A. C. ..... Direction de la sûreté militaire de l'Armée de campagne. (Direction of Military Secret Service of the Field Army.)
D. G. ..... Directeur Général. (Director General.)
D. T. ..... Direction Technique. (Technical Direction.)
D. T. M. ..... Direction (ou Directeur) de la télégraphie militaire. (Direction (or Director) of military telegraphs.)
D. T. Pj. ..... Direction technique du Service des projecteurs. (Technical Direction of the Searchlight Service.)
D. T. S. E. ..... Direction technique du Service des eaux. (Technical Direction of the Water Supply Service.)
D. G. A. S. T. A. ..... Direction (ou Directeur) Général(e) de l'Armement et des Services Techniques de l'Armée. (General Direction (or Director General) of the Armament and of the Technical Services of the Army.)
D. I. ..... Division d'infanterie. (Infantry division.)
Dep. I. ..... Dépôt d'Intendance. (Intendance depot—Q. M. Depot approx.)
D. O. A. ..... Détachement d'ouvriers d'artillerie. (Detachment of artillery workmen.)
D. R. ..... Dépôt de Remonte. (Remount depot.)
D. R. A. ..... Dépôt de Remonte de l'Armée. (Remount depot of the Army.)
D. R. O. ..... Dépôt de Remonte pour officiers. (Remount depot for officers.)
D. V. C. ..... Direction des Voies de Communication (Ministère de la Guerre). (Direction of Communications—Ministry of War.)
D. Z. ..... Dépôt de zône. (Zone depot.)
1ère D. G. ..... 1ère Direction Générale. (First General Direction.)
D. S. M. ..... Direction signalisation militaire. (Direction of military Signal Service.)

E.

E. A. ..... Etablissements d'Artillerie. (Artillery establishments.)
E. M. ..... Etat-Major. (Staff.)
E. M. G. ..... Etat-Major Général. (General Staff.)
E. T. E. ..... Ecole de tireurs d'élite. (School for expert riflemen.)
E. A. P. ..... Equipage automobile de ponts. (Motor transport bridge unit.)
E. H. P. ..... Equipage hippomobile de ponts. (Animal-drawn bridge unit.)
E. M./C. T./1D. A. ..... Etat-Major du Corps des Transports de la 1ère. D. A. (Staff of the Transport Corps of the First Army Division.)
E. M./T. A. ..... Etat-Major du G. A. T. A. (Staff of the G. A. T. A.)
E. M./1. ..... Etat-Major du 1er régiment de Ligne. (Staff of the First line regiment.)
E. C. T. A. ..... Ecole des chauffeurs techniciens automobiles. (School for motor transport drivers.)
E. Gr. ..... Ecole de Grenadiers. (School for grenadiers.)

F.

f/G. Q. G——— Peloton de fonteniers du G. Q. G. (Platoon of G. H. Q. Water Supply Service troops.)
f/1D. A——— Peloton des fonteniers de la 1ère. D. A. (Platoon of Water Supply Service troops of the First Army Division.)

G.

G. A. T. A——— Groupement Administratif des troupes d'Armée. (Administrative grouping of Army troops.)
G. B. P——— Groupe de batterie de parc. (Park battery group.)
G. T. E. T. G——— Groupement de travailleurs des exploitations techniques du Génie. (Group of workmen of the technical Engineer establishments.)
Gd/1D. A——— Prévôté de la 1ère D. A. (Military Police of the First Army Division.)
G. Q. G——— Grand Quartier Général. (General Headquarters.)
Gr. G./2D. A——— Groupe de Guides de la 2ème. D. A. (Group of guides of the Second Army Division.)
Gr. L./2D. A——— Groupement léger de la 2ème. D. A. (Light group of the Second Army Division)
Gt./1D. A——— Peloton gueutteurs de la 1ère. D. A. (Outpost platoon of the First Army Division.)
G. P. A. R——— Grand parc automobile de réserve. (Main Motor Transport reserve park.)
G. P. C——— Grand Parc de campagne. (Main Field Park.)
G——— Régiment des Guides. (Regiment of the Guides.)
Gn——— Bataillon du Génie. (Battalion of Engineers.)
Gr——— Régiment de Grenadiers. (Grenadier regiment.)
Cy/Gn——— Compagnie Cycliste du Génie. (Engineer Cyclist company.)
1/A. G——— ler. groupement de T. A. G. (1st group of T. A. G.)

H.

H. M——— Hôpital Militaire. (Military hospital.)
H. M. B——— Hôpital militaire Belge. (Belgian military hospital.)
H. E. A——— Hôpital d'évacuation d'Armée. (Army evacuation hospital.)

I.

I. D. D——— Inspecteur des dépôts. (Inspector of depots.)
I. G. Ad——— Inspecteur Général de l'Administration de l'Armée. (Inspector General of the Army Administration.)
I. G. A——— Inspecteur Général de l'Armée. (Inspector General of the Army.)
I. G. S. I——— Inspecteur Général des Services de l'Intendance. (Inspector General of the Intendance Services.)
I. G. S. S——— Inspecteur Général du Service de Santé. (Inspector General of the Medical Service.)
I. M. I. O——— Institut Militaire des Invalides et Orphelins de Guerre. (Military Institute for War Veterans and War Orphans.)

I. P. P. E. T. G_____ Inspecteur des personnels des parcs et exploitations techniques du Génie. (Inspector of the personnel of the technical Engineer parks and establishments.)
I. V. A_____ Infirmerie Vétérinaire d'Armée. (Army veterinary infirmary.)
I. V. D_____ Infirmerie Vétérinaire divisionnaire. (Divisional veterinary infirmary.)
I. V. E_____ Infirmerie Vétérinaire d'évacuation. (Evacuation veterinary infirmary.)

L.

L_____ Régiment de Lanciers. (Regiment of Lancers.)
1/4 L_____ 1er. Escadron du 4ème. Régiment de Lanciers. (1st. squadron of the 4th. Lancer regiment.)
M. S. O. A_____ Magasin spécial pour Officers à Adinkerke. (Special Commissary store for officers at Adinkerke.)
M. S. O. I_____ Magasin spécial pour Officers à Isenberghe. (Special Commissary store for officers at Isenberghe.)
4 M. 75 S_____ 4ème. batterie de mortiers 75 Schneider. (4th battery of 75 Schneider mortars.)
M. V. D_____ Mortiers Van Deuren. ("Van Deuren" Mortars.)
M_____ Mitrailleurs. (Machine gunners.)
M. A_____ Magasin d'alimentation. (Supply (food) depot.)
M. A. G_____ Magasin d'Artillerie et du Génie. (Artillery and Engineer storehouse.)
M. B_____ Escadron de mitrailleurs de brigade. (Squadron of brigade machine guns.)
M. H_____ Magasin d'habillement. (Clothing depot.)
M. R_____ Escadron de mitrailleurs régimentaires. (Squadron of regimental machine gunners.)

O.

Ob. 105/7A_____ Batterie d'obusiers de 105 du 7ème. d'Artillerie. (Howitzer battery of 105s of the 7th Artillery.)
O. L. P_____ Officier de liaison avec la population civile. (Liaison officer with the civilian population.)

P.

P. A. A. B_____ Peloton automobile d'ambulances et de brancards. (Motor transport platoon of ambulances and stretchers.)
P. A. D. I_____ Parc automobile du Département de l'Intérieur. (Motor transport park of the Department of the Interior.)
P. A. M. A_____ Peloton automobile de munitions d'artillerie. (Motor transport platoon of artillery munitions.)
P. A. M. I_____ Peloton automobile de munitions d'infanterie. (Motor transport platoon of infantry munitions.)
P. E_____ Peloton d'équipages. (Equipage (train) platoon.)
P. E. R. I_____ Peloton d'équipages régimentaire d'infanterie. (Platoon of infantry regimental equipage or train.)
P. E. R. A_____ Peloton d'équipages régimentaire d'artillerie. (Platoon of artillery regimental equipage or train.)

P. M. A—— Peloton de munitions d'artillerie. (Platoon of artillery munitions.)
P. M. I—— Peloton de munitions d'infanterie. (Platoon of infantry munitions.)
P. A. R—— Peloton automobile de réserve. (Motor transport reserve platoon.)
P. A. Ra—— Peloton automobile de ravitaillement. (Motor transport supply platoon.)
P. A. V—— Peloton automobile de vivres. (Motor transport food-supply platoon.)
P. B—— Peloton de bagages. (Baggage platoon.)
P. G—— Parc du Génie. (Engineer park.)
P. G. A—— Parc du Génie d'Armée. (Army Engineer park.)
Pj/1D. A—— Peloton de projecteurs de la 1ère D. A. (Searchlight platoon of the First Army Division.)
pj/T. A—— Compagnie de projecteurs des troupes d'Armée. (Searchlight company of Army troops.)
p/T. A—— Compagnie de pontonniers des troupes d'Armée. (Company of pontoniers of the Army troops.)
P/T. A—— Bataillon de pontonniers des troupes d'Armée. (Battalion of pontoniers of the Army troops.)
P. V. R—— Peloton de vivres de réserve. (Platoon of reserve food-supplies.)
P. E./12—— Peloton d'équipages régimentaire du 12ème de ligne. (Platoon of regimental train of the 12th. Line regiment.)
P. L. A./5 D. I—— Peloton d'équipage d'artillerie du C. T. de la 5ème D. I. (Artillery train platoon of the transport corps of the 5th. Inafntry division.)
P. G./5 D. I—— Parc du Génie de la 5ème. D. I. (Engineer park of the 5th. Infantry division.)
P. A. M. I—— Parc automobile du Ministère de l'Intérieur. (Motor transport park of the Ministry of the Interior.)
P. S. G .I. Ax—— Peloton spécial pour grades inférieurs auxiliaries. (Special platoon for inferior auxiliary grades.)
P. M—— Peloton de matériel de campement. (Platoon for camping material.)

Q.

Q. G./D. A—— Quartier Général de la D. A. (Army Division headquarters.)
Q. G./D. C—— Quartier Général de la D. C. (Cavalry Division headquarters.)
Q. G./D. I—— Quartier General de la D. I. (Infantry Division headquarters.)

R.

Rh/13 Gn—— Compagnie de réhabilitation du 13ème bataillon du Génie. (Rehabilitation company of the 13th. Engineer battalion.)
2R. A. L—— 2ème. regiment d'artillerie lourde. (2nd. Regiment of Heavy Artillery.)

S.

s. a_____ Compagnie du service arrière. (Company of the service of the rear.)
s. a./B. A. L_____ Service arrière de la B. A. L. (Service of the rear of the Heavy Artillery Brigade.)
s. a./G. A. T. A_____ Service arrière de la G. A. T. A. (Service of the rear of the G. A. T. A.)
S. B. M_____ Service des Bâtiments Militaires. (Service of military constructions.)
s. c./C. T./1D. A_____ Service des colis de la 1ère D. A. (Parcel post service of the First Army Division.)
S. C. F. C_____ Section des chemins de fer de campagne. (Field Railways Section.)
S. G_____ Secrétariat General (au département de la Guerre). (General Secretary—War Department.)
S. G. A_____ Service du Génie d'Armée. (Service of Army Engineers.)
S. M. A. C_____ Sûreté Militaire de l'Armée de campagne. (Military Secret Service of the field army.)
S. M. B_____ Sûreté Militaire Belge. (Belgian Military Secret Service.)
s. p./C. T./1 D. A_____ Service des postes de la 1ère. D. A. (Postal service of the First Army Division.)
sp/T. A_____ Sapeurs pontonniers des troupes d'Armée. (Sappers-pontoniers of the Army troops.)
S. R_____ Service des Routes. (Roads Service.)
S. R. A_____ Service de répérage de l'artillerie. (Artillery observation service.)
S. S_____ Service de Santé. (Medical Service.)
S. T. A_____ Service topographique de l'Armée. (Army topographical service.)
S. V. C. F_____ Section vicinale de chemins de fer. (Narrow-gauge Railways Section.)
S. H_____ Section d'hospitalisation. (Hospitalization or hospital section.)
S. A. B. M_____ Service d'administration des bâtiments militaires. (Administrative service of military buildings.)
S. D. A_____ Service Divisionnaire de l'Arrière. (Divisional Service of the Rear.)

T.

t/D. C_____ Peloton cycliste des télégraphistes de la D. C. (Cyclist platoon of the telegraph troops of the Cavalry Division.)
T. Ev_____ Train d'évacuation. (Evacuation train.)
T. E_____ Troupes d'étapes. (Troops of Army Service Zone.)
T. E. I_____ Transports par Eaux Intérieures. (Inland Water Transport Service.)
1t/G. Q. G_____ 1ère compagnie de télégraphistes du G. Q. G. (1st telegraph (signal) company of G. H. Q.)
T. J_____ Thain journalier. (Daily (supply) train.)

TMB/A. G—— Train de matériel et de baggage du C. T. A. G. (Train of material and baggage of the C. T. A. G.)
T. S—— Train sanitaire. (Hospital train.)
1/T. S. F./A—— 1ère compagnie de télégraphie sans fil d'Armée. (1st company radio (signal) troops of an Army.)
T. S. F./4D. A—— Peloton de telegraphie sans fil de la 4ème. D. A. (Radio (signal) platoon of the 4th. Army Division.)
t/1D. A—— Compagnie de télégraphistes de la 1ère. D. A. (Telegraph (signal) company of the First Army Division)
T. S. H—— Train spécial hebdomadaire. (Special weekly (supply) train.)
Tr. B—— Train de bagages. (Baggage train.)
Tr. C—— Train de combat. (Combat train.)
Tr. V—— Train de vivres. (Supply (food) train.)
T. S. F—— Télégraphie sans fil. (Wireless (radio) telegraphy.)
t/1Gn—— Peloton télégraphistes du 1er. Génie. (Telegraph (signal) platoon of the 1st. Engineers.)

Numerals.

1—— 1er. régiment de Ligne. (First Line Regiment.)
1/1—— 1er. bataillon du 1er. régiment de Ligne. (1st Battalion of the First Regiment of the Line.)
10/7—— 10ème Compagnie du 7ème Régiment de Ligne. (10th Company of the 7th. Regiment of the Line.)

ADDITIONAL.

A. F. A. P—— Ateliers de fabrication des armes portatives. (Small arms manufacturing shops.)
A. F. M. G—— Ateliers de fabrication de munitions (Ammunition manufacturing shops.)
A. M—— Ateliers de maréchalerie. (Blacksmith shops.)
A. R. M. A—— Ateliers de réparation du matériel automobile. (Repair shops for motor transport matériel.)
C. T. H—— Corps des Transports du Hâvre. (Transport Corps at Le Havre.)
S. A—— Service des Achats. (Purchasing Service.)
S. E—— Service Electrique. (Electrical Service.)
S. I—— Service des Inventions. (Invention Service.)
S. T—— Service des Transports. (Transport Service.)
O. P. B—— Office de propagande Belge. (Belgian propaganda office.)
D. D./1D. A—— Dépôt divisionnaire de la 1ère. D. A. (Divisional depot of the First Army Division.)
C. I. S. L. A. I—— Centre d'Instruction de Sous-Lieutenants auxiliaires d'infanterie. (Training center for auxiliary 2nd. Lieutenants of Infantry.)
T. A. G—— Troupes Auxiliaires du Génie. (Engineer auxiliary troops.)

APPENDIX TO VOLUME II.
SECTION IV.

ABBREVIATIONS, TERMS, AND EQUIVALENTS (ITALIAN ARMY).

NOTE.—This list is far from being a complete list of all abbreviations, terms, etc., in use in the Italian Army, however, it is presented here with the idea that it may prove useful to students of Italian military documents. As a matter of fact, the Italian Army employs *pictorial symbols* quite extensively instead of abbreviations. (Examples will be found in the various Italian charts in connection with Volume I, of the study on interallied supply prepared by the Military Board of Allied Supply.)

EXPLANATORY.—The Italian term is given first, followed by its abbreviation, where such abbreviation is known, and, beneath the Italian term, in parenthesis, the English equivalent (as near as possible).

A.

Aliquota di Magazzino Avanzato d'Artiglieria
(Annex of Advanced Artillery Depot)
Aliquota di Magazzino Avanzato del Genio
(Annex of Advanced Engineer Depot)
Aliquota di Magazzino Avanzato di Materiale Sanitario
(Annex of Advanced Medical Depot)
Aliquota di Magazzino Avanzato V. E.
(Annex of Advanced Depot for clothing and equipment)
Aliquota di Magazzino Avanzato Viveri
(Annex of Advanced Depot for Food Supplies)
Aliquota di Parco Buoi
(Annex of Cattle Park)
Ambulanza Chirurgica----------Am. Ch.
(Surgical Ambulance or Infirmary)
Ambulanza da Montagna C. R. I.
(Italian Red Cross (C. R. I.) Mountain Ambulance or Infirmary)
Ambulanza Radiologica----------Am. Rad
(X-Ray Ambulance or Infirmary)
Autoparco
(Motor Transport Park)
Autoreparto
(Motor Transport Detachment)
Autosezioni—Ordinaria.
(Motor Transport Sections—Ordinary)
Autosezioni per Munizioni
(Motor Transport Sections for Munitions)

B.

Battaglione ciclisti (del 7° Bersaglieri)---Btg. cicl. (7°)
(Cyclist Battalion of the 7th. Bersaglieri (Sharpshooter) Regiment)
Battaglione di Fanteria (II del 6°)---II Fant. Bgl. del 6°
(Infantry Battalion—(2d. Battalion of the 6th. Infantry Regiment))
Batteria da Campagna da 75A---Btr. A.
(75 m/m. Field Artillery Battery)
Batteria di Cannoni (120)---Btr. Can. Pes.
(120-cal. Gun Batteries)
Batteria di Cannoni d'Assedio---Btr. Can. Ass.
(Battery of Siege Guns)
Batteria di Obici (149A)---Btr. Ob. Pes.
(149-A Howitzer Battery)
Batteria di Obici d'Assedio---Btr. Ob. Ass.
(Battery of Siege Howitzers)
Patteria Pesante da Campagna
(Heavy Field Artillery Battery)

C.

Centro d'Ispezione dei Laboratori Batteriologici
(Inspection Center of the Bacteriological Laboratories)
Colonna Munizioni Divisionale---Col. Mz. Div.
(Divisional Ammunition Column or Train)
Colonna Munizioni per Divisione di Cavalleria---Col. Mz. Cav.
(Ammunition Column or Train for Cavalry Division)
Colonna Munizioni per Gruppo Alpino---Col. Mz. Gr. Alp.
(Ammunition Column or Train for Alpine Group)
Colonne e Squadre Carreggio a Disposizione
(Unassigned Animal Transport Columns or Squadrons)
COMMANDI. (Commands or Headquarters)---Cm.
di Artiglieria di Corpo d'Armanta (IX)---Art. IX C. d'A.
(of the Artillery of the 9th Army Corps)
di Brigata di Cavalleria (V)---V Br. Cav.
(of the 5th Cavalry Brigade)
di Brigata di Fanteria (Pisa)---Br. Pisa.
(of the Pisa Infantry Brigade)
di Corpo d'Armata (III)---III C. d'A.
(of the 3rd Army Corps)
di Divisione di Cavalleria (2a)---2a. D. Cav.
(of the 2nd Cavalry Division)
di Divisione di Fanteria (4°)---4° D.
(of the 4th Infantry Division)
di Gruppo Alpini (II)---II Gr. Alp.
(of the 2nd Alpine Group)
di reggimento Alpini (4°)---4° r. Alp.
(of the 4th Alpine Regiment)
di reggimento Bersaglieri (5°)---5° r. Bers.
(of the 5th Bersaglieri (Sharpshooter) Regiment)

COMMANDI. (Commands or Headquarters)—Continued.

di reggimento d'Artiglieria da Campagna (9°)----------9° r. Art. Camp.
(of the 9th Field Artillery Regiment)
di reggimento di Carabinieri Reali----------r. CC. RR.
(of the Royal Carbineer Regiment)
di reggimento di Cavalleria (18°)----------18° r. Cav.
(of the 18th Cavalry Regiment)
di reggimento di Fanteria (6°)----------6° r. Fant.
(of the 6th Infantry Regiment)
Comandi di Gruppo Treno d'Artiglieria
(Commands of the Artillery Train Groups)
Comando d'Armata (2°)----------Com. 2° A.
(Headquarters of the 2nd Army)
Comando di Compagnia Treno d'Artiglieria
(Command of Artillery Train Company)
Comando Supremo----------Cm. Supr.
(General Headquarters)
Comando di Tappa
(Headquarters of the Lines of Communication)
Compagnia di Fanteria (3ª del 6°)----------3 Fant. Cp. del 6° Fant.
(3rd Company of the 6th Infantry Regiment)

D.

Depositi Centrali----------D. C.
(Central (Supply) Depots)
Deposito Medicinal—Materiale Veterinario
(Medical Depot—Veterinary Supplies)
Deposito Rifornimento Quadrupedi
(Animal Supply Depot)

F.

Forni in Muratura
(Wall Ovens)

I.

Infermeria Cavalli----------Inf. Cav.
(Veterinary Hospital or Infirmary)
Infermeria di Tappa
(Infirmary or Hospital of the Lines of Communication)
Intendente Generale----------I. G.
(Quartermaster General—approximately)
Intendenza d'Armata----------Int. A.
(Intendenza (Quartermaster or Supply Section) of an Army)
Intendenza Generale----------Int. G.
(Intendenza (Quartermaster or Supply Section—G. H. Q.) of the Army)

L.

Laboratorio Batteriologico----------Lab. Bac.
(Bacteriological Laboratory)
Laboratorio Materiale d'Artiglieria
(Artillery Material (Ordnance) Repair Shop)
Laboratorio Materiale del Genio
(Engineer Material Repair Shop)

M.

Magazzinato Avanzato d'Artiglieria.....Mag. Av. Art.
(Advanced Artillery Depot)
Magazzinato Avanzato del Genio.....Mag. Av. Gen.
(Advanced Engineer Depot)
Magazzino Avanzato di Materiale Sanitario.....Mag. Av. M. S.
(Advanced Medical Depot)
Magazzinato Avanzato Munizioni.....Mag. Av. Mz.
(Advanced Ammunition Depot)
Magazzinato Avanzato Viveri Ordinari.....Mag. Av. Viv.
(Advanced Depot for ordinary Food Supplies)
Magazzino Salagione Pelli
(Storehouse for hides)

O.

Ospedale da Campo che puo funzionare da Lazzaretto
(Field Hospital which may be operated as a Lazaret or Quarantine Hospital)
Ospedale da Campo Impiantato.....Osp.
(Stationary Field Hospital)
Ospedale da Campo per Isolamento Malatti Infetti Comni
(Isolation Field Hospital for Infectious Diseases)
Ospedale di Guerra C. R. I.
(Italian Red Cross (C. R. I.) Hospital)
Ospedale di Guerra S. M. O. M.
(Sacred Military Order of Malta (S. M. O. M.) Hospital)
Ospedaletto da Campo da 100-Letti.....Osp. (100)
(100-bed Field Hospital)
Ospedaletto da Campo da 200-Letti.....Osp. (200)
(200-bed Field Hospital)
Ospedaletto da Campo da 50-Letti (Carreggto.).....Osp. Carr. (50)
(50-bed (animal-drawn) Field Hospital)
Ospedaletto da Campo da 100-Leti (Someggto.).....Osp. Som. (100)
(100-bed (motor-drawn) Field Hospital)

P.

Parco Buoi
(Cattle Park)
Parco Genio
(Engineer Park)
Parco Vestiario ed Equipaggiamento d'Armata.....Pc. Vest. Eqm. A.
(Army Park for clothing and equipment)
Parco Viveri per Corpo d'Armata.....Par. Viv. C. d'A.
(Army Corps Supply (Food) Park)
Parco Viveri per Gruppo Alpini.....Par. Viv. Gr. Alp.
(Alpine Group Supply (Food) Park)
Parco Tratrici
(Tractor Park)
Pattuglia, piccola guardia e posto di scoperta.....Ptg., p. g. p. sc.
(Patrol, small outpost and observation post)
Platone di Fanteria.
(Infantry Platoon)
Panificio Avanzato
(Advanced Bakeries)

R.

Reggimento di Fanteria (6°)----------6° r. Fant.
(6th Infantry Regiment)
Reparti di Treno Ausiliario Militare
(Auxiliary Military Train Detachments)
Reparto Someggto di Sanita----------Rep. Som. San.
(Auto Medical Detachment)
Reparto Tratrici
(Tractor Detachment)

S.

Salmerie a disposizione o speciali
(Unassigned or special transportation)
Salmerie a disposizione per Gruppo Alpini
(Unassigned transportation for Alpine Group)
Sezione di Carabinieri Reali----------CC. RR.
(Section of Royal Carbineers)
Sezione di Colonna Munizioni per Fanteria----------Sz. Col. Mz. Fant.
(Section of Infantry Ammunition Column or Train)
Sezione di Disinfezne d'Armata----------Sz. Dis. A.
(Army Disinfecting Section)
Sezione di Disinfezne di Corpo d'Armata----------Sz. Dis. C. d'A.
(Army Corps Disinfecting Section)
Sezione di Sanita per Cavelleria----------Sz. San. Cav.
(Cavalry Medical Section)
Sezione di Sanita per Fanteria----------Sz. San. Fant.
(Infantry Medical Section)
Sezione di Sanita per Gruppo Alpini----------Sz. San. Gr. Alp.
(Alpine Group Medical Section)
Sezione di Treno con Trattrici
(Section of Train, with tractors)
Sezione Mitragliatrici ordinaria----------Sz. Mtr.
(Ordinary Machine-Gun Section)
Sezione Panattieri con Forni Mod. 93
(Bakery Section with Model 93 Ovens)
Sezione Panattieri con Forni Mod. 97 (Carreggti o Sommeggti)
(Bakery Section with Model 97 Ovens—Animal or Motor drawn)
Sezione Panattieri con Forni Weiss
(Bakery Section with "Weiss" Ovens)
Sezione Panattieri per Gruppo Alpini
(Bakery Section for Alpine Group)
Sezione Panattieri senza Forni Mobili----------Sz. Pan. sen. Mob. For.
(Bakery Section without Mobile Ovens)
Sezione Sussistenze per Cavalleria----------Sz. suss. Cav.
(Cavalry Supply (Subsistence) Section)
Sezione Sussistenze per Fanteria----------Sz. suss. Fant.
(Infantry Supply (Subsistence) Section)
Stabilimento Croce Azzurra
("Blue Cross Society" Establishment—care and treatment of animals)
Stabilimento Disinfezione e Riattamento Calzature
(Establishment for the disinfection and repairing of shoes)

Stabilimento Disinfezione e Riattamento V. E.
(Establishment for the disinfection and repair of clothing and equipment)
Stato Maggiore.....S. M.
(General Staff)
Squadra del Parco Viveri di Corpo d'Armata
("Squad" or Detachment of the Army Corps Supply (Food) Park)
Squadra di Sezione Panattieri.....Sq. Sz. Pan.
("Squad" or Detachment of a Bakery Section)

T.

Treno Attrezzato.....Tr. Att.
(Supply Train)
Treno Ospedale.....Tr. Osp.
(Hospital Train)

APPENDIX VOL. II.
SECTION V.

ABBREVIATIONS (AMERICAN ARMY).

EXTRACT.—This list will be found to include most of the abbreviations which have been used in the A. E. F., *although* not intended as a complete compilation.

The abbreviations given fall into four classes. Those followed by the letter "R" are *regulation* abbreviations, as contained in Bulletin 13, G. H. Q., 17 Feb., 1919. Those followed by "O" may be designated as *official*, having appeared in past official literature of the War Department or of General Headquarters, and those followed by "D" are *departmental* abbreviations whose use has been sanctioned by the departments concerned or by lesser headquarters. Those abbreviations which fall into the fourth class, or of which the status is undetermined, are not followed by any letter. These are the miscellaneous abbreviations that have come into use informally for the most part.

For further abbreviations reference is made to Special Regulations No. 56, W. D., Washington, D. C., 23, May 1919, containing latest list of *authorized* abbreviations.

NOTE.—These abbreviations are the compilations of Lt. E. Krieger and Lt. Raymond Hall, Corps of Interpreters, assembled under a single heading.

AMERICAN MILITARY ABBREVIATIONS.

NOTE.—(Re more or less arbitrary abbreviation.)
O before an abbreviation generally means "Office of."
O after an abbreviation generally means "Officer."
A before an abbreviation generally means "Assistant."
C before an abbreviation generally means "Chief."
D before an abbreviation generally means "Director," "Deputy," or "Divison (al)"
D after an abbreviation generally means "Division" or "Department."
B before or after an abbreviation generally means "Bureau."

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
	A		
A	Advance section S. O. S. (rare) (usual form AS, SOS)		
AA	Army artillery (rare)	D	Art.
	Anti-aircraft		Art. & Ord.
AAA	Anti-aircraft artillery	R	Art. & Ord.
AAAP	Amer. Aviation acceptance park	D	AS.
AAD	Aerial armament div	D	Ord.
AAMGB (or Co.)	Anti-aircraft M. G. Bn., (or Co.)	D	
A. A. Pk	Army art. park (rare)		Art.
AA Sec	Anti-aricraft sector	R	Art.
AAS	Army ambulance service (rare) (usual form USAAS)		MD.
ACE	Asst. Chief Engineer	D	Eng.
Act	Acting		
AC of S	Asst. Chief of Staff	R	
ACQM	Asst. Chief Quartermaster	D	QMC.
AC	Army Corps		
ADAC of S	Asst. Deputy to Deputy Asst. C. of S. (rare)		
Adjt	Adjutant		
A DLB	Asst. Director Labor Bureau	D	ASC.
Admin. Div	Administrative Division		
Admins. Lab. Co. of A. S. C.	Administrative Labor Co., Army Service Corps	D	
ADS	Attending dental surgeon (rare)		

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
AEC	Amer. embarkation center	D	
AEF	Amer. Expeditionary Forces	R	
Aero Constr. Co.	Aero Construction Co	R	AS
Aero Sq	Aero Squadron	R	AS
AFC	Army Field Clerk	O	AGD
A. F. in F	American Forces in France		
A. F. in G	American Forces in Germany		
AFS	American Field Service		
AG	Adjutant General	R	AGD
AGA	Adjutant General of the Army	O	
AGD	Adjutant General's department	R	
AGO	Adjutant General's office	O	
AGS	Aerial Gunnery School	D	AS
AIC	Aviation Instruction Center	D	AS
AID	Aviation Instruction Detachment	D	AS
Air. Arm	Aircraft armament	D	Ord.
Air Pk. Co	Air Park Co	D	AS
ALA	American Library Association	D	
ALC	Administrative Labor Co. (rare) (usual form AL Co.)		
ALVF	"Art. Lourde sur voie ferrée" (Hvy. Ry. Art.)	D	Ord.
AM	Aviation mechanician	D	AS
AM	American Member		
AM	American Mission		
AMB. Co	Ambulance Company	R	MD
Amb. Sect	Ambulance Section	R	MD
Amb Serv. Pk	Ambulance Service Park	R	MD
Am. E. F Amer. E. F	American Expeditionary Forces (changed to A. E. F.)		
Amerforces	American Expeditionary Forces (cable address)		
AM	Ammunition	O	
Amn	Ammunition	D	Ord
AMM	American Military Mission		
Am Tn	American Train	O	
ANC	Army Nurses Corps	D	MD
An. Trans. Depot	Animal Transport Depot	R	QMC
A. O. A. of O	Army of Occupation		
AOBDF	Amer. Ord. Base Depot in France	D	Ord
AOD	Adv. Ord. Depot	D	Ord.
AP	Armour piercing	D	Ord
APM	Asst. Provost-Marshal	R	PMGD
A. P. O	Amer. Post Office		
APO	Army Post Office	O	
AQM	Acting Quartermaster		
ARC	American Red Cross	R	
ARC Conv. Home	American Red Cross Convalescent Home	R	
ARC Hosp	American Red Cross Hospital	R	
Arm	Armament	D	Ord
Army Arty. Pk	Army Artillery Park	R	Ord
Army Gard. Serv. Co. (ASC).	Army Garden Service Company	R	
Army Insp. Pk	Army Inspection Park	R	
Art	Artillery	O	
AS	Air Service	R	(indep)
	Amb. Serv. depending on context	D	
	Adv. Sect. SOS	D	
ASC	Army Service Corps	R	(indep)
ASDI	Amer. Salvage Depot, intermediate	D	QMC
ASAP	Air Serv. Acceptance Park	D	AS
Regt. ASM	Air Serv. mechanics (rare)		
AS Mech Regt	Air Serv. mechanics (usual form)	R	
ASPC	Air Serv. Production Center	D	
ASRCB	Air Serv. Replacement Construction Barracks (now obsolete).	D	
AS, SC	Aviation Section, Signal Corps (obsolete) (changed to Air Service).	O	
AS, SOS	Adv. Section, S. O. S	D	
Asst. C. S	Asst. Chief Surgeon	D	MD
ASTS	Air Serv. Transport Section	D	
AST	Automatic Supply Table	D	Ord
AT	Anti-tank	D	Ord
A of T	Arrondissement of Tours (usually ATD)	D	SC
ATD	Animal Transport Depot	D	QMC
Ath. Dir	Athletic Director	D	
ATM	Asst. Town-Major	D	
ATP	Army Traffic Police	D	MPC
ATS	Army Transport Serv	R	TC
Att. Surg	Attending Surgeon	D	MD
Aut. Arms Rep. Depot	Automatic Arms Repair Detachment	R	Ord
AW	Articles of War	O	
AWOL	Absent without leave	A	

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
	B		
Bak Co	Bakery Company	R	QMC
Bal Wing	Balloon Wing	R	AS
Bal Gr	Balloon Group	R	AS
Base VH	Base Veterinary Hospital	R	VC
BATD	Base Animal Transport Depot	D	QMC
BC	Battery Commander		
BCC	Bricklaying Constr. Co. (obs.)	D	AS
BCM	Bureau Central Militaire	O	
BDL	Billeting Distribution List	O	
BDTS	Bombardment Div. Training Sect. (obs.)	D	AS
BEF	British Expeditionary Forces		
BFP	Bureau Fire Prevention	D	QMC
Bgd	Brigade (Brig. preferable)	O	
BH	Base Hospital	R	MD
Bks	Barracks	O	
BLIS	Base Laboratory, Intermediate section	D	ARC
BM	British Mission (rare) (BMM preferable)		
BMM	British Military Mission		
BM, TS	Business Manager, Transportation Service (changed to Transportation Corps)	D	
Bn	Battalion	R	
BO	Billeting Officer	D	QMC
BOD	Base Ord. Depot	D	Ord
BOO	Base Ord. Officer (rare)	D	Ord
BQM	Base Quartermaster		
Brig	Brigade	R	
B. G	Brigadier-General		
BR & I	(see R & ID)		
BSO	Base Signal Officer		
B Sec, F Tn	Baggage Section, Field Train	O	
BS	Base Section	D	
B. S. No. 9	Base Section No. (9) (numeral varies with different sections)		
Btry	Battery	R	
Bug	Bugler	O	
Bul	Bulletin	O	
Butch. Co	Butchery Company	R	QMC
	C		
CAC	Coast Artillery Corps	R	
Cam	(see Engrs)		
CA Pk	Corps Art. Park	D	Art
CAS	Chief Air Service	R	
Cav	Cavalry	R	
CBO	Central Baggage Office	D	QMC
CB of C. & A	Chairman Board of Contracts and Adjustments	D	GPA
CDO	Chief Disbursing Officer	D	QMC
CE	Chief Engineer Corps of Engineers (rare)—usually: Engrs	D	
Cem-Mills Co	Cement Mills Company	R	ASC
CEO	Chief Engineer Officer (usually CE)	R	
CG	Commanding General	R	
CGO	Chief Gas Officer (corps or army)	D	CWS
CH	Camp Hospital	R	MD
CGS	Chief Gas Service (obs.) (changed to Chief Chemical Warfare Service)	O	
CCWS	Chief Chem. War Serv	O	(Indep)
CI	Corps of Interpreters		
C. in C	Commander-in-Chief	R	
CIP	Corps Intelligence Police	R	(indep)
Ck	Cook	O	
CLO	Chief Liaison Officer	D	(indep)
CM	Court-martial	O	
CMTC	Chief Motor Transport Corps	R	
CMTS	Chief Motor Transport Service (obs) (changed to Motor Transport Corps)	O	
CO	Commanding Officer	R	
COAS	Commanding Officer Air Serv	D	
COD	Casual Officers' Depot	D	
C of A	Chief of Artillery	R	
C of C	Chief of Cavalry	R	
C of I	Chief of Infantry	R	
C of E	Corps of Engineers (obs. usually Engrs)		
C of O	Chief of Ordnance	D	
C of S	Chief of Staff	R	
C of T. C	Chief of Tank Corps (changed to C. Tank C.)	D	
C of U	Chief of Utilities (obs) (functions taken over by CE, AEF)	O	
Ch	Chief		

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
Comdg	Commanding	O	
Cmdg	Commanding	O	
COMP	Commanding Officer Military Police	D	
Constr. QM	Construction QM	D	
Conv. Camp	Convalescent Camp	R	MD
Conv. Depot	Convalescent Depot	R	MD
COO	Chief Ordnance Officer	R	
CORD	Combat Officers' Replacement Depot		
CPES	Combat Postal Express Service	D	
CPO	Central Post Office	D	PES, ASC
CPO	Chief Purchasing Officer	D	QMC
Cps	Corps		
CPWE	Central Prisoner of War Enclosure	D	ASC
CQM	Chief Quartermaster	R	
CRB	Commission for Relief in Belgium (obs.)		
CR Dept	Central Records Department	D	ASC
CRS	Chief Remount Service	D	QMC
CRO	Central Record Office	O	
c. s.	current series	O	
C. S	Courier Service		
CS	Chief Surgeon	R	MD
CSO	Chief Signal Officer	R	
C Sig. O	Chief Signal Officer	D	
C Sup. O	Chief Supply Officer (rare)		
C Tank C	Chief Tank Corps	R	
C Tn	Combat Train	O	
CTO	Chief Transportation Officer	R	TC
CWS	Chemical Warfare Service	R	(indep)
C & GE	Clothing & Garrison equipage	O	
C & M	Construction and Maintenance Div	D	Ord
C & P	Cleaning and Preserving	D	Ord
C & R Depot Bn	Conservation & Reclamation Depot Bn	R	QMC
	D		
DAC of S	Deputy Asst. C. of S	R	
DASC	Director Army Service Corps	D	
Day Bomb Gr	Day Bombardment Group	R	AS
DB	Depot Brigade		
DCCWS	Deputy Chief C. W. S	D	
DCE	Deputy Chief Engineer	D	
DCF	Division Construction & Forestry (official form DC & F)	D	ED
DCI	Division of Criminal Investigation	R	PMGD
DCQM	Deputy Chief QM (rare)—usually Dep. CQM	D	
DC of S	Deputy Chief of Staff	R	
DC & F	Division of Construction & Forestry	O	ED
DC	Dental Corps	O	(ind)
DC	District Commander (obs) (changed to Sect. C)	D	
DDGT	Deputy Director General of Transportation	O	TC
Def Div	Defense Division	D	CWS
Dep CQM	Deputy Chief QM	D	
Det	Detachment	O	
DGO	Division(al) Gas Officer	D	CWS
DGT	Director General of Transportation	R	TC
Dir C. & F	Director of Construction & Forestry	D	ED
Dir LR & R	Director of Light Railways & Roads (obs)	D	ED
Dir MTC	Director of Motor Transport Corps (obs) (usual form DMTC–q. v.)		
Dispr	Dispatcher	O	TC
Dist Engr	District Engineer	O	ED
Div	Division	O	
Divl Art	Divisional Artillery		
Divl Engrs	Divisional Engineers		
DLR	Division of Light Railways (discont.)	D	ED
DLR & R	Division of Light Railways and Roads (obs) (changed to Div. of Lgt. Rys.)	D	ED
DL & BU	Delousing & bathing unit	D	QMC
DMA	Director of military affairs	O	TC
DME & ES	Division of Military Engineering & Engr. Supplies (obsolete)		ED
DMGO	Division(al) Machine Gun Officer	D	
DMP	Division(al) Military Police (rare)		
DMPES	Director Milit. Postal & Exp. Serv. (obs) (changed to Chief Postal Ex. Serv.—CPES)	D	
DMTC	Director of Motor Transport Corps (obs) (changed to Chief Motor Transport Corps—CMTC)	D	
DO	Disbursing Officer	D	QMC
D of P	District of Paris	D	
D of R & I	Division of Research and Inspection (changed to Special Service Division—SS Div)	D	SC
DPCE	Detachment of plant construction engrs		
DPES	Detachment Postal Express Service	D	PES
DQM	Depot Quartermaster	D	
DRC	Dental Reserve Corps	O	(indep)

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
DRR & C	Director Rents, Requisitions & Claims	D	(indep)
DS	Detached Service	O	
DSC	Distinguished Service Cross	O	
DSM	Distinguished Service Medal	O	
DSO	Division(al) Signal Officer		
	E		
EAC	Evacuation Ambulance Co	D	MD
ED	Engineer Department	R	
EH	Evacuation Hospital	D	MD
Eng	Engineer (rare)		
Engr	Engineer (usual form)		
Engr Dept	Engineer Department (rare) (Usual form ED)		
Engr Det	Engineer Detachment	D	
Engr Pk	Engineer Park	D	
Engr Sec Det	Engineer Section Detachment	R	ASC
Engr Tn	Engineer Train	R	
Engr M of W	Engineer Maintenance of Way	O	TC
Engrs	Engineers	O	
Engrs Sap	Sappers Regt (Engineers)	R	ED
Engrs Man	Mining Rgt (Engineers)	R	
Engrs Elec &Mech	Electrical & mechanical regt	R	
Engrs For	Forestry Regt	R	
Engrs Gen Constr	General Construction Regt	R	
Engrs Cam	Camouflage Bn Regt	R	
Engrs Lt. Ry. Opr	Light Railway operation Regt	R	
Engrs Qy	Quarry Regt	R	
Engrs Rd Serv	Road Service Regt	R	
Engrs Ry Const	Railway Construction Regt	R	
Engrs Serv	Service Bn	R	
Engrs SL	Search Light Regt	R	
Engrs Sp Serv	Supply Service Regt	R	
Engrs Sp & Shop	Supply and Shop Regt	R	
Engrs Sur & Prin	Surveying & Printing Regt	R	
Engrs T & S	Surveying Topographical Regt. (Obs) (changed to: Sur & Prin)	R	
Engrs W Sp Serv	Water Supply Service Regt	R	
Engrs F & SR	Flash and Sound Ranging Regt	R	
Elech & Mech	(see Engrs)		
EO	Engineer Officer	O	
EOCC	Engineer Officer in charge of Construction	D	
E of C, TC	Engineer Officer Constr., Transportation Corps	D	
EORC	Engineer officers' Reserve Corps	D	
ERC	Engineer Reserve Corps	O	
ES Co	Engineer Supply Co	D	
ESD	Engineer Supply Depot	D	
Evac Amb Co	Evacuation ambulance Co. (usually EAC)	R	MD
Evac Hosp	Evacuation hospital (usually EH)	R D	MD
Exec Offcr	Executive Officer		
	F		
FA	Field artillery	R	
FB	Finance Bureau	D	GS
FD	Foreign Detachment (rare)		
FH	Field hospital	R	MD
FHT Co	Fire Hose Truck Co	R	QMC
Fld	Field	O	
Fld Rem Sq	Field Remount Squadron (usually FRS)	R D	QMC
FLO	Financial liaison officer	D	GPA
FM	Franchise Militaire (postal frank)		
FM	French Mission (rare—usually FMM)		
FMM	French Military Mission		
FO	Field Order	O	
FOD	Field officer of the day (rare)		
For	(see Engrs)		
FRO	Financial requisition officer	D	GPA
FRS	Field Remount Squadon	D	QMC
F Sig B F Sig Bn	Field Signal Bn	D R	SC
FSR	Field Service Regulations	O	
F Tn	Field Train	O	
FWD	Four-wheel drive	D	ORD
F & FD	Fuel and Forage Division	D	QMC
D & SR	(see Engrs)		
	G		
G-1	First Section, General Staff (other Sections: G-2, G-3, G-4, G-5).		
G-4 D	Motor Transportation Subsection of 4th Section, Gen. Staff.		

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
Gas Serv	(changed to CWS)		
GCM	General Court-martial	O	
Gd	Guard	O	
Gd Co	Guard Co	R	ASC
Gen Con	General Control	D	Ord
Gen Constr	(see engrs)		
GHQ	General Headquarters	R	
GISD	General Intermediate Storage Depot	D	QMC
GM, TC	General Manager, Transportation Corps	D	
GO	General Officer		
GPA	General Purchasing Agent	O	(indep)
GPB	General Purchasing Board	O	(indep)
GO	General Order	O	CWS
	Gas Officer	D	
Gr Reg Unit	Graves Registration Unit	R	QMC
GRS		D	
GRS, MTC	General Repair Shop (obs)	R	
GS	General Staff (Corps)	R	(indep)
GSA	General Sales Agent	D	
GSB	General Sales Board	D	(indep)
GSO	General Staff Officer		
GS, motive power	General Superintendent, motive power	D	TC
	H		
H	Howitzer	D	Ord
HAEF	Headquarters Amer. Expeditionary Forces		
Hdqrs. A. E. F	Headquarters American Expeditionary Forces	O	
Hdqrs., A. F. in F	Headquarters American Forces in France		
Hdqrs., A. F. in G	Headquarters American Forces in Germany		
Hdqrs., S. O. S	Headquarters Services of Supply		
HE	High explosive	D	Ord
HED	Head Engineering Division	D	Ord
Hist	Historical	D	Ord
Hist Sec, GS	Historical Section, Gen Staff	D	GS
HMORS	Heavy Mobile Ord. Repair Shop	D	Ord
Hosp Tn	Hospital Train	R	MD
Hq. Hqs	Headquarters		
Hdqs., Hdqrs			
HQC	Headquarters Commandant	O	PMS
Hq Co (Bn)	Headquarters Company (Battalion)	R	
Hq Det	Headquarters Detachment	R	
Hq. MC	Headquarters Motor Command	O	
Hq Ptg Co	Headquarters Printing Co	D	ASC
Hq Tr	Headquarters Troop	R	
Hs	Horseshoer	O	
Hv MORS	Heavy Mobile Ord Repair Shop (usually HMORS)	R	Ord
	I		
IAR	Interallied Rulings		
IAWG	Interallied War Council		
IC	Inspected and condemned	O	
IC	Intelligence Corps	D	(indep)
Ice Pl Co	Ice Plant Co	R	QMC
IG	Inspector General	R	IGD
IGD	Inspector General's department	R	(indep)
IMM	Italian Military Mission (rare)		
Ind	Indorsement	O	
Inf	Infantry	O	
Insp	Inspector	O	
Inst Repair unit	Instrument Repair unit	R	MD
Int Div	Intelligence Division	D	
Int. SOS	Intermediate section, Services of Supply	D	
IRC	Infantry Reserve Corps	O	
It Serv Bn	Italian Service Battalion	R	ASC
IWTS	Inland Water Transport Serv	O	TC
	J		
WB	Jewish Welfare Board		
	K		
K of C	Knights of Columbus		
KP	Kitchen Police		
	L		
LAB	Leave Area Bureau	D	ASC
Lab Bur	Labor Bureau	D	ASC
Lab Unit	Laboratory unit	R	MD
LA Det	Leave Area Detachment	R	ASC
Laund Co	Laundry Co	R	QMC
LB	Labor Bureau (rare)		

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
LB Bur, TC	Lost Baggage Bureau, Transportation Corps	D	
LD	In line of duty	O	
LOC	Line of Communications (rare)		
L of C	Line of Communications (obs)	O	
	(changed to Services of the Rear)		
LRS	Light Railway service (rare)	D	ED
	(usually—SLR)	R	
Lt	Lieutenant		
Lt. Col	Lieutenant-Colonel		
Lt. Ry Opr	(see Engrs)		
	M		
MC	Medical Corps	O	MD
MC Co, MTC	Motor Car Co, Motor Transport Corps	R	
MD	Medical Department	R	
MDS	Motor Dispatch Service	R	SC
Mec	Mechanic (rare—usually Mech)	O	
Mech	Mechanic	R	
Med Depot	Medical Depot	R	
Med Dept	Medical Department	O & R	
	(usually—MD)	R	
Med Det	Medical Detachment		MD
Med Lab	Medical Laboratory	R	
Med Rep	Medical Representative	D	MD
Med Sp Depot	Medical Supply Depot	R	
	(usually—MSD)	D	
Memo	Memorandum		
Meteor Sec, Sig C	Meteorological Section, Signal Corps	D	SC
Met Sec, Sig		R	SC
ME & ESS	Milit. Engineering & Engineering Supply Serv. (rare) (usually—Div. Milit. Eng. & Eng. Sup.) (obs).		
MG	Machine Gun		
MGB	Machine Gun Battalion (rare)		
MG Bn	Machine Gun Battalion (usual form)	R	
MGC	Machine Gun Company (rare)		
MG Co	Machine Gun Company (usual form)	R	
MG O	Machine Gun Officer		
MID	Military Intelligence Department	R	
MBAS	Military Board of Allied Supply	O	GPA
Min	(see Engrs)		
MMR	Motor Mechanics' Regt	D	MTC
Mob Hosp	Mobile Hospital	R	
Mob Lab	Mobile Laboratory	R	MD
Mob Laund Unit	Mobile Laundry Unit	R	QMC
Mob Opr Unit	Mobile Operating Unit	R	MD
Mob Optic Unit	Mobile Optical Unit	R	MD
Mob VH	Mobile Veterinary Hospital	R	MD
M of W	(see Engrs)		
Mon Purs Wing	Monoplace pursuit wing	R	As
MORS	Mobile Ord Repair Shop	R	
MP	Military Police	R	MPC
MP Bn (Co)	Military Police Battalion (Company)	R	MPC
MPC	Military Police Corps	D	indep
MPES	Military Postal Express Serv (obs)	D	
MPO	Military Police Officer	D	MPC
MRC	Medical Reserve Corps	O	MD
MRS	Mechanical Repair Shop	D	MTC
Mr Sig Elect	Master Signal Electrician	O	
	(usually—MSE)	D	SC
MS D	Medical Supply Depot	D	
MSE	Master Signal Electrician	D	SC
MSRS	Mobile Salvage Repair Squad	D	QMC
MST	Motor Supply Train (rare)		
MS Tn	Motor Supply Train (usual form)	R	MTC
MSTU	Motor Shop Truck Unit (obs)		
	(Changed to Serv. Pk. Unit—SPU)	D	MTC
MTC	Motor Transport Corps	R	indep
MT Co	Motor Truck Company	R	MTC
MTC Res Pk	Motor Trans. Corps Reserve Park	R	
MTO	Motor Trans. Officer	D	MTC
MTRS	Motor Trans. Repair Shop	D	
MTS	Motor Trans. Service (Obs)	O	
Mun O	Munitions Officer		
Mus	Musician		
	N		
	National Army (Obs)	O	
NA	Naval Aviation		
Nav BH	Naval Base Hospital	R	
NCO	Non-commissioner officer		
NG	National Guard (obs)	O	
NLD	Not in line of duty	O	
NR	Naval representative (rare)		

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
	O		
O	(Company, Troop, Battery) Orders	O	
OA	Obus Allonge (Fr. term)	D	Ord
Obs Wing	Observation wing	R	AS
Obs sq	Observation squadron	R	AS
OCDO	Office Chief Disbursing QM Officer	D	QMC
OCE	Office Chief Engineer Officer	D	ED
OCOO	Office Chief Ord Officer	D	Ord
OCQM	Office Chief QM Officer	D	QMC
OCSO	Office Chief Signal Officer	D	SC
OCS	Office Chief Surgeon	D	MD
OC & ES	Overseas courrier & Express Serv	D	PES
OD	Ordnance Department		Ord
OD	Olive drab	O	
ODQM	Office of the Depot Quartermaster		QMC
ODT	Ordre de Transport		
Off Div	Offense Division	D	CWS
OG	Officer of the Guard		
OIC	Officer in charge		
OIC, S. & D, Sig C	Officer in charge Sales & Disbursing Div	D	SC
OMPD	Ordnance Motor Park Detachment		
OO	Ordnance Officer	D	
OP	Observation Post		
OPM	Office Provost Marshal	O	PMS
OPMG	Office Provost Marshal General	O	
OQMG	Office of the Quartermaster General		QMC
ORC	Officers' Reserve Corps		
ORD	Officers' Replacement Depot	D	
Ord Depot	Ordnance Depot	R	
Ord Dept	Ordnance Department	R	
Ord RC	Ordnance Reserve Corps	O	Ord
ORSO	Ordnance Repair Shop Officer	D	
OSG	Office of Surgeon General	O	
OS Unit	Orthopedic surgery unit	R	MD
Ot Bn	Orthopedic battalion	R	MD
O & P Surg Unit	Oral & Plastic surgery unit	R	MD
O & TC	Organization & training center	D	Ord
O & TC, HA	Organization & training center Hvy. Art	D	Art
O & TC, TA	Organization & training center Tractor Art	D	Art
	P		
P	District of Paris (rare)		
PA	Personnel Adjutant		
PC	Command Post		
PC	Post Commandant	D	PMS
PDQM	Post Disbursing QM	D	
PE	Post Exchange	O	
Pers Div	Personnel Division	D	
PES	Postal Express Service	R	ASC
PIAC	Permanent Interallied Armistice Commission		
Pion Inf	Pioneer Infantry	R	
PLU	Provisional Laundry Unit	D	QMC
PM	Provost Marshal	D	PMS
PMG	Provost Marshal General	R	
PMGD	Provost Marshal General Department	R	(indep)
PMS	Provost Marshal Service	O	
Pn	Platoon	O	
PO	Post Office		
POC	Pursuit Organization Center (obs)	D	AS
Pon Tn	Pontoon Train	R	ED
PQM	Post Quartermaster	D	
Prov Ord Dept Co	Provisional Ordnance Depot Company	R	
PS & T	Purchase, Storage & Traffic Section G. S		
PV	Proces-verbal (Fr. term—rarely used)		
Pvt	Private	O	
PW	Prisoner of War	D	
PWE	Prisoner of War enclosure	O	ASC
PWE	Prisoner of War Escort Company	R	ASC
PWL	Prisoner of War Labor Company	D	ASC
P & R Br	Precedent & Research Branch	D	QMC
P & S Div	Purchase & Supplies Division	D	CWS
	Q		
QM	Quartermaster	O	
QMAAC	"Queen Mary's Auxiliary Army Corps" (insignia worn is: W. A. A. C.—Women's Auxiliary Army Corps)		
QMC	Quartermaster Corps	R	
QMG	Quartermaster General	O	
QMGO	Quartermaster General Office	O	
QMRC	Quartermaster Reserve Corps	O	
Qy Serv	Quarry Service	D	ED

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
	R		
RA	Regular Army (obs)	O	
Rad Sec, Sig Rad Sec, Sig C	Radio Section, Signal Corps	R D	SC SC
RAR	Railway Art. Reserve	R	Ord
RD	Remount Depot	D	QMC
Rd serv	(see engrs)		
Ref Pl Co	Refrigerating Plant Co	R	QMC
Regt	Regiment	R	
Reg	Regular		
Rem Depot	Remount Depot (usual form RD)	R D	QMC
Repl Depot	Replacement Depot	D	QMC
Rep Unit	Repair Unit	R	MTC
Rpr Unit	Repair Unit	R	MTC
Rgt	Regiment (rare)		
RMS	Remount service	D	QMC
RO	Regimental Orders Regulating Officer Remount Officer (rarely used)	O O D	 TC QMC
RO	Recruiting Officer		
RORS	Railway Ordnance Repair Shop	R	Ord
ROTC	Reserve Officers Training Camp		
RR & CS	Rents, Requisitions & Claims Serv	O	indep
RR & C Co	Rents, Requisitions & Claims Company	D	ASC
RS	Recruiting Service		
RS	Regulating Station		
R Sec, F Tn	Rations Section, Field Train	O	
R Serv	Road Service	R	ED
RSM	Reserve Station-Magasin (Fr. term)	D	QMC
RTO	Railway Transportation Officer	R	TC
RTC	Railway Transportation Corps (obs) (changed to Transportation Service—T. S. and in turn to Transportation Corps—T. C.)		
RVD (MTC)	Reserve Vehicle Depot	R	
Rwy Constr Bn	Railway Construction Battalion	R	ASC
Ry Const	(see engrs)		
R & ID	(see D of R & I)		
	S		
SA	Salvation Army		
SAA SA Am	Small Arms Ammunition	D O	Ord Ord
Sad	Saddler	O	
Sales Com Unit	Sales Commissary Unit	R	QMC
Salv Co	Salvage Company	R	QMC
San C	Sanitary Corps	R	indep
San Sq	Sanitary Squad	R	San C
San Tr	Sanitary Train	R	San C
Sap	(see engrs)		
SATC	Students' Army Training Corps		
SC	Summary Court (rare) Signal Corps (usual form)	O O	
SCBD	Signal Corps Base Depot	D	
SCD	Surgeon's Certificate of Disability	O	
SCISD	Sig. Corps, Intermediate Supply Depot	D	
SC Photo D	Sig. Corps, Photo Depot	D	
SD	Special duty Searchlight Department Supply Depot (rare)	O D	 ED
SD, AGD	Statistical Div., Adj-General's Dept	R	
SDO	Signal Disbursing Officer (rare)	R	
SE	Section engr	D	
Sec Sect	Section (Sec preferable)	O	
Sec Civ Lab Offcr	Section Civilian Labor Officer	D	ASC
Sec Rep	Section representative	D	ASC
Serv	Service	O	
Serv Bn	(see engrs)		
Serv Pk Unit	Service Park Unit	R	MTC
SG	Surgeon General	O	
SGRT Bn	Standard Gauge Railway Transportation Bn	D	TC
Sgt 1st Cl	Sergeant, first class	O	SC
Shrap	Shrapnel	D	Ord
SI	Sanitary Inspector (rare)	D	San C
Sig C	Signal Corps	R & D	
Sig O	Signal Officer	D	SC
SL	(see engrs)		
SLR	Serv. light railways	R	ED
Sn Tn	Sanitary Train (rare) (usually San Tn)	O	
SO	special orders Supply Officer (rare—usually Sup O) Signal Officer (preferably Sig O)	O	

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
SO, A of T	Sig. Officer, arrondissement of Tours		
SOL	Sure out of luck		
SOR	Services of the Rear (obs) (changed to Services of Supply—S. O. S.).	O	
SOS	Services of Supply	O	
SPCGM	Self-propelled caterpillar gun-mount	D	Ord
Sp Co	Supply Company	R	QMC
Sp Depot	Supply Depot	R	MTC
SP Depot	Spare parts depot	R	MTC
Sp Serv	(see engrs)		
Sp. Tn	Supply Train	R	QMC
SPU, (MTU)	Service park unit	D	
Sp & shop	(see engrs)		
Sq	Squadron	O	
Sqd	Squad		
SRC	Signal Reserve Corps	O	SC
Sr Ch	Senior Chaplain	R	
SRS	salvage regulating station	D	QMC
	sound ranging station		
	sound registration service (rare)		
SGS	Secretary, General Staff	R	
SS	Salvage Service	D	
SS Div	Special Service Division	D	SC
Stab Sgt	Stable Sergeant	O	
Stat Div	Statistical Division	D	
Stat O	Statistical Officer (rare)		
Stat	Statistics (rare)		
Stev Co	Stevedore Company	R	TC
Sup Co	Supply Company (much used Reg. form: Sp Co)		
Sup Div	Supply Division	D	SC
Sup O	Supply Officer		
Sup & Shop	(see engrs)		
Surg	Surgeon	O	
Sur & Prin	(see engrs)		
SWO	Section work order	D	Ord
S & D	Sales & disbursing	D	SC
	T		
T	Arrondissement of Tours (rare)		
TA	Tractor artillery	D	Ord, art
TC	Transportation Corps (reg. abbrev. now Trans Corps).		Indep
Tank C	Tank Corps	R	Indep
TC	Training Centers		
	Tank Corps		
TC, DL & BU	Training Camp, Delousing & Bathing Unit	D	QMC
TC & O Div	Telegraph, Cable & Order Division	D	TC
TD	Temporary duty	O	
Tel Bn	Telegraph battalion, Signal Corps	R	
Teleg Bn. Sig C		D	
T Bn, Sig		R	
TH & MP	Train Headquarters & Military Police		
TI	Technical Information Section	D	SC
TM	Town major	O	
	Trench Mortar	D	Ord
TMB	Troop Movement Bureau	D	G-4
TM Btry	Trench Mortar Battery	R	
TNT	Trinitrotoluol	D	Ord
Tr	Troop	O	
TS	Transportation Service (obs) (changed to Transportation Corps—TC).	O	
TW repair shop	Typewriter Repair Shop	D	QMC
T & C Br	Telegraph and Cable Branch	D	QMC
T & C Div	Telegraph and Cable Division	D	ATS
T & S	(see engrs)		
T & T Dept	Telegraph & Telephone Dept	D	TC
T & T Div	Telegraph & Telephone Division	D	SC
	U		
USA	United States of America		
	United States Army	O	
USAAS	United States Army Ambulance Service	D	MD
USACT	United States Army Commercial Transport	D	ATS
USG	United States Guards ("Home Guards")		PMGD
USL	United States Liquidation Commission	D	Indep
USMC	United States Marine Corps	R	
USN	United States Navy	O	
USR	United States Reserves	O	
	V		
VB	Visitors Bureau		
VB	"Viven Bessieres" Grenades	D	Ord

Abbreviation.	Designation in full.	Class of abbreviation.	Arm of service.
VC	Veterinary Corps	O	Indep
Vet Hosp	Veterinary Hospital	R	VC
VH	Veterinary Hospital (usual form)	D	VC
VO	Verbal Order		
VOCC	Verbal Orders Company Commander	O	
VORC	Verbal Orders Regimental Commander	O	
VRC	Veterinary Reserve Corps	O	VC
VS	Veterinary Service	O	
	W		
WAAC	Women's Auxiliary Army Corps (British)	D	
Wag	Wagoner	O	
Wag Co	Wagon Company	R	QMC
WD	War Department	O	
Well Dr Det	Well Drilling Detachment	R	ASC
WO	Word Order	D	Ord
WRB	War Risk Bureau (informal)	D	ASC
WRI	War Risk Insurance (informal)		
WRS	War Risk Section	O	ASC
W So Serv	(see Engrs)		
WT TN (MTC)	Water Tank Train (Motor Transport Corps)	R	
	Y		
YMCA	Young Men's Christian Association	O	
YWCA	Young Women's Christian Association	O	
YMHA	Young Men's Hebrew Association		
	Z		
Z of A	Zone of the Advance (obs)	O	