The Royal Engineers Journal.

VOL. LVI. **SEPTEMBER, 1942.**

CHATHAM:
THE INSTITUTION OF ROYAL ENGINEERS.
TELEPHONE: CHATHAM 2669.
AGENTS AND PRINTERS: W. & J. MACKAY AND CO., LTD.

LONDON:
HUGH REES, LTD., 47, PALL MALL, S.W.1.

All Correspondence connected with Advertisements should be addressed
C. ROWLEY, LTD., ADVERTISEMENT CONTROLLERS, R.E. JOURNAL,
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THE ROYAL ENGINEERS AND THE ROYAL TANK CORPS DURING THE WAR OF 1914-1918.

(An Extract from Corps History, compiled in 1938 *from the work of various authors.)*

FROM the earliest times soldiers have endeavoured to build vehicles in which they could advance against the enemy behind armour protection and from which they would be able to throw missiles at their opponents. There are a few instances of the successful use of early types of fighting vehicles but it was usually found impossible, with the feeble muscular power of man or horse, to carry sufficient armour protection to withstand the missiles of the day. With the arrival of the internal combustion engine armoured cars were suggested, but the poor cross-country capacity of the wheeled vehicle of that time limited their use to special conditions and circumstances. It was not until the two inventions of the internal combustion engine and the endless track were combined, that the construction of proper fighting vehicles became possible which could carry sufficient armour to withstand the missiles of the normal weapons with which the infantry were armed.

Track vehicles propelled by internal combustion engines made their appearance some years before the war. A proposal was made by Mr. de Mole in 1912 that such vehicles should be armoured and used as fighting vehicles. No nation, however, was sufficiently progressive to develop this idea.

There are few inventions which have not been sought by many minds simultaneously. Sometimes the inspiring flash has come to only one individual, but much more often several people have been independently groping towards the right solution, and previous inventions of another type have pointed the way to the answer to the new question. The final product has been the result of several independent experiments, each giving some portion of the solution.

So it was with the Tank. But Lieut.-Colonel (now Major-General Sir E.) Swinton, R.E., was the first to put forward the practical conception of an armed fighting vehicle protected by armour and propelled on caterpillar tracks. He specified exactly what the machine should be like and what it should do. After the war, a judicial commission was appointed to adjudicate upon the rewards due to inventors who had supplied the nation with valuable new devices for winning the war. This Commission had, therefore, the duty to reward the inventor or inventors of the Tank. They decided that the answer was in the plural, and they distributed the reward among a fairly small band of men, among whom we are glad to note in this history Major-General Sir Ernest Swinton (late R.E.). The Commission considered that Swinton was mainly responsible for the initiation of the use of Tanks in war.

Space being limited, the other inventors and the many able men who developed the use and application of the Tank to war, and fought this new arm to such great victory, will not quarrel with us if we now confine ourselves in this history of our Corps to the work of Royal Engineers in this achievement.

Towards the end of 1914, Lieut.-Colonel E. D. Swinton was at General Headquarters in France as "Eyewitness," providing the Public with information. He was impressed with the great waste of man power in trying to overcome the defence of the machine gun and barbed wire, and he turned his mind to finding some mechanical device to overcome the strength of this defence. He had not heard of Mr. de Mole's suggestion of 1912 to use track vehicles for this purpose, but he had heard of caterpillar tractors, and he conceived the idea that they could be armoured and adapted to carry forward machine guns to overcome the power of the defence. In October, 1914, Lieut.-Colonel Swinton brought the idea

to the notice of the Committee of Imperial Defence, on the Staff of which he had worked before the war. Eight months later he persuaded G.H.Q. France to submit the proposal officially. In the meantime, in January, 1915, through the channel of the C.I.D. the idea came to the notice of Mr. Winston Churchill, the First Lord of the Admiralty, who, with his usual quick intuition, seized upon the idea and brought all his great driving power to bear to enlist the services of able men, notably Sir Eustace Tennyson D'Eyncourt, Commander Wilson and Mr. Tritton, to design and produce practical results. With these gentlemen were associated Colonel W. C. Dumble, R.E. and the indefatigable Colonel Crompton, R.E. (T.A.), always noted for appearing at the right place at the right time. There were, of course, many others concerned with the development of the Tank, and other proposals and committees were formed later, for which the reader must go to other sources of information.

In July, 1915, Colonel Swinton returned to England as an assistant secretary of the C.I.D. and at once took in hand the co-ordination of the efforts which were being made in relation to the design of fighting vehicles on caterpillar tractors. Finally, on 2nd February, 1916, a machine became available for inspection as a fighting vehicle constructed on Colonel Swinton's specification. The trials took place at Hatfield and as a result of these trials it was decided to form a small unit of the Machine Gun Corps, to be called the "Heavy Section," and Lieut.-Colonel Swinton was appointed to command it, with his headquarters in London. He established a training camp at Elvedon, near Thetford, and two R.E. officers—Major Tandy and Captain Martel—were lent to him for a month to prepare a modern battlefield on the ground over which the machines could practise.

These new fighting vehicles, at first called land cruisers, were rechristened "Tanks" by Colonel Swinton, a name which has continued ever since, though its origin was due to the necessity for secrecy and, therefore, the pretence that they were vehicles for use on water supply.

Lieut.-Colonel Swinton had the usual difficulty encountered by any new branch that tries to insert itself into a Government office, but in spite of this he collected a band of very keen officers and men whom he inspired with enthusiasm. He particularly impressed the importance of secrecy on all ranks and it was largely due to his influence and leadership that secrecy was maintained until the Tanks were employed. The Army in general and the Tank Corps in particular owe much to the great work carried out by Lieut.-Colonel Swinton in those early days.

This "embryo" of a new arm in warfare was officially named "The Heavy Section of the Machine Gun Corps."

In August, 1916, the first units of the Heavy Section, M.G.C., began to move to France. At the end of September the Commander-in-Chief in that theatre of war appointed Lieut.-Colonel H. J. Elles, R.E., to command these units. They now became known as the "Heavy Branch," M.G.C., and it was arranged that Lieut.-Colonel Swinton should remain at home to guide design and development and raise new units. Later, however, Lieut.-Colonel Swinton was replaced, and his valuable experience was lost; this was a sad blow to the "Heavy Branch" and to Lieut.-Colonel Swinton himself. The Army lost much from this change of leadership at home in an important new branch of warfare that was destined to play such a great part in war.

In May, 1917, the "Heavy Branch" became the "Tank Corps" in France, with Brigadier-General H. J. Elles in command, and in April, 1918, the same officer had become G.O.C. Tank Corps.

There was much controversy (continued since the war) as to whether the first detachment of these new weapons should be thrown into battle for experiment and thus disclosed to the enemy or whether they should wait until a strong force could effect a great tactical, even strategical, surprise. Colonel Swinton strongly urged the latter view.

It was on 15th September, 1916, that a small unit of "Tanks" first went into

battle, but on this occasion and in subsequent operations for fourteen months the Tanks were used after the point of attack had been disclosed by the artillery preparation for the battle. The Tank Corps had continually pressed G.H.Q. for permission to use the Tanks in the way for which they had been originally proposed, *i.e.*, for a surprise attack and not as an additional assistance after a long preliminary bombardment. This point had been stressed in a remarkable memorandum on the role and employment of Tanks written by Colonel Swinton, dated February, 1916. The great Tank break-through of August 8th, 1918, was almost exactly in accordance with the forecast of their role in this memorandum.

In November, 1917, the Tank Corps was at last given an opportunity to attack without preliminary artillery bombardment and preparations were made at very short notice for the Battle of Cambrai. In this battle General Elles advanced in the leading Tank and led the Tank Corps to their great victory, which once for all settled the controversy as to the value of Tanks and established them as a new arm in war.

At a very early stage it became clear that the repair side of the Tank Corps in France would be a matter of primary importance. Repairs in the field are normally the duty of the Ordnance Services, for which they employ ordnance mechanical engineers, but the Ordnance Corps started the war with a totally inadequate strength and organization of mechanical engineers to compete with the work. From the earliest days it was manifest that the R.A.S.C. must take over from the R.A.O.C. the responsibility for maintenance of mechanical transport. On the arrival of Tanks in France it was, therefore, decided not to overload the R.A.O.C. with additional responsibilities, but to form a body of engineers within the Tank Corps for this work. The decision was a wise one. These engineer officers belonged to the Tank Corps and wore the Tank Corps badge, though they remained on a special list as Tank Engineers. Several engineers who had received temporary commissions as Royal Engineers were transferred to the Tank Corps for this purpose. The head of the Tank Engineers was Colonel F. Searle, who had been well known in civil life before the war as a mechanical engineer. He founded a system of maintenance and repair by spare parts which undoubtedly contributed very largely to the mechanical success of the Corps, and this system has been largely followed ever since by all mechanized units.

In addition to repair work, these Tank engineers formed salvage units, which were later called field companies, for the salvage of damaged Tanks on the battlefield. The work was a most hazardous undertaking, in which Captain Hon. R. T. R. P. Butler, D.S.O., M.C., distinguished himself. This officer originally held a temporary commission, R.E.

Many Royal Engineer officers in France were anxious to join the Tank Corps but few could be spared. Lieut.-Colonel R. C. R. Hill, however, commanded a Tank battalion, and Lieut.-Colonel L. C. A. de B. Doucet, R.E., commanded the Tank supply units, which consisted of the older pattern Tanks fitted up as supply Tanks and which could pass over the shell-torn ground and refill the fighting Tanks in the field. Captain G. le Q. Martel, R.E., was G.S.O.2 at Tank Corps Headquarters in France. Another officer, Captain S. H. Foot, R.E. (S.R.), joined as an engineer officer and a little later he became a brigade major to a Tank Brigade, and in 1918 he went to the War Office on the Staff of Major-General Sir John Capper, where he made some very valuable proposals for future policy in mechanization.

We have already seen that a body of mechanical engineers was needed on the repair side for Tanks, and it soon became clear that assistance from engineers was also needed on the tactical side. For instance, although the Tanks had considerable obstacle-crossing capacity, there were many common and natural obstacles that would hold them up, and demands were made for assistance in crossing these obstacles, and this assistance was required in the forefront of the battle. It soon became clear that Royal Engineer units would eventually be

required to carry out much of this work and would have to make use of mechanical power to assist them in the work.

Special Royal Engineer units were not, however, formed until 1918 for such purposes, but in the meantime some interesting work of this nature was carried out—partly by the Tank Corps itself—and partly by Royal Engineer officers who were detailed to assist in this work. It will be remembered that the commander of the Tank Corps and some of his staff were Royal Engineer officers, so that no difficulty was experienced in directing this work even though the Royal Engineer units were not formed until 1918.

The first apparatus that had to be devised was a type of bridge which would enable medium tanks to follow heavy tanks across very wide trenches which were beyond the spanning capacity of the medium tanks. To meet this demand, a bridge was designed in the form of a sledge. This consisted essentially of two steel joists as main girders which were cross braced together, and light timber decking was used. The bridge was 20 feet long and could be towed quite easily by a heavy tank; the tank would cross the wide trench and the bridge followed across without difficulty. When the bridge was spanning right across the trench, the towing attachment could be released from inside the Tank, leaving the bridge across the trench. A number of these bridges was made and would have been laid by the Tank Corps themselves during an advance, but by the time we had a number of medium tanks in France, the conditions of warfare had changed, and the bridges were therefore little used.

Another bridging device that was developed was to provide a means for assisting the passage of infantry, who were co-operating with tanks, across obstacles. The solution was found by carrying a light bridge in the form of a trench board on the tail of the tank. While advancing to the attack the tanks would carry these bridges like horns on their tails, and if they crossed a trench filled with barbed wire, the bridge would be lowered and released over the trench so as to provide a crossing place for the infantry. The work of lowering the bridge into position was, of course, done quite simply from inside the Tank.

At about this time it became clear that the Tank Corps would need a great deal of assistance from the Royal Engineers and that special mechanized Royal Engineer units would eventually be required. As a first step Major C. E. Inglis, Royal Engineers (Professor of Engineering at Cambridge), so well known to the Corps, who was at that time engaged at home on the design of bridges, was instructed to co-operate with the Tank Corps on all this work. Major Inglis visited headquarters Tank Corps in France; it was explained to him that special mechanized Royal Engineer units would probably be formed, and certain requirements were discussed with him. First of all as regards main bridges, it was clear that Tanks would be built in increasing numbers and their weight and size were such that special bridges were required. This was a question affecting the whole Army, and Major Inglis was charged with the responsibility of producing designs of both girder and floating bridges to meet these requirements. As regards the special needs of the Tank Corps, one of the first demands was for a form of bridge to enable Tanks to cross short gaps under fire. The country in France was intersected with small streams and canals; such obstacles could often be crossed by the use of quite short bridges about 30 feet in length. It was, however, decided to start on experimental work for a 21-ft. bridge which would enable Tanks to cross canals at the locks. The idea was that the bridge would be carried by a special Tank and lowered over the gap when required, the work of lowering being controlled from inside the Tank, so that no one would be exposed to enemy fire.

Another request from the Tank Corps was that some thought should be given to the possibility of pushing a bridge mounted on idle tracks, the idea being that the bridge would be launched by a Tank from the rear and so enable gaps up to perhaps 60 feet to be spanned under fire.

In 1918 it was decided that three special Royal Engineer battalions should

be formed to carry out this work in the field. These were the first fully mechanized Royal Engineer units. They were formed at Christchurch, Hants., in October, 1918.

Each of these battalions was to have been equipped with twelve heavy Inglis tubular bridges to take the heaviest Tanks and also forty-eight special bridging Tanks, each carrying a 21-ft. bridge for use on short spans such as canal locks. In addition, it was intended that these Royal Engineer units should carry out other special work of an engineering nature rendered necessary by the introduction of mechanization.

They were hardly established when the Armistice occurred, and two of the three battalions were then disbanded. The third battalion was to be maintained to continue the experimental trials which had been begun. This battalion was commanded by Lieut.-Colonel G. Le Q. Martel, R.E., who had initiated this work in France, while serving as G.S.O.2 at headquarters of the Tank Corps. Shortly after the Armistice, however, this battalion was reduced in size and was called "The Experimental Bridging Company," with Lieut.-Colonel Martel still in charge.

In the meantime, Major Inglis had produced some excellent experimental equipment. The tubular bridge carried the 35-ton Tanks over a span of 105 feet and could be erected very quickly. The special bridging Tanks carrying the short span bridges also materialized. In addition, special large pontoons were provided for use in conjunction with the tubular work for bridging wider rivers.

Before leaving the war period mention must be made of the valuable work carried out for the Tank Corps by Major-General Sir John Capper. In May, 1917, General Capper was appointed Director-General of the Tank Corps with his headquarters in London. The Tank Committee was formed under his chairmanship to systematize and strengthen co-operation between the Army and the Ministry of Munitions. The Director-General was responsible for all training at home, which was carried out mainly at Bovington under a brigadier-general.

The Director-General constantly came over to France in an advisory capacity and this established a close and valuable liaison between the Tank Corps in the field and the administrative problems at home. He also visited G.H.Q. and the armies in the field, to press on them the importance of Tanks.

Under the direction of the Director-General, a close liaison was established between the section of the Ministry of Munitions dealing with Tanks and the headquarters Tank Corps in France, and the Director-General did much to guide design on the right lines. He was responsible for putting proposals for numbers and types of Tanks required before the War Cabinet. The Director-General was not, however, on the War Office staff and this made his position much more difficult. In spite of this he had steered the Tank Corps through a difficult time, but in August, 1918, a change was made in the organization and Colonel J. F. C. Fuller came home to be in charge of a branch dealing with Tanks under the Director of Staff Duties at the War Office, and the appointment of Director-General was abolished.

*MILITARY BRIDGES AND BRIDGING.**

By CAPTAIN C. E. MULLINS, Corps of Engineers.

(Reprinted from *The Military Engineer* (*Washington*) of July-August, 1941.)

THE military strategist, in general, visualizes the theatre of war in terms of terrain compartments, formed by the mountains and valleys, in which are located lines of communication, industrial areas and hostile forces. Unfordable streams are to him possible defensive lines, obstacles to cover his flanks or means of communication. Seldom does he realize that these unfordable streams form the most serious compartments possible for the modern mechanized army. He has not realized that these streams form a barrier equally as effective as a barrier of fortifications and fire. He has not realized the importance of planning his attack to crack these lines in the same careful, painstaking manner that the strategist would conventionally plan for cracking a defended area. He has not realized that unless means are provided for leading from one compartment into the other, the beautifully conceived mechanized and motorized forces that we now have available in our Army lose the value of their great mobility and great speed.

Consequently, it is the function and the duties of the Engineers, as a part of the technical staff, to devise means to exploit the mobility of these units to the absolute maximum. Without these means, and once through a barrier, no modern motorized or armoured force can move very far or very fast before coming to a terrain boundary formed by an unfordable stream, particularly if we assume that all bridges and means of communication over or under these obstacles are destroyed or non-existent. In general, the distance which a force can move before coming to an obstacle will depend on the location of the theatre of operations, but we can state, without fear of much contradiction, that the average motorized forces will come to a barrier within approximately every two hours of travelling time. Against an alert enemy it is safe to predict that the previous crossing means will not only be destroyed, but will be covered by fire.

Suppose that we come to a river requiring a 250-foot pontoon bridge, or a stream or other obstacle requiring a 75- or 100-foot trestle bridge; how many hours will it be before the vehicles will have re-formed in column and will be passing over the new bridge? To make matters still more favourable, assume that a bridgehead was established without delay, removing the hostile small arms fire. I believe that under the best of conditions, it would be at least 6 hours after the advanced guard stopped before traffic would be resumed.

NEED FOR FLYING BRIDGE COLUMNS.

What then are the needs for exploiting to the absolute maximum the tremendous mobility and fire power in our new formations? Of course, the vehicle which would allow the maximum exploitation would be a vehicle which would negotiate any terrain or cross any stream under its own power. This is more theoretical than practical. This vehicle, of course, is an amphibian, and one which will, in all probability, receive more attention for specialized operations in the future. Since the Army cannot be equipped in its entirety with amphibious fighting cargo- and personnel-carrying vehicles, the next best thing is the creation of flying bridge columns. This is important because we must realize that a period of 3 to 4 hours'

* Paper presented before the Annual Meeting of The Society of American Military Engineers, May 12th, 1941.

grace afforded an enemy in which to collect his wits and muster his reserves could be fatal to a successful follow-through or exploitation or an initial break.

Today terrain plays a much more important part than terrain in the past, particularly against an alert enemy who is going to utilize the unfordable streams to the best advantage. Unless we, Engineers, can crack these lines in depth, the total speed of our advance is going to be so seriously delayed that we will increase the enemy's reaction time, and, consequently, lose the initiative and the advantage of the initial surprise. Once our own forces begin to roll, it is the duty of the Engineers to keep them rolling.

Now, as always, the first two enemies of the Engineers are time and tide. These we must be prepared to conquer. To defeat them we must organize our own mobile forces of equipment and men. We must impress the staffs with the necessity of complete co-ordination and co-operation, and must make them realize that along the axis of the main thrust or thrusts, the Engineers cannot resort to improvisations. Enough information must be acquired beforehand, by our intelligence or aerial reconnaissance, to give the Engineers an opportunity to assemble and place in mobile parks sufficient bridging materials of a portable, prefabricated design to cross any obstacle along the lines of the attack. More so than in the past, this preparation must provide for actual Engineering rehearsals of all phases of the attack, penetration, and exploitation.

To do our jobs, we must be in a state of tactical and technical readiness. That means we must have within the Engineers sufficient quantities of mobile bridging equipment capable of crossing at any given site in any given time any vehicle whose services are required to sustain the attack on the other side. In the first few minutes, these vehicles will probably be ammunition carriers, prime movers for anti-tank guns, weapon carriers, command cars, reconnaissance cars or scout cars, ambulances or any number of the light vehicles of the present Infantry divisions. An hour or more later, the need for heavier prime movers for displacing artillery, supporting tanks or other and heavier vehicles must be met. To meet the needs of our forces at the water-line, many officers consider the means capable of progressive solution; that is, by the construction of bridges that will carry any traffic at the hour of its probable need.

As for the matter of tactical preparedness, this is a matter of Engineer training and organization. More field experience will determine this organization. Manœuvres will develop the technique and the training required to do our tasks. There is one thing I wish particularly to emphasize, and that is: the state of proficiency of an Engineer outfit should be determined by its ability to build bridges. The ability to build bridges is a function of the training of the men and the command experience of the company officers. Remember the last, every company officer in the Corps of Engineers must be thoroughly grounded in the technique of bridge building, and must be made absolutely bridge-conscious. The sooner the better! The sooner the young brains of the Army realize the significance of this problem, the sooner will come the technical solution to our problems. The tactical solution will come with training and an awareness of imminent danger.

The tremendous performance demanded of bridge construction troops in modern warfare is evidenced by the fact that one of the German armies participating in the drive on the Western Front in 1940 built 57 pontoon bridges and 183 emergency bridges, 75 to 1,200 feet long, in a period of 8 to 10 weeks. Each of these bridges had a capacity of from 16 to 24 tons. The import of these figures is staggering. Bridges of this size cannot be improvised if a *Blitzkrieg tempo* is to be maintained.

Standard Floating Bridge Equipment.

At the present time, here is a list of standard floating bridge equipment in the American Army.

1. Footbridge.
2. 10-ton Pontoon bridge.
3. 25-ton Pontoon bridge.

The footbridge is a good one, but it is of relatively minor significance in modern warfare. The 10-ton pontoon bridge has the most favourable capacity weight per foot ratio of any military bridge in existence. The standard bridge will just carry the 13-ton light tank under favourable conditions. Reinforced, the 10-ton bridge will just carry the old medium tank which weighs 23 tons. Last summer, the medium tank was to be raised in weight to 25 tons. It is now approximately 28 tons. To carry this tank the capacity of the bridge had to be increased. Consequently, the Board designed what it considered the largest practical bridge patterned after the 10-ton type. This new bridge was designated the 25-ton bridge, but its capacity has not yet been definitely determined. The first unit of this bridge was recently erected on dry land to determine the strength of the boat gunwales and sides, the trestle spans, and the fittings. A 44-ton tank of World War I vintage was put over the standard bridge without damaging any of the

Rubber Pontoons and Treads

parts. The bridge, reinforced, will carry this load in water, and the normal bridge will carry the new medium tank—weight, 28 tons.

The equipment we now have is good, and is adapted fairly well to our present needs, but there is considerable feeling among many officers that we need a light bridge for close support of the Infantry. This bridge may be built from half-boats and treads, or from rubber pontoons and treads, or by rubber pontoons utilizing standard baulk and chess. The latter bridge is preferable for its capacity and its general serviceability, but for economy, duplication of use, speed of erection, and ease of transportation the 5-ton half-boat tread bridge is better. The varying wheel treads and the consequent necessity for walking a chalk-line add their complications, but the tread bridge to my mind is quite as satisfactory as a fully decked bridge and this bridge can be thrown with amazing rapidity. With trained troops it can be constructed from its transportation at a rate exceeding 100 feet in fifteen minutes.

As a satisfactory light bridge, I favour a bridge constructed from half-boats and light trusses which permits an assembly similar to that for the half-boat tread bridge; after the assembly the chesses may be laid, giving a fully-decked bridge. Experiments with this type of bridge at Fort Belvoir have been particularly gratifiying; it conforms with the general principal of the type of bridge which we are seeking; namely, a bridge with a better balance between superstructure and flotation than has any bridge now in use. I feel that this bridge can

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be constructed at the rate of approximately 100 feet in 20-25 minutes and when completed, will carry the light tank, and when reinforced, perhaps the 20-ton truck. The present 10-ton bridge has excellent flotation, but it has a superstructure of such narrow depth that there is not sufficent rigidity in the baulk to transmit the loads out far enough to bring more than the next adjacent pontoon into play. This we propose to defeat by use of a relatively deep box girder truss which will serve two purposes: First, it will permit sufficient span from the abutment to the first gunwale to eliminate the use of a trestle; secondly, it will be stiff enough and strong enough to transmit the load over more boats and consequently, increase the flotative capacity of the bridge. To date, the Engineer Board has emphasized the necessity of keeping all parts light enough to be handled by manpower alone. Future experience and load requirements may force upon us the creation of special bridge-building machinery; I have no doubt that the solution can be found. I visualize the floating bridge of the future as consisting of a series of built-up barges, the components of which can be manhandled into the water and quickly assembled, and are spanned by prefabricated trusses of sufficient length and strength to eliminate trestles in most cases.

Pontoon Bridge Constructed of Half-Boats and Light Trusses

Fixed Bridges.

Of the two types of bridges, fixed and floating, I feel that the ratio of 57 pontoon bridges to 183 fixed is a good average figure. Therefore, if this is true, it would seem that the greatest needs of the present are well-designed fixed bridges of the portable-trestle or fixed-span type.

Military fixed bridges at present are of two types—prefabricated steel bridges and timber bridges constructed on the site. Recently, however, we have been adapting our pontoon trestle bridges for crossing dry obstacles. We now have two standard prefabricated steel bridges—light and heavy. The light bridge will carry the H-10 loading, or the light tank, over a 72-foot clear span. The heavy bridge will carry the H-20 loading, or a medium tank, over a 125-foot span. Both of these bridges consist of two steel box-type girders with a wood floor and curb rail. The girders of the H-10 bridges are prefabricated sections 12 feet long. The H-20 sections are 12 feet 6 inches. Only two sections of each can be loaded into a 1½-ton dump truck. These bridges are fairly satisfactory, but their limited span and transportation requirements leave much to be desired.

The Board now has under development three bridges of larger capacity: One similar to the present standard steel bridge which will carry H-25 loading over a 150-foot span; another bridge of similar type which will carry a 50-ton tank over a 150-foot span; and a third bridge which will be of knock-down rather than a sectional type and will carry H-30 loading over a 200-foot span. The knock-down type has an advantage over the sectional type in amount of transportation required, but the advantage is gained at a sacrifice in speed of erection. Three

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problems, therefore, must be solved simultaneously, before a satisfactory solution will be reached; namely, capacity, transportation, and speed of erection. This problem is now under consideration and it is felt that it can be solved.

CABLEWAY AND SUSPENSION BRIDGES.

The Board is also studying portable cableway and suspension bridges. Bridges of this type are not adapted to all situations and all sites, but they do have inherent advantages not possessed by bridges of other types. Length of span is very flexible, being dependent, with given equipment, only upon the height of the towers. A suspension bridge can be used, of course, only where conditions are favourable for the placement of anchors.

EXPEDIENCY.

No amount of design, procurement, or availability of prefabricated bridge is going to take the judgment, initiative, skill, or need for training out of the American Engineers. On the contrary, the more advanced the design, the greater will be the necessity for thorough and painstaking training. Not even the wealth of America will provide a prefabricated bridge for every obstacle to be bridged by the American Engineer in the next war. In short, all the technical developments in the world will never obviate the necessity for improvisations and emergency crossings constructed from materials available. Here the Engineer must be ready and worthy of his great traditions.

The importance of emergency bridges cannot be over-stressed. Pontoon equippage particularly is limited in quantity and must be replaced as soon as practicable for re-use in forward areas. In describing German operations one of our intelligence reviews states:

> "The large number of emergency bridges which were built shows the importance of this type of construction in modern warfare, and also emphasizes the need for numerous well-equipped mobile bridge construction troops. The accomplishment of the task in so short a time was made possible by good organization in the procurement, preparation, and transportation of construction material, as well as ingenuity in procuring such material, quick judgment as to its possible usefulness, rapid evaluation of construction possibilities, and a correct estimate of the repair possibilities of destroyed bridges. In addition, good equipment and efficient machinery, such as power-driven circular saws, heavy rams, cranes, smiths, etcetera, were required since, for the transportation of supplies, it was necessary to build heavy bridges of at least 16-tons capacity. The destroyed bridges which were met in the west were of the most varied types, ranging from the flat-arched stone bridge of the Rococo period and ancient suspension bridges, to the most modern concrete and steel bridge types. The correct and rapid estimation of the repair possibilities of these bridges required wide technical knowledge, and, above all, experience. Thus it appears that in the type of war that is waged to-day, there is not only a need for fighting pioneers, but also bridge-building and construction troops whose responsibilities in comparison with former times have vastly increased."

As stated earlier, I believe that our Engineer officers must be made to appreciate the demands of modern warfare on bridge building proficiency. We must learn by actually doing the work. Simulation in bridge construction must be eliminated from manœuvres. From the experience gained under realistic conditions will come the organization, and equipment to keep our Army rolling.

SELECTION TESTING OF RECRUITS, OR FROM COUPON TO QUARTERMASTER.

By Major P. Hunter Gordon, M.C., R.E.

At this stage of writing this article I have hardly got beyond wondering what percentage of those who glance at the title have had the interest, courage, endurance, call it what you will, to get any further. To those who have, I want to explain what the article is about and why it is of such importance especially to-day. Simply, it is as follows. Every man has his own soul and body, his own mental and physical characteristics. Selection testing is the name given to any method employed to tabulate in a short time those special characteristics and to use the tabulation to find out for what job in the Army the man is best suited. Wait! those who say this only concerns recruits, wait! just a moment. This selection testing can be and is also employed on soldiers already in the Army to see if they are best placed where they are. Just recently in one division a new Battalion was formed and it was supposedly from the pick of all other units in the division. It did not function, it was a bad unit and its Commanding Officer employed modern selection methods to find out why—and he found the answer; he had been given, not the pick of the division but the dregs. Now you may say that it would have been obvious; yes, it might have been obvious, but only selection testing could have reduced it to figures to substantiate any case the Battalion Commander put up for returning the duds to where they belonged.

Selection testing has always been applied to a greater or lesser degree. Height standards, medical standards, and of course, voluntary enlistment, in which a man can pick his arm, all these are included in selection testing. But the necessity of making the best use of our very limited manpower has made it necessary to improve our methods. When 60,000 men are called in one month from civilian life and have to be sorted and graded into the three Services and inside these Services into the various arms, all in a short space of time, it can be seen that efficient selection testing is of supreme importance. These men, who in most cases have had no preliminary training, have to be placed quickly where their previous knowledge and trade can best interest them and benefit the Service and it is not surprising that mistakes have occurred and will occur again. In my opinion it is those mistakes that produce 50% of the crime in an Army. When a man is discontented with his job, and shows it in civilian life, he gets the sack or takes it, and gets a job that suits him better. In the Army he gets 7 days' C.B. and is back to the same job till the next time, and his Company Commander says "I can't understand that fellow." There is somewhere a round hole for every round peg and selection testing helps to find it. The more efficient our selection methods are, the better our Army will be. I hope this first paragraph has aroused the reader's interest and before I explain the system I want to produce a brief summary of what other countries have done or are doing.

First take Germany. It can be seen what importance she places in this, from the fact that 95% of Germany's manpower undergoes constant selection testing and preliminary training until old enough to join the Armed Forces.

The selection of suitable manpower for the various Arms of the German Army starts in the case of a large percentage of the population at the age of nine. Remember in Germany peace is regarded by the National Socialist Party and by the Army Staff as an interlude of preparation between one war and the next. Their policy therefore is military training for every individual from the age of nine until he is of no further use. As I have already hinted, the voluntary system

is almost the perfect type of selection system. Every man gets into what he thinks most fits him and he has the added moral uplift of being a volunteer, so in Germany also those who voluntarily prepare themselves for, or show interest in, any particular branch of the Service normally get into it.

The Hitler Youth, which is a compulsory movement, starts at the age of nine and is continued in Nazi Organizations which bring out all sides of military life, such is the N.S.K.K. which was particularly developed to give training for the operation of Mechanical Transport, tanks, power plants, etc., because the number of men experienced in M.T. in civil life was very small. The Hitler Youth, however, contained sections for preliminary training in Flying, Signals, M.T., Pioneers (our R.E.), etc. The result of this was a terrific struggle to get into the technical corps and over years the testing went on until the actual call-up age arrived, when the best were drafted into those arms they had already trained themselves for, and the rest, those who had made little voluntary effort or who had failed to get good certificates, were drafted into infantry or horsed field artillery.

The preliminary ten years' period of selection is followed up after they are called into the Army proper. Within the technical corps training starts afresh and recruit training is followed by courses, etc., and as the result of this training men are allotted to special tasks, for each corps has within it a considerable number of special jobs, some more technical than others, some requiring primarily character and others requiring chiefly technique. Men can be selected inside their corps for the special sides for which they show most aptitude. Remember that the Germans prefer in their Army the Master of one Trade system to the Jack of all Trades, which we have adopted, particularly in our Engineers.

Here is a picture of German efficiency which takes, let me repeat, ten years of training and testing in semi-military organizations, to allot a man to his corps and then his training purely became a selection for what part of that corps he is most suitable and making him fanatically efficient in it. It is safer to realize that there are no civilians in Germany, and this is borne out by the ease with which two millions of the Army can be put into the Factories for Castra Hiberna to turn out their machines of war in readiness for the opening of the season again.

Germany gives, therefore, not a very useful picture to help us with our problem. France also does not help. She has had ever since the last war compulsory training of all the able-bodied of the men. I am not completely *au fait* with her system of selection but her problem is different. Her armies are raised on a regional basis, they are trained during their period of compulsory training on a regional basis. In 1929 the period of compulsory training was reduced from three years to twelve months but even twelve months is sufficient to select and place efficiently an age group called up annually to regional depots from a country, the bulk of whose people are engaged in agriculture and the bulk of whose army were *horse drawn infantry* and artillery. It may be that when a recruit joined he is told a funny joke and according to his reactions he is selected and placed in the Army, for there is an old French Infantry saying about this. When a joke is told the sapper laughs three times; once when he is told, again when it is explained and for the third time when he understands it. A gunner laughs twice: when he hears it and again when it is explained—he never understands it; a Staff Officer laughs only once when he hears it, no one ever dares to explain it to him and so he never understands it; the Doctor never laughs because he has always heard it before. Perhaps that story has nothing to do with this article but I don't think the French system helps us much and I like to remember friends in the French Army with a laugh.

Poland again is not of much help to us because of her peace conscription which allowed time for selection and again because her manpower situation was not so serious nor her Army so mechanized. But I have a little knowledge of the subject. A Polish citizen registers when he is 17 and again when he is 20 for Military

Service, which he may be called upon to perform between the ages of 21 and 23. From their medical interview they were graded into the following categories:

1. Fit for primary service.
2. Temporarily unfit for military service.
3. Fit for service in event of national mobilization.
4. Fit for auxiliary services.
5. Completely unfit for military Service.

Military Service was compulsory for those in category (1) with their age group or as volunteers between the ages of 17 and 20. It lasted, according to the arm of the service, for about two years. After this, these were transferred to the reserve and liable to be called up for service until the age of 50 for Officers and 40 for other ranks. During this period on the reserve they had to carry out five months' training and about six–ten months, depending on rank or commission, on manœuvres. This was done in principle for six weeks in every year. This military service, less a certain amount of the manœuvres, was also compulsory for categories (2) and (3) and category (4) had to do training as guards and anti-aircraft personnel, medical and transport services, offices, etc.

Thus in the Polish Army two years were spent in the initial training and during these two years it was possible to correct any mistakes made by the original selection committee; but in Poland this selection committee was run by the Services and not by the Ministry of Labour, and the Services had the call of all the nation of a certain age and not only what was released by the Ministry of Labour. Here also there was not the great fight between services. A central committee knew what was wanted and the selection committee allotted those most suitable. Here again, as in all countries, the volunteer was given choice of arm and preference of service. The selection committee, which endeavoured to place the recruit initially, was composed as follows. There was in charge an Officer of the General Staff, there was a service and a civil doctor and a representative from the civil authorities. At the same time as a man's medical category was decided on ,so also it was decided for which arm he was most suitable. In this, physical qualifications played the greater part, but naturally if a man had special qualifications these were picked out. However it was done by personal interview and it is reasonable to presume that all territorial associations, trade qualifications or interests would therefore be taken into consideration and then, if a mistake were made and a man were a misfit, in his two years' training he had all opportunities of transferring to a more suitable arm.

So far we have only considered nations that prepared in peace time for national mobilization, nations who were not blessed with a moat to give them precious months to prepare hurriedly and, therefore, necessarily without maximum efficiency. But there is a nation which has started or had started in peace time perhaps with six months or more to plan for the very same thing. In 1941, was it? America called up one million men, as far as the uninitiated can gather, called them up by the luck of the draw inside certain age groups. But it was not luck which sent them to the Gunners, Sappers or Air Corps. The selection of the recruit for his arm of the service is done scientifically over a basic period during which all recruits are learning basic military training at a vast training centre.

When a recruit arrives at this training centre, known as the reception centre, he is given a General Classification Test, a compact written intelligence examination which lasts about one hour. Its various tests of perception, ingenuity, power of analysis and knowledge run from simple questions to extremely difficult ones bringing out answers, some of which experience and tests had shown are only answered by certain types and others that are only answered by other types. There are also questions which test speeds of thought and reaction, and powers of reasoning. Simple questions which are not answered in the time show a tendency to panic.

After this basic examination the draftee confers with a "classification" interviewer, who fills in his Soldier's Qualification Card. This is an elaborate record which will follow him throughout his military career. On it are details of education, knowledge of languages, details of former occupation, particulars of any position of authority, his hobbies, musical or theatrical talents, and previous military or service experience. If the interviewer is not satisfied that a man who claims to be an expert tradesman, is an expert tradesman, he gives him the appropriate trade test by means of an ingenious examination which has been devised for every trade. After the interviewer has done his job, the qualification card goes to the Classification Officer, who is a man trained in personnel work and who has a great knowledge of what types are wanted in what arms. He sorts out what is wanted. John Jones was a graduate of a law university, but the Army has plenty of lawyers. He had, before going to College, also been employed as a telegraph operator. The Classification Officer, therefore, marks on Jones' card a recommendation for the Signal Corps. Edward Smith was a chief usher in a movie palace. There is nothing there to mark him for any of the hundreds of military trades or occupations. But this superior mark in the General Qualification Test and the fact that he supervised 30 ushers under him mark him as a potential non-commissioned officer. Albert Henry was a construction foreman and in his spare time a pigeon fancier. He will do for either the Signal Corps Pigeon Unit or the Engineer Corps. The alternatives are marked on his card with his preferences.

The cards now go to the Assignment Officer. One unit, let us say, has put in for telegraph and teletype operators, another wants basic material of a good type for armoured vehicles, the Engineers want experienced construction men. The Assignment Officer puts the cards, which have along their edges certain holes corresponding to certain qualifications, into his sorting machine and leaves it to put out the categories of the men required. As the cards go through the machine, Jones drops out as a teletype operator and Smith as basic material of exceptional quality, and Henry as a constructional engineer. Within twenty-four hours each is on his way to the Replacement Centre that wants him.

At the replacement centre the recruit goes through another thorough weeding out. During the initial training period in which he learns how to drill, shoot and take care of himself, he is continually under the eye of a unit personnel officer.

He is watched for any special qualifications to become a tank gunner or a driver and as he goes on with his training he is watched for any suitability for command. When he goes out to his unit or permanent station, his Qualification Card goes with him augmented by the remarks of his officers at the replacement centre. From this the Unit Commanders have a very complete inventory of the special abilities of the men under them. A telegrapher who is fluent in Russian may not cause much comment at the replacement centre but he is of vital importance in Alaska. Radio operators proficient in Spanish are invaluable in the South.

This is the system evolved while there was still time to think and plan, evolved before there was a call-up and not during it and always trying to keep pace with it. But even this is not perfect. A man may have been unfitted for his civilian profession, family circumstances may have made him one type, but released from his home environment he may become another type. The system above is clockwork and chromium plated, it offers scope for another Charlie Chaplin in "Modern Times," it does not afford the recruit, or draftee as the American calls him, a chance to develop in his new role. Remember the Germans take ten years to sort the pegs into the holes, the main selection, in this case done by interview and testing, takes only twenty-four hours.

The British picture now is slightly different again; the big call-up has passed and now it is a question of turnover, calling up to replace casualties. Manpower, compared with all these others we have looked at, is very scarce and, therefore, twice as valuable. Do we use it correctly? Do we try to make the best possible use

of it? The answer is "yes we are trying to, under difficult circumstances, with a bad start the Army is trying to evolve a system better than these others." Let us first see what happens to a recruit called into the British Army and then trace the growth and development of the use of selection testing.

When a man's age group is reached, he has to register on a certain day at his local Ministry of Labour Office, and at this registration he is asked certain questions, the answers to which are filled in on a form. John Davidson of Scotland, gives his date of birth and his occupation, carpenter and joiner, and his present employer. He is single, and was born on the 21st March, 1919, and his Identity Card No. is——. He is given a form N.S.2 which certifies he has registered. John Davidson puts his Identity Card back in his pocket, buttons up his coat and goes out into the street where, after a few moments' chatting with a group of young men much like him, he wanders off to see about a job he was doing down the road.

Meanwhile in the Labour Office all the cards are collected and sent off to the District Office with the various entries on them checked. John Davidson's employer is verified and it is ascertained that John Davidson is not employed on any reserved or priority work and that he is not on whole time A.R.P.

The cards arrive in the District Office with all this necessary information and are sorted and collected and presently John Davidson receives a letter requesting him to report to a Recruiting Centre, using the railway warrant enclosed, in order to attend his medical. He makes the journey to Recruiting Centre with two or three others who were called for as well as he. He'd been there a few times before and soon found his way down to the recruiting office. He walks in and is put into a room where he waits. There are posters showing Cameron Highlanders in dress of various periods round the room, he cannot see any one of a Seaforth; well, he'd join the Seaforths anyway.

The line between him and the door grows less and soon it is his turn. Inside are three doctors and various charts on the wall, a vertical six-foot rod with a sliding scale and other instruments and he feels that peculiar emptiness and coldness that comes to every man who finds his destiny suddenly and completely in the hands of others. But he has a slight pride, he need be afraid of no doctors. So it turns out, 5′ 7″, with heart and lungs of a horse and good eyesight. He is marked Grade A and passed very quickly into another room.

Here at a table is sitting an officer, "an'ither Cameron" he sees and automatically entering the room John Davidson straightens and fumbles with his cap behind his back. His card has been brought in, the same one on which his particulars were entered at the Labour Office, now with his medical grade on it. The officer at the table studies it for a minute and then begins a string of questions, education, when did he leave school, how long in his present job, has he had any military experience before. His life history is quickly dug out by skilful questions and after it has been elucidated that he has been at his trade since he left school at the age of 15, the Interviewing Officer is finished with him, and completes his card. Suitable for R.E. Field or Seaforths.

John Davidson went out and walked round the town breathing the crisp air into his lungs. He'd call, while he was here, on his mother's sister who was married to a baker in Castle Steet. John Davidson's card recommended for R.E. Field or Seaforths goes into a central box and awaits a posting order. This comes from the Ministry of Labour through the Regional Office. 100 Infantry are required to report to No. —— I.T.C. and John Davidson gets his wish to become a Seaforth.

John Davidson's case was a simple one and yet all cases must fall into a hole, edged towards it by this or that characteristic. In this District Office sit Navy, Army, and Air Force Interviewing Officers. If a man expresses a preference for the Navy or Air Force he is interviewed by them first and if they have a vacancy and if he is found suitable he is accepted providing his service trade is suitable. This

is the first mention of service trade. Every man is allotted a code number according to the work he did in civil life. These code numbers coincide with various similar trades in the Services and a man is bound by his service trade to go to the Service to which that trade is affiliated. Thus a marine fitter or a fisherman goes to the Navy, a timberfeller or platelayer goes to the Army and so forth and the only by-pass from a service trade posting is to volunteer and be accepted for flying duties in the Naval Air Arm or Royal Air Force.

After service trades, physical standards are the next great sorters. Certain arms of the Service only take A.1 men of a certain height. The Guards take A.1 men over 5′ 9″, the Household Cavalry Motorized Bn. and the R.A.C. take A.1 men over 5′ 7″ and 5′ 3″ respectively, the R.E. Field takes A.1, and A.2 and A.3 men over 5′ 4″ and R.E. Lines of Communication take down to B.4 and down to 5′, etc. These gradings are given as examples and may not be accurate to date. But they give an idea of how a man is sorted. Then comes along intelligence. This was done at the beginning by his educational standard, and the R.A.C. and certain branches of the Royal Corps of Signals get the highest grades, the R.A. and R.E. Field get the next highest grades, etc.

Territorial and family connections are taken into consideration, before the Interviewing Officer gives his final recommendation. But so often this recommendation was ignored. The War Office wanted 500 men for the R.A.C., the Ministry of Labour allot 100 vacancies to one Region, who sub-allot a further amount to the district and perhaps if that amount was the total number of cards the district had available they were all posted to the R.A.C. regardless of the recommendation on the cards, making necessary the re-sorting and repeating of the process later in the unit, all because sections of the nation were called at a time and in sections there are bound to be preponderances of one type, but it may not have been the type that was wanted and so because in peace we had never classified the nation so in war bits of the nation are called into wrong jobs.

The growth of selection testing can be traced by the institution of the F.H.3 test in all intakes at training units. The test consisted simply of two parts. The first one only was actually utilized and the second part was a mechanical test. This first part consisted of various questions, type of which is as follows :

Robin is to salmon as bird is to ——— ? Answer : Fish.

They are simple but have to be done inside a certain time and from the results obtained on these, illiterates and mentally slow people were easily picked out. Those who got below a certain percentage were put up for interview to a specialist in psychological medicine, who recommended what action should be taken in their particular case. The result was that 15% of intakes into an R.E. Unit were on successive occasions transferred during their training to the Infantry or Pioneer Corps. In many cases this transfer, due to changing regulations, took over six months to effect ; in some cases even longer. If the recommendation on these men's cards had been followed, a large saving in the time of the Training Unit and the man would have been made.

Long after the great majority of the manpower of Britain was called up, selection testing started to gain strength. The selection test was used at the Medical Examination in the Ministry of Labour District Office. The Interviewing Officer used the result of the selection test to make his recommendation for choice of arm. It is a more accurate test than the old method of judging by educational standards. The selection test is a more modern and more efficient grader, picking out the craftsman from the scholar and the interviewer's recommendation has improved so much by it. But is any more attention paid to the recommendation ? Can the Ministry of Labour post according to the recommendation marking on the N.S.1 Form ? The system of allotting block postings to one office appears to nullify the trouble taken in testing and interviewing so far.

However, selection testing is not only carried out in the Ministry of Labour Office. Ask the Unit Interviewing Officer, ask his clerks, ask the harassed Adju-

tant in half a hundred Training Units. Every man who arrives without having done his Intelligence Test is given one. Intakes into all units are graded according to their Service Code and can be generally classified as Tradesmen and Non-Tradesmen. All tradesmen are interviewed to find out if they really are qualified in the trade which the Ministry of Labour has marked against them. In this connection it is interesting to note that this marking is often wrong. A man when registering says he is a carpenter and joiner and the clerk behind the counter enters it on his form, but it is not his trade history. He may have been a carpenter and joiner the day he registered and for a month before it, but he may have been a fitter for ten years before that. On the other hand he may have been a carpenter and joiner, so called, in a mass-producing furniture factory and have for years carried out one action in woodwork and know nothing of the remaining tools or of the necessary knowledge of an all-round carpenter. It is to eliminate facts like this that tradesmen marked as such are tested. And as a result of this testing they are re-grouped in their correct trade or given the necessary opportunity to train further in their correct trade until they can be mustered in that trade by the Army or they may have to be classified as non-tradesmen and treated as such.

But the new selection testing deals with non-tradesmen : it is primarily to develop, to sort out into the following four classes :

1. The tradesmen.
2. The potential tradesmen.
3. The men who, for any reason, should be transferred to other arms.
4. The duds, who go up to the psychiatrist for interview and are by him recommended for suitable postings or for discharge.

In order to carry out this, the Unit Interviewing Officer in conjunction with a travelling team of N.C.O's from D.S.P., The War Office, carry out the following tests on the non-tradesmen intakes. General aptitude tests to show latent qualities of general ability and mentality—Mechanical aptitude tests to show latent qualities as a tradesman. Attainments tests, both vocabulary and mechanical, which bring out the standards of education and mechanical knowledge already gained. From these tests it is possible to gauge the intelligence of the recruits and to pick likely tradesmen.

But a large percentage of these tests must be a matter of duplication if the recommendation of the Interviewing Officer at the Ministry of Labour had been acted on. It would appear that the system falls down between the time the Ministry of Labour interviews the man and the Army receive him. The question is how can it be done more efficiently. To answer it let us face the difficulties. These are :

1. Men have to be called from civil life for the three Services without upsetting the civil machine.
2. These men have to be allotted to the three Services in the proportion required by them. (It is too much to hope that it will ever be two Services, each with its own arm of the third. At least it would make it simple from the point of view of splitting the call-up.)
3. The men have to be allotted to the Training Units of various arms in the three Services.

When it is realized that the Ministry of Labour carries out all these functions with the aid of, for Service advice, one, generally, long retired Service Officer of each arm in each District Reception Centre, it will be realized how much the well-being of the Services depends on the Ministry of Labour if the basic fact is accepted, that the well-being of the Services depends on the right men being in the right jobs.

The answers as to the correct method of carrying out selection testing are

difficult. The Ministry of Labour must arrange the releasing of men from industry and, therefore, must carry out the registration and interview. But from there it would surely be better that the men released from industry with all their civil qualifications assessed by the Ministry of Labour should go to a vast depot. Here they should undergo the various Service Interviews, medical tests and, if necessary, preliminary inoculations, etc., and be sorted out by the Services, thus avoiding the wasted interviewing done at the Ministry of Labour. But this scheme has its disadvantages. Vast reception centres are necessary, which cannot be easily improvised in wartime. Staffs of the three Services have to be obtained and trained in each other's jobs as well as their own so that the Service Interviewer, knowing the needs of the other Services, becomes, not a partisan stealing the best for his own Service, but a first-class thinking machine sorting the raw material with the reasoning powers of a human and the indifference of a machine. In this first interview a recommendation might be given for the arm of the Service to which the recruit is to go, but it is important to make each Service test and allot its own raw material.

I can visualize one day if and when peace-time conscription comes in, a man called up by his age group will enter one of the great centres above, be tested and interviewed at the entrance and sent to that part of it which concerns the Service he is chosen for. That in this part each man will be clothed, equipped, inoculated, and given preliminary drill and exercises by a training staff of his own Service. During these four weeks each man will again be carefully watched and tested and picked accurately and well for the arm of the Service for which he is most suitable. But, if during his preliminary training he is found more suitable for one of the other Services, he can be marched across for interview, trial and subsequent acceptance or rejection.

This dream of the future can be more easily realized in part. It is my dream that the Army, for example, should have a centre capable of housing, say, 40,000 men, where a month's intake to the Army can be clothed, equipped, and inoculated and receive their initial training and from there be posted to special training centres of R.A.C., R.A., R.E. or Infantry or where required. The die-hards may cry "but the team spirit," "the regimental traditions, and customs," or any other such cry. I do not decry the moral effect of them, but first the team spirit of all arms will be greatly helped if the recruit is a member of a vast intake who are sent to all arms where best suited for the country's good. If he is keen to go to any special arm it will naturally be better to put him there unless physically debarred from it, and if again he is sent to where he is best suited he will get a pride in that arm because it is his and *esprit de corps*, etc., can be built up from a firm basis, rather than from one of dissatisfaction.

Not only this, the Army has a hold on all its intake. One centre can deal with the Ministry of Labour on those who fail to report, instead of 100 training centres. One centre can report on wrong medical categories and either retain or return those placed in Category C as the Army requires. When they are tested in the centre, it will be for particular vacancies which exist at the moment of testing. Skilled testers can select them or turn them down for those vacancies. At the moment they are tested for all arms, selected for one or two possibles, and posted *faute de mieux* to wherever they are wanted, as bodies regardless of their selection. This system has many obvious advantages and must some day be possible of execution. Let the Services be masters of their own and then they can be to a greater degree responsible for their successes or failures.

Note.—This monumental work was written about 6 months ago, when the author was in a Training Battalion. Owing to the difficulty of finding anyone with the special qualifications needed to read his writing, the author delayed getting it typed until jerked into action by an announcement on the six o'clock news on Friday, 29th May. The Adjutant-General announced that in future all recruits

would spend their first six weeks in a preliminary Training Centre with General Service badges: that there they will be thoroughly sorted out over the whole period, and will pass out into the Arms of the Service for which they are considered most suitable. This seems to make this article out of date instead of the prophetic vision I had intended it to be: but I hope it may still be interesting as a history of what led up to this new system.

Details of how Selection Testing is worked in America were taken from *Reader's Digest* with their permission; Major-General F. E. Hotblack, D.S.O., M.C., who was Military Attaché in Berlin just before the war, gave the facts about Germany.

CAMP SANITATION: MODERN PRACTICE IN THE TREATMENT AND DISPOSAL OF SULLAGE WATER.

By MAJOR HENRY H. CLAY, R.A.M.C.

(Reprinted by permission from the *Journal of The Royal Sanitary Institute*, for January, 1942.)

IN the prolonged occupation of any site for camp purposes, the disposal of sullage water—ablution, laundry and cookhouse waste—is a problem of great importance and generally of increasing difficulty. At the outset, special attention is almost invariably given to the disposal of excremental and similar wastes, primarily and quite rightly, on account of the possible infectivity of excreta, but also for the reason that insanitary conditions resulting from neglect or failure properly to deal with these, are obvious and immediate. The effects of inefficiency in the disposal of sullage water in the early stages are less obvious, but from the point of view of camp sanitation they are equally serious, and as time goes on they may constitute an even more difficult problem. The amount of sullage produced and to be disposed of is proportionate to, and directly dependent upon, the water supply. Where water is "laid on," the consumption reaches anything from twenty-five to thirty gallons per head per day; where the supply is of an indirect or improvised character it may be as low as ten gallons per head per day, but the sullage produced is of a denser or stronger character. In either case, nearly the whole of the water has finally to be disposed of as sullage.

Organization for war conditions necessitates the construction of large camps of permanent character. Even though hastily constructed, these are in most cases provided with a piped water supply, since no other sort of supply would be adequate to meet the needs. It is not however always practicable to provide such camps with the logical and necessary corollary of a piped water supply, viz., a drainage system, and there are in existence at the present time camps of this character in which no such provision is made. Latrine accommodation may be some form of bucket or container type, fæcal wastes being dealt with after removal to a suitable place of disposal. No such removal is possible with sullage water, and with the large permanent camp, as with the smaller camp, and sites occupied temporarily or spasmodically by smaller numbers of men, disposal "on site" is the only practicable measure.

Wherever possible, sites for military occupation are chosen and developed for their purpose only when found on inspection to be suitable from a health or hygiene point of view. Freedom from dampness or seasonal flooding, or from a high-water table, is a requisite of a suitable site, and in assessing its suitability, the nature of the subsoil and its capacity to absorb water are taken into account. Military necessity must always however be the dominating factor, and there will always be sites in military occupation, permanently as well as temporarily, which, though valuable and perhaps indispensable from the purely military point of view, are not entirely suitable when viewed from the standpoints mentioned above.

In the absence of a drainage system the disposal of sullage water on such sites must sooner or later present a major problem. The simplest, and in the early stages the only available method of disposal, is by soil absorption. It is obvious that in any one place the ability of the subsoil to absorb sullage water will be lessened as time goes on, and it may be reduced below a point at which complete disposal is possible. In order properly to utilize and preserve natural soil absorptivity, attention must be given to two principal factors, viz., the geological formation of the site concerned, and preparation of the sullage water itself—the removal from it of those elements which naturally tend to prevent absorption and render the earth water-tight.

With reference to the first factor, considerable advantage may be secured by proper utilization of the subsoil, regard being had to the thickness, formation, and, in particular, the gradients of the substrata, where more than one is sufficiently near the surface to be affected. In stratified formations the absorptivity of the soil is often greater in one direction than in another. By proper sectionizing of the strata—and adoption of the elongated soakage pit referred to later—a maximum rate of absorption and the preservation of that rate for maximum periods of time, can be secured ; both the efficiency and the " life " of the soakage pit are increased correspondingly. In camps, as in building sites, the digging of " trial holes " can be well worth while. Where an impermeable stratum is near the surface and is thin, it may be pierced, and a permeable stratum below it may be brought into use, often with great advantage, due care being given in this, as in all similar cases, to the question of water pollution. In other words, a form of vertical drainage may be obtained. This is often used with considerable effect in anti-malarial and similar drainage works.

The second factor—preliminary treatment of the sullage water with a view to preserving the natural absorptivity of the subsoil, consists in (*a*) straining to remove suspended matter, and (*b*) the removal of grease and soap curd. A suitable strainer is easily improvised and needs no description. The straining medium (hay, straw, bracken, etc.), together with the solids retained, can be disposed of by burial or by incineration.

Grease as it leaves the point of production in cookhouse sullage is in suspension, and owing to its temperature is in an abnormal condition. If the sullage is cooled, *e.g.*, by passing into a body of cold water at rest, the grease will solidify and, its specific gravity being less than unity, it will float to the surface. These factors are catered for and utilized in the cold water grease trap, which if properly designed and used, is a simple and efficient separator.

The efficiency of a grease trap is relative to four factors, viz. its effective capacity, design, construction and fixing. Recognition of this has led to the development of a type of trap which is a considerable improvement on those formerly used.

The effective capacity must be sufficient to ensure that as far as is practicable water passing through at any one time—a peak load—will be cooled to a temperature at which ordinary cookhouse grease is solidified.

The design must be such as to ensure a long journey at low velocity between inlet and outlet, so that in its passage, grease may separate completely and float

to a position from which access to the outlet is effectively prevented. To achieve these objectives a grease trap should be deep rather than shallow (minimum depth one foot four inches); long and narrow rather than square. A length-to-breadth proportion of three to one is desirable. The trap should be provided with "baffles," passing down to two-thirds the depth, at the inlet and outlet ends, but the spaces enclosed by these should be small, thus leaving as large a volume of water as possible in the body of the trap. A third (central) baffle, the sole object of which is to prevent the passage of suspended matters through the trap by momentum, is not necessary as, in a trap properly designed, a velocity sufficient to cause this will not occur.

The remaining factors of importance are construction and fixing. A grease trap must retain water. It must, of course, be well made, but it is not generally recognized that it must also be well fixed. To resist the hydrostatic pressure set up when it is filled with water, a grease trap—especially if constructed of wood—must be solidly bedded in position on heavy puddled earth and the sides must be similarly supported. Unless this is done it cannot resist the disruptive pressure exerted on the bottom and sides when the trap is filled; the joints will be opened and leakage will be inevitable. If the trap is properly fixed, the closely puddled earth on the outside will filter out the suspended matter contained in water from any small leak that may occur, and will itself rapidly become water-tight.

Much attention has been given to the production and use of standardized grease traps. Owing to the many variables associated with field conditions it is not practicable to fix any set standard for the capacities of grease traps for camps of given accommodation. A rational approximation may however be arrived at.

In a camp cookhouse provided with a piped water supply the amount of water necessary for the preparation and cooking of food and for the washing of utensils, including plates, etc., may be taken as six gallons per head per day. The estimation of sullage production at the cookhouse, and therefore of grease-trap capacity, is relative to this rather than to the nature, number or capacities of cookhouse fittings, *e.g.*, sinks, etc.

Of the total amount, not more than one-half (three gallons per head) will be used at the principal meal. The use and discharge of this amount of water will be spread over a period of not less than two hours. The peak load passing to the grease trap may therefore be taken as one and a half gallons per head per hour (not all of this will be heated). Thus, for one hundred persons the maximum production of sullage water in the cookhouse will be approximately one hundred and fifty gallons per hour. In ordinary circumstances it is found that cookhouse sullage is cooled sufficiently to effect solidification of suspended grease if added to cold water equal to five times its own volume. This applies to large individual discharges. The ratio may be reduced where (as is usual in the field) discharges are gradual and more or less continuous over a period of time, and a one-to-one dilution, incoming water meeting a volume (contained in the trap) equal to its own—with a minimum volume of fifty gallons—is satisfactory. The approximate capacity of a required grease trap can be estimated accordingly and it may serve as a guide in the provision of standardized grease traps. Where a trap of this standard is, or is likely to be, insufficient, a second and smaller trap fixed in series, *i.e.*, so as to receive the effluent from the first trap, is a more effective provision than a single trap of larger capacity, or than a second trap of equal capacity fixed in parallel, *i.e.*, so as to be used alternately. Two traps of one hundred gallons and fifty gallons respectively, arranged in series, are more efficient than either a single trap of one hundred and fifty gallons, or two of seventy-five gallons fixed in parallel.

Standard grease traps can be made to the dimensions given in the following table. They can be constructed in wood, the bottoms, sides and ends being easily stacked and transported, and assembled where required.

Capacity.		Length.		Width.		Effective Depth.*	
Gallons.	Cubic Ft.	Feet.	Ins.	Feet.	Ins.	Feet.	Ins.
50	8	4	0	1	4	1	6
75	12	4	6	1	4	2	0
125	20	5	0	2	0	2	0
150	24	6	0	2	0	2	0

Combinations of these can be used to meet most normal requirements. The following are examples :

Persons catered for	*Grease Traps required.*
30 and under	50-gal. (minimum size).
30 to 50	75-gal.
50 to 100	125-gal. or two of 50 gallons in series.
100 to 150	225†-gal. or one of 125 gallons and one 50-gallon in series.
150 to 250	300-gal. or one 150-gallon and one 75-gallon in series.

Experience has shown that for field use a grease trap should not be of less capacity than fifty gallons. There is also an optimum upper limit, though this is not easily demonstrated. From the point of view of grease removal only, it is true that, given proper design, the larger the grease trap the greater will be its efficiency, but except when it is dealing with the peak load for which it is designed, an excessively large grease trap tends to become a cesspool. In this connection it needs to be emphasized that solidification, though helpful, is not essential to the separation of grease from water ; quiescence—a long journey at low velocity —is more important than cooling. In a grease trap, design—depth and shape—is more important than capacity. Except in special circumstances, no trap should exceed three hundred gallons capacity. If this is not sufficient the necessity should be met by the use of an additional trap placed in series.

Cold ablution water can in all cases be taken into grease traps without necessitating any increase in the sizes given above. Where ablution water is soft and it is desirable to remove contained soap, the water should be passed through a chamber containing limestone before reaching the grease trap, or milk of lime could be " dripped " into it. This will impart the hardness necessary to curdle the soap and thus ensure its retention in the trap.

The effluent from a grease trap is not fit for direct discharge into streams, etc., or for disposal over unprepared ground. It is best disposed of by soil absorption, through a soakage pit.

Soakage pits are of great value in field sanitation. Their purpose is to receive sullage water in quantities as and when produced, and to act as reservoirs from which the water can be absorbed continuously by the surrounding ground.

Apart from geological conditions, the efficiency of a soakage pit is relative to (*a*) its water content, (*b*) the extent of its soakage surface or area. The water content is equal to the voids existing between the stones, etc., with which the pit is filled. If small stones are used the voids may be as low as 20 per cent. of the original excavation. The pit should be filled with materials, *e.g.*, large stones, etc., which afford a maximum percentage of voids or water-way. The variation in the water level in a soakage pit at different times may be observed by means of a rod or

* The gross depth is four inches additional in each case.

† Traps of this size and over are best made in concrete.

"dip-stick" let down to the bottom through a rough tube placed at any convenient point in the pit.

The soakage surface or area of the pit is relative not only to its capacity, but also to its shape. The object is to obtain the maximum perimeter in proportion to sectional area or content. A soakage pit in the form of a cube four feet by four feet by four feet, has a maximum capacity of sixty-four cubic feet and a maximum soakage surface of eighty square feet. If the shape is oblong—eight feet by two feet by four feet deep—the capacity is the same, but the soakage surface is increased by sixteen square feet—ninety-six square feet total—and the pit is to this extent more efficient, the water being presented to a correspondingly larger area of ground for disposal. Moreover, the extra sixteen feet is in the sides, which in time are more effective than the bottom. The labour involved in construction is the same in each case.

It need hardly be said that in no circumstances may crude sullage water be discharged directly into a river or stream, or into ditches in rural areas, or even over the surface of unprepared ground.

The ability of ground to absorb water is generally limited, and may be reduced as time goes on to a point at which the ground is no longer capable of absorbing the total water to be disposed of. Even in the most favourable geological conditions a soakage pit will sooner or later become useless, because a cold-water grease trap does not entirely remove the elements which tend to make ground watertight.

Where the site occupied has become, or is by its nature, non-absorbent, the disposal of sullage water presents a different problem, requiring more positive methods of treatment than those already described. In such cases, if an ordinary drainage system is not practicable, the sullage water must be purified or, more correctly, clarified. It may then be disposed of in the same way as ordinary surface water.

Chemical Precipitation.

The most simple method of purification is by chemical precipitation. Work done at the Army School of Hygiene shows that from considerations of cost, availability and efficiency, the most suitable precipitants are ferrous sulphate (Copperas) and lime. The method was first devised by Hattersley in 1935.[1] Ferrous sulphate is easily soluble in water, and a suitable admixture of this chemical produces a floc which, when lime is added, precipitates readily, leaving the supernatant water clean. Ferrous sulphate renders the sullage water acid. Effective precipitation is obtained by adjusting the pH value of the water with lime after it has been dosed with the ferrous sulphate. A pH value of 9 is found most suitable, a degree of alkalinity which turns phenol-phthalein paper pink.

The quantities of the two simple chemicals required varies with the nature of the sullage. In special cases the necessary amount can be determined only by experiment, using a sample of the sullage concerned,[2] but a round figure can now be given which will suit all ordinary cases. It is found that for every two hundred and fifty gallons of crude sullage, one pound of ferrous sulphate (thirty grains per gallon) and from one to one and a half pounds of lime (thirty to forty grains per gallon) are required. The amount of lime required is influenced by several factors, *e.g.*, the use of soda in the cookhouse.

The sullage is collected into tanks. Two or more of these are needed and are used in rotation, one being precipitated while the other is filling. The ferrous sulphate is first dissolved in water and added to the tank. The requisite amount of lime is then mixed with water and added, and the contents of the tank are thoroughly agitated. Precipitation then commences at once and is sufficiently advanced in one hour, though a longer period of rest is beneficial. The longer it is left, within limits, the clearer the effluent becomes, and the more closely the floc or sludge packs down.

The process cannot be relied upon to precipitate all grease. For this reason, and also with a view to salvage, the sullage from a cookhouse should be passed through a grease trap before treatment. After treatment, the clarified water is comparable to a purified sewage effluent, conforming to the standard recommended by the Royal Commission on Sewage Disposal, except that it is deficient in oxygen ; the oxygen-absorbed figure is above two parts per hundred thousand. The suspended solids also may exceed three parts per hundred thousand unless adequate time is allowed for precipitation. These factors are of no importance if disposal is over land, etc., but if the disposal is directly into a stream the oxygen deficiency must be corrected. This may be achieved by aeration, *e.g.*, causing the effluent to flow over a long route and, if possible, over weirs, etc., before discharging into the stream. Where these measures are not practicable, the necessary oxygenation may be obtained by chlorination. The suspended solids are reduced by secondary precipitation, *i.e.*, by re-agitating the sullage after the first precipitation and allowing adequate time for the subsequent sedimentation. Water so treated may be disposed of in all respects as if it were surface water.

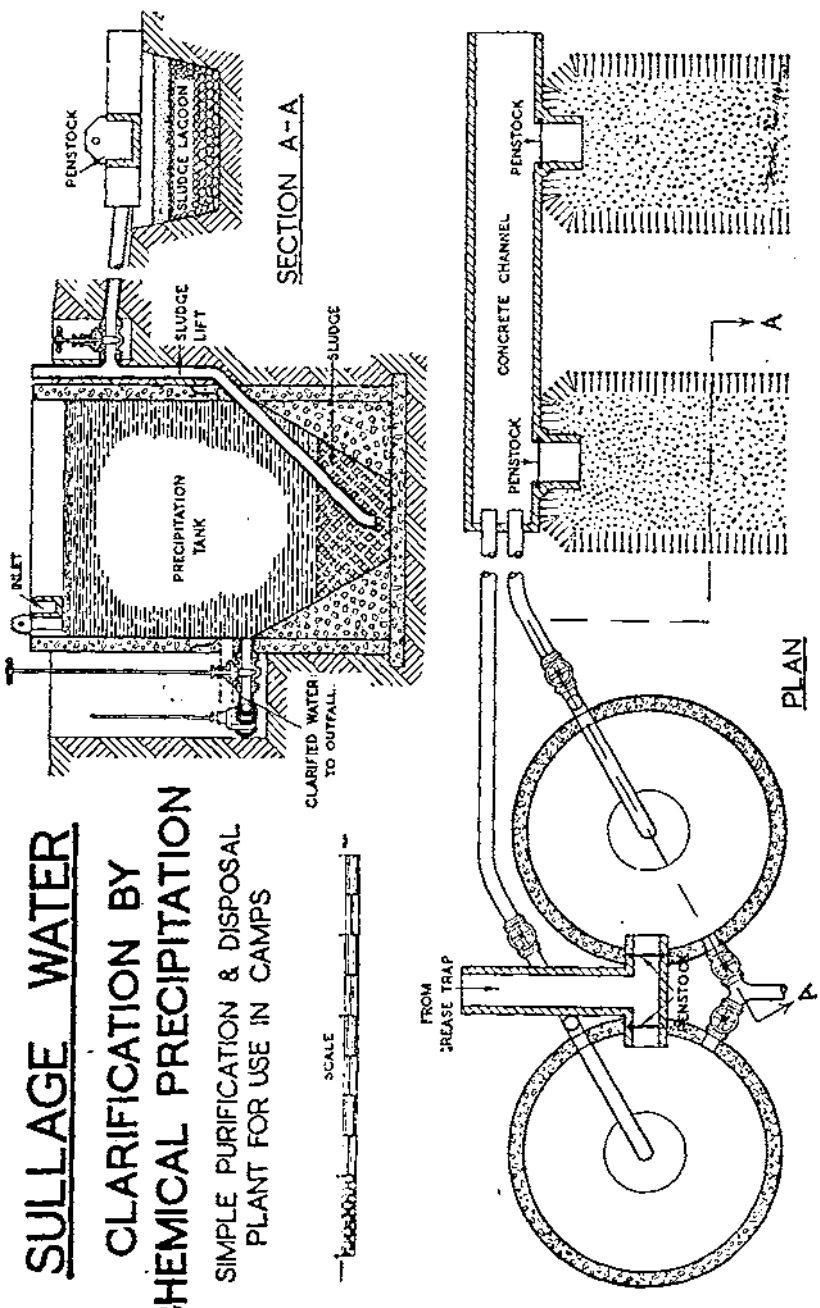
The plant required for the process consists of two precipitating tanks, to be used in rotation. These, since the sullage water usually reaches them at ground-level, must be sunk into the ground. In horizontal section they may be round or square. The bottom of each must slope sharply to one point, *e.g.*, in the shape of an inverted cone or pyramid ; this ensures concentration of the sludge and facilitates its ejection. The tanks should be deep rather than shallow. The level at which clarified water can be run off is determined by the level of the outfall. Adequate depth in the tank affords a good working distance between the sludge surface and the clear-water outlet, and greatly increases the flexibility of the process. The early stage of precipitation is more rapid than the later stage, in which the floc becomes more closely packed. A good depth below the clear water outlet enables this water to be run off without waiting for the precipitation to be completed in the lower section of the tank. It also lengthens the periods between de-sludging. This is economical, as after the first two or three charges are precipitated, the ferrous sulphate and lime contained in the sludge is available to assist in the precipitation of a subsequent charge ; it may, indeed, be sufficient for this purpose.

In ordinary circumstances the sludge in the tanks is below the level at which it can be run off by gravitation. The hydraulic head provided by the supernatant water when the tank is full is utilized to lift the sludge to prepared lagoons. It dehydrates rapidly, leaving an innocuous and non-putrescible residual resembling humus, which may be disposed of on land and presents no further problem.

A simple plant in which the above points are incorporated is shown in the illustration The tanks are constructed of standard pre-cast concrete rings or pipes placed on end in a suitable excavation, the bottom being concreted to slope to the centre at an angle of 60°, thus forming a pocket into which sludge will gravitate and from which it can be ejected without agitation or any appreciable mixing with clarified water above it. Flexibility in the time factor in working is increased by the provision of more than one outlet for clarified water placed at different levels (see dotted lines in the plan).

Plants of this kind can be enlarged to meet the requirements of camps accommodating any number of persons. Tanks may be of six thousand gallons effective capacity—in which case some form of mechanical agitator is necessary—and three or four may be provided for use in rotation. Where the construction of a plant for purification of complete sewage is contemplated, certain units of a chemical precipitation plant, *e.g.*, the tanks, may be designed with a view to their ultimate incorporation in such a plant.

As has been indicated above, the amounts of water dealt with by chemical precipitation may be very large. In arid places where water is scarce, the question


SULLAGE WATER
CLARIFICATION BY CHEMICAL PRECIPITATION
SIMPLE PURIFICATION & DISPOSAL PLANT FOR USE IN CAMPS
SCALE
SECTION A-A
PENSTOCK
SLUDGE LAGOON
SLUDGE LIFT
SLUDGE
INLET
PRECIPITATION TANK
CLARIFIED WATER TO OUTFALL
PLAN
CONCRETE CHANNEL
PENSTOCK
FROM GREASE TRAP
A

of its regeneration for re-use is an important one, and the problem is now the subject of investigation. In an army mobile bath unit,[3] using approximately six hundred gallons of water per hour, and producing a sullage which it must be admitted is of the simplest and most favourable kind for the treatment, clarification by chemical precipitation followed by a crude form of filtration, produced an effluent which, instead of being wasted, could without detriment be mixed with raw water and re-used.

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[2] *Army Manual of Hygiene and Sanitation, Appendix 12.*
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TRANSPORTATION IN WAR.

BY THE LATE BRIGADIER-GENERAL SIR VALENTINE MURRAY, K.B.E., C.B., C.M.G.
(Director of Railways, France)

A Lecture prepared for delivery to the Staff College in 1930, but not delivered.

THE subject of the Lecture I have been asked to give to-day is "Transportation in War Time" with special reference to our operations in France during the recent war.

Transportation, so far as this lecture is concerned will primarily mean Transportation by a Railway of the normal gauge, *i.e.*, a railway of the same gauge as those in Great Britain.

There are other branches of Transportation, used for military purposes, such as Water Transport, transport by metre- or narrow-gauge railways, and railways of the 60 centimetre or 2 ft. gauge, but these branches of transportation are merely incidental helps to the main system, the normal gauge railway, and though they are often of invaluable assistance, and though many of the conclusions and solutions applicable to the normal gauge railway are equally applicable to military transportation on the other branches, yet for all practical purposes we may take the normal gauge railway as the basis from which all military transportation starts and on which it is carried out.

The subject is peculiarly interesting and of paramount importance in war time.

It seems therefore desirable that the problems in connection with the question should be studied as part of the normal preparation for war.

I do not intend giving any statistics of what was actually done in France, other than those bearing on certain general principles, but I shall confine myself to the latter as far as possible and try to explain the method of working in war time, and how the best results are obtained.

Functions of a Railway.

As no campaign of any magnitude can be carried on at the present day without utilizing railways, I wish first to explain what the true functions of a railway are. It is these functions which must always be borne in mind. They are often lost sight of—not only in war time—but equally in peace time.

The sole *raison d'etre* of a railway is to carry material and personnel as quickly and efficiently as possible from one point to another point, and except for the periods during which the material or personnel are being loaded and unloaded, the ideal position would be for the wheels of the vehicles conveying the personnel or material always to be turning round. Therefore, fluidity is essential to efficiency and the moment fluidity is curtailed or lost, and the stream of traffic stopped or dammed up, efficiency is reduced or lost.

It is not part of the functions of a railway to provide warehousing facilities. The station buildings and premises are as a rule provided only for the reception and delivery of material and personnel, for a reasonable period, either immediately before their despatch or immediately after their arrival. It therefore follows that the holding up of wagons under load, the blocking of station yards with goods awaiting orders for despatch, or with goods awaiting removal, immediately affects the fluidity, and militates in a very serious manner against the general efficiency of the railway system.

Moreover, and this is another point to which special attention is necessary, the occupation of a railway line for the haulage of material or personnel over a short distance seriously affects the efficiency of the railway as a whole, as such a course reduces its capacity for carrying long distance traffic over the same section as that on which the short movement is taking place. I shall have something more to say about this point later. These true functions of a railway must be constantly borne in mind, because it is only by continually thinking of them, and adhering to them as far as possible, that the greatest efficiency is obtainable in military transportation.

How to Ensure the Functions Being Carried Out.

Now, how is adherence to these functions to be ensured so that the best use may be obtained out of a railway in war time?

In peace time, any person who wishes to travel or to despatch goods can go to the nearest station and purchase a ticket or book his goods without any apparent central control being necessary. In civil practice, however, a time often does come when stations get blocked or lines get jammed up with traffic, and then the central civil authority steps in, and traffic has to be curtailed or shut down altogether for a time until the block is removed or the lines cleared, but in the meantime fluidity has been curtailed and efficiency lost.

But the main object in war time is to prevent such a state of things happening. We dare not lose fluidity and it must be maintained at all hazards. If local departmental officers of the various military services, and local commanding officers had unlimited power to despatch material and personnel whenever they wished without reference to any central authority, congestion would be bound to arise, and it would probably, in fact almost certainly, be impossible to execute big movements ordered by the Commander-in-Chief.

Therefore a most highly concentrated central control over all military transportation is essential for the purpose of ensuring fluidity and consequent efficiency.

This control must be military and I shall probably be asked at once—why the control cannot be left in the hands of the civil railway officials, who must obviously know much more about the working and capacity of their own lines, than any, presumably amateur, military officer appointed on the spur of the moment for the special purpose.

I can answer this very shortly. The control of military traffic cannot be left to the civil railway authorities in war time for four main reasons :—

(i) The local railway official cannot assert authority over or refuse to carry out the orders of a local military officer.
(ii) He is not in a position to appreciate the necessity for not doing certain things, *i.e.*, he has been brought up to believe his duty and main object in life is to accept all traffic which is offered him for despatch.
(iii) It is impossible to keep the local railway official acquainted with what is happening in areas outside his immediate jurisdiction—and even were such a course possible, it would be out of the question to leave to his judgment the decision as to what should or should not then be done, and
(iv) The desirability of maintaining secrecy in all military movements, to which point I shall refer later.

I am not talking here only of junior officials of a railway such as the station masters, *i.e.*, the officers in charge of the stations, but also of the administrative officers of the line.

I may say that I have known very disastrous results obtaining in England even in peace time from a high civil railway official interfering in the control of military traffic.

M. JACQMIN'S BOOK.

A very interesting book on the subject was written many years ago by a M. Jacqmin, the General Traffic Manager of the *Nord* Railway in France during the Franco-Prussian War.

It is probably in your library. If it is not, it ought to be. It is a most illuminating treatise on the dreadful results which can be reached on a railway in war time when no proper military control is exercised.

I should like to have quoted you some extracts from this book but I am afraid time does not permit. Its perusal, however, will I think do more than anything I can say to prove the absolute necessity for a concentrated rigid military control of railways in war time—and this military control must not only control military traffic—but all traffic—*i.e.*, civil, as well as military,—passing over the railways. It would obviously be useless controlling one without controlling the other.

The French after their sad experiences during the Franco-Prussian War proceeded to put their house in order and introduced a very elaborate and practical system of control, which, I believe, all authorities will now acknowledge worked with a remarkable degree of success during the war of 1914–18—though this was, for all practical purposes, the first time it was put to a real test, since it was framed some 30 years previously.

It was this system which we adapted in a large measure to our purposes in the South African campaign, and which we were obliged to follow and frame our own organization on in the recent war.

During the war certain alterations in the higher organization of the system were made, but no practical alterations were effected in its main points, and I think it unlikely that the result of the six years' experience the French have now received will necessitate any radical alterations thereto.

THE FRENCH METHOD OF CONTROL.

I will now outline how this French system of control was organized and effected and how we adapted ourselves to it.

On the order for mobilization, the whole of the French railway systems come under military control.

The whole of France is divided into two parts, the *Zone des Armées*, *i.e.*, that portion of France adjacent to the frontier in which the Armies in the field are

operating more or less, and the *Zone de l'Interieur*, comprising the remaining portion of France.

The demarcation line between the two zones varies from time to time in accordance with the operations—and is notified by Ministerial decree. A demarcation line is necessary, as the restrictions on civil railway traffic in the *Zone des Armées* are naturally more onerous than those in the *Zone de l'Interieur*. The *Zone des Armées* is under the direct control of the C.-in-C. of the Armies in the field—the *Zone de l'Interieur* under that of the Minister of War, *i.e.*, the former is entirely removed from all political interference.

The method of control employed in both zones is practically identical. Each railway system is managed by a Joint Commission, known as the *Commission de Réseau* (*Réseau* is French for a system), consisting of a military member and a technical member.

The Military member, an officer of the French General Staff, is known as the *Commissaire Militaire du Réseau*. The technical member is usually the General Traffic Manager—in some cases the General Manager—depending on the civil organization of the railway—and he is known as the *Commissaire Technique du Réseau*.

In the *Zone des Armées*, the *Commission de Réseau* is directly under the orders of the Director of Railways, a high Staff officer under the *Directeur de l'Arrière* (The D.A.) at General Headquarters, an officer corresponding in a large measure to our Q.M.G.

The Director of Railways is also assisted by high civil railway officials of the Great *Réseaux* comprised in the *Zone des Armées*.

It will thus be seen that all railways in the *Zone des Armées* come under the direct control of the C.-in-C. of the Armies in the field.

It will be observed how very different this organization was from that laid down in our *F.S.R.* at the outbreak of the war, under which the railways were placed under the orders of an officer, the I.G.C., who, though under the orders of the C.-in-C., was away from G.H.Q. and out of touch with G.H.Q.—I shall refer to this later.

In the *Zone de l'Arrière*, the *Commissions de Réseaux* are similarly under the orders of a high staff officer attached to the Ministry of War.

All these *Commissions de Réseaux* are assisted by various sub-Commissions and station commissions, to whom certain powers are delegated and who give effect to the orders of the Commissions.

Each of these Commissions consists of a military member and of a technical member, the lowest commission of all being the *Commission de gare*, the two members of which are the *Commissaire militaire de la gare*, corresponding to our British R.T.O., and with whom our R.T.O. was in close liaison, and the station master.

These Commissions are entirely independent of the officers commanding troops in the field, and of local Commandants. They take no orders from such officers and receive orders only from G.H.Q. No interference with their functions, either by local Commanders, or by officers commanding troops travelling, is allowed under practically any circumstances whatever. It is the duty of these Commissions to carry out the orders of G.H.Q. and to see that the best results are always obtainable on the railway system, and that fluidity and efficiency are always maintained.

It is the duty of the military member always to consult his technical colleague, when any movement is in contemplation—and settle with him the best means of execution. He must be guided by his advice—and never interfere with his technical functions, but in the last resource, the military member has always the final say in any matter, and can always take a decision against the advice of his technical colleague, though he may have subsequently to justify his action.

In practice the necessity for the latter course very seldom arises, and I do not remember such a case.

ADVANTAGE OF THE SYSTEM.

The great advantage of the system outlined above is that it centralizes the control of the railways and, in the *Zone des Armées*, enables G.H.Q. to know at any time what is taking place, and what can or cannot be done on them.

The powers of the *Commissions de Réseaux* are limited in extent, as for instance, the authority for the movement of a complete division, or more, by rail is vested in the hands of G.H.Q. only. The reasons for this will be seen later when I am referring to troop moves.

In addition to the Commissions referred to, there is one very important officer whose functions are partly combined with the *Commission de Réseau*, and partly independent of them under the direct orders of the D.A. at G.H.Q. This officer is the *Commissaire Régulateur*, who is in military control of each Regulating station and regulates therefrom the daily supplies for the maintenance of the Army which is based on this Regulating station. By supplies I mean here not only *food*, but material of all kinds—ammunition—R.E. stores, etc.

I shall have more to say about this *Commissaire Régulateur* when I come to consider the subject of Regulating stations.

All military demands and requirements of any and every nature are placed on the military members of these Commissions and under no circumstances whatever are any of the forces operating in the field, or the local officers of the various Army services allowed to go to the technical member of the Commission or to any of the technical staff of the railway, direct.

DECREES AND REGULATIONS, ETC.

This system which I have outlined and summarized is gone into in great detail in various Decrees and Regulations framed by the French Government, and I am convinced that it is the best and most practical method of controlling the working of railways in war time. I believe that when this system of control was first introduced during the recent war the French civil administration did not quite appreciate the position—particularly owing to the restrictions it placed upon what might be looked upon as their own preserves, viz.: the civil traffic, but experience soon showed them the great advantages they gained, and I doubt if, by the end of the war, one civil railway official of any standing could have been found who did not fully appreciate and speak well of the system.

Quite apart from its inherent excellence, I think the result was in a great measure due to the ability and training of the French General Staff officers, who were entrusted with its execution. I hope to have time to refer to this point later.

APPLICATION TO BRITISH FORCES.

Now the point with us was how to apply this system to a British Army operating in a foreign country.

Had we been operating in British territory, it would have been comparatively simple to have placed the railways under military control, and form—on the French basis—Commissions for working them with the British military officer in supreme command, even though our regulations do not provide for such a course.

This is somewhat what we did in South Africa. Here the Cape Government Railways were not actually placed under military control—the conditions did not warrant it—but the railways in the Orange Free State and the Transvaal were so placed, and were worked under much the same kind of commissions as are laid down in the French regulations.

But, in France, we were working in a foreign and a friendly country, which naturally wished to retain control of its own railways.

Moreover, from first to last, and whatever its size, so far as the railway situation was concerned, the British Army was only a unit of the French Army—and in accordance with the principles of centralization I have already explained, its railway requirements had of necessity to be centralized at French G.H.Q.—so that no British railway move could take place without the authority of the French. Consequently, all British railway requirements had to be carried out under the authority and orders of the French Railway Commissions and in this respect from the outset, the British Army was completely under the orders of the French.

This situation must always be the same where a British Army is operating in conjunction with foreign troops in a foreign country—unless the British Commander-in-Chief is the Allied Commander-in-Chief.

In France, therefore, all British railway demands had to be placed on the French military member of the various Commissions. Now it is obvious, I think, that this officer was not and could not be in a position to discriminate, co-ordinate and regulate between the demands of the various British local services—or when these conflicted, to refer to some higher British authority for instructions.

Our first obligation, therefore, was to provide for a British officer to receive and co-ordinate all the demands of the various British services and place them in an ordered fashion before the French military members of the Commissions—in other words to establish a Liaison Service with them. This was the foundation of the British Railway Transport service.

The principles should be identically the same, if we were working with a British worked railway, though in such a case the demands would be placed before the technical railway representative direct.

In France, accordingly, we were obliged to duplicate with British officers all the French military members of the various Commissions, and our organization was framed with this object in view.

In fact, we had to parallel the French organization throughout—but this of course could not be done at the outset of the campaign, as we were in no way prepared for such a course. Fortunately our work in relation to the *Commissions de Réseaux* was considerably simplified, because our operations were practically confined to only two of the great French railway systems, the *Nord* and the *Etat*—and the major portion was on the former.

You will observe that the British officer who acted as Liaison officer with the French Commissions, in reality fulfilled two functions so far as the British Army was concerned. He was a commission in himself. He was in the first instance the military member on whom all the demands of the British Army was made—and in the second instance he was technical member who gave the best advice he could to the various British services as to how their demands should be put into execution.

Now if this British officer could not combine in an effective manner so as to meet the French views, the British railway demands, he had to refer them to higher British authority, and finally they would have to be referred to the highest British authority under the British C.-in-C. We had not been 3 months in France before we reached our first difficulty in this respect.

Our Difficulty in this Respect.

Who was the highest British authority in questions of railway transport? It is necessary for me here to touch on a somewhat controversial subject. I must do so because the whole railway organization for war depends thereon.

It is clear, I think, as I have already explained that there can be only one supreme authority on railway matters, but under our regulations at the outbreak

of the war, the Q.M.G. of the forces in the field was responsible for the maintenance of the Army in the field—and the I.G.C. for the means of maintenance, *i.e.*, G.H.Q. was not solely responsible for railways—and there was for all practical purposes a division of responsibility in this respect. The position was anomalous, and, moreover, did not correspond to the French system.

It is quite clear to my mind that the officer responsible for the maintenance of an Army must also be responsible for the means of maintenance—and accordingly in October, 1914, the position was rectified to a certain extent by the appointment of a British Director of Railways located at G.H.Q. directly under the orders of the Q.M.G. With this appointment some 3 months after the opening of the campaign the first step towards a satisfactory solution of the problem was attained. But the position was still unsatisfactory.

The Director of Railways had a representative at the H.Q. of the I.G.C. and so long as the regulations were not altered there was bound to be a certain amount of clash in the respective functions of the Q.M.G. and the I.G.C., particularly in so far as their powers of reference to French G.H.Q. were concerned.

A further step in the right direction was taken at the end of 1916, when the appointment of the I.G.C. was abolished.

Please bear in mind that I am only speaking from the railway point of view, though I think the argument might possibly be applied more generally.

But, on the abolition of the I.G.C., a new principal staff officer to the C.-in-C. was created, *viz.*: the D.G.T., under whose orders came the Director of Railways —and that is the present position in our regulations. I cannot help thinking that we went wrong here, in that we reverted to the original mistake of having one officer responsible to the C.-in-C. for the maintenance, and a separate officer responsible to the C.-in-C. for the means of maintenance.

Fortunately matters adjusted themselves gradually and automatically, and by the middle of 1917 or the commencement of 1918, it became quite apparent that the D.G.T., instead of being a separate staff officer, was for all practical purposes responsible to the Q.M.G. In fact, the practice for the last 18 months of the war was for all railway demands to be finally settled at a daily conference held by the Q.M.G. and this procedure was of invaluable assistance to the Railway Directorate.

I have felt compelled to give you this short narrative, because I want to emphasize most particularly, firstly, the absolute necessity for having one supreme military control of railways in war time, and, secondly, that this control can only be exercised by the officer who is responsible for the efficient equipment of the Armies, both in material and personnel.

The sooner we recognize this principle and alter our regulations accordingly, the better it will be.

It simply means that when a D.G.T. is necessary, this officer should be placed under the orders of the Q.M.G. and not given an independent status.

I have now explained to you, how we paralleled and duplicated the French system of control, and I have little more to say on the subject.

ADDITION WE MADE TO THE FRENCH SYSTEM.

In one respect, we went, I consider, one better than the French—though entirely on the same lines.

This was in the establishment of little railway commissions of our own in the forward areas. These were known as the Traffic officers of the Army Areas and the officer in charge was an Assistant Director of Railway Transport, or a D.A.D.R.T. The extent of their controls was not specifically confined to Army areas. Sometimes it happened to correspond with the areas occupied by an Army—but, as the latter were constantly changing, it was found better to constitute the Traffic officer's area as a geographical one, dependent on the position

of the railways. These commissions were quite unauthorized so far as the French were concerned—they had no official status with them—but they did invaluable work, and I believe Army Commanders had great confidence in them and thoroughly appreciated their presence. Their technical members were the local French civil railway officials, unofficially—or, in the case of the British operated lines, the technical officer of the British Railway-Operating Division, who was in charge of the working.

Incidentally, I should here like to point out that the British officers who paralleled the French staff officers on the various Commissions had no right and no authority to approach direct the French civil technical officers of the Commissions. Their only legal channel of communication was through the French military member.

In practice, and as the campaign proceeded and the French came to know us better, we were often allowed to go direct to the civil member. This became very marked during the last year of the war, when the French withdrew many of their station *Commissaires Militaires*, and left the work to be settled between our R.T.O.s and their station-masters direct.

The Actual Working of the Military Control.

Having detailed the general principles on which the control organization was based, I shall now proceed to explain what this military control actually did, and how it worked, so that should any of you at some future period be called upon to undertake its duties you will have something to guide you and you will know the main points to look to.

Before doing so, I must point out that so far I have dealt with my subject only from the point of view of control of traffic. I have not referred to the technical aspects of military transportation, namely, the military construction and the actual military operation of railways in war time. For the purposes of this lecture, I am afraid these may be looked upon as quite independent subjects, though if I have time I may be able to say something about them later on, and the organization necessary for the purpose.

Now the first and most important duty of the military control is to regulate and authorize all despatches, both military and civil—personnel and material. I cannot emphasize this duty too highly—and if fluidity and military efficiency of railways are to be ensured—too much attention cannot be paid to it.

You will find this principle will come up in various forms in the course of my lecture, but it resolves itself to one elementary and outstanding fact :—

No loading or despatch of a consignment of either personnel or material must be authorized, unless it is reasonably certain :—

(i) that the consignment will get through to destination,
(ii) that the destination station is or will be in a position to receive it,
(iii) that the consignment will be unloaded from the railway vehicles in which it has been conveyed, and will be removed from the station premises within a reasonable time after arrival, and
(iv) that the point of origin and the route to be taken is the best and most economical source of supply.

This is the cardinal principle of the military control and, to enable it to be adhered to, it is essential to have staff and good means of communication. As regards the former, we must have military representatives overseeing districts—in position at depots and regulating stations—and at large stations, all concentrating finally under one central authority, *viz.* : the Q.M.G.

Means of Communication Necessary.

As regards means of communication, difficulties will always arise—but there is only one satisfactory solution, and that is to give the military control an

independent telephone system, *i.e.*, not the Army telephone system *per se* —which is always overloaded and strained—but a separate railway control telephone system.

Here I must emphasize one fact—and it is no use burking it or putting it aside—it applies to the whole subject of military control.

The success of any campaign depends primarily on the efficiency of the means of transport—this efficiency depends entirely on the proper working of a military control—and this can only be ensured by as perfect a means of communication as can possibly be given between the various points. The better your means of communication, the more likely you are to obtain efficiency.

These remarks apply to all means of transport—but they are especially applicable to the primary means of transport, *viz.*: that by rail. Do not be misled by the idea that the railway telegraphs or telephones already in existence for the civil working of the railway will do your work efficiently. I can tell you that they will not. You must have independent means of communication.

At this stage of my lecture I am only touching somewhat lightly on this primary duty of the military control—but I shall have considerably more to say on the subject towards the conclusion, as it will then, I think, be easier for you to realize what it means in its true bearings.

UTILIZATION OF HAULAGE POWER AND LINE CAPACITY.

Once in a position to authorize despatches, the next great object of the military control is to consider how the haulage power available and the line capacity of the railway are to be utilized.

In military operations of the nature we have been undertaking during the last six years, and, in fact, during all military operations, it is most important that the haulage power, *i.e.*, the load behind the engine, and the running capacity of the railway should be utilized to the best possible advantage, and the object of the military control is to effect this.

We may take it as an accepted fact that in practice there is always a strict limit to both these factors, and that the haulage power and the running capacity are never sufficient to do all that an Army Commander would like to see done. No power on earth is likely to bring forth the necessary facilities in war time—for even in peace time they are often insufficient.

This being so, we come to what is probably the next most important principle in all matters of military transportation by rail—and that is the necessity for regulating all despatches, both of material and personnel, so as to make up full train loads from one station of despatch to one destination station, *i.e.*, the transit of any train should take place without the necessity arising for any vehicle or vehicles to be shunted off or cut off *en route*.

This was a very burning question with us in France, particularly during the first two years of the campaign, and here again I must particularly emphasize the importance of this principle, as, combined with the first principle, it really is the basic and fundamental factor by which the best military results are obtained.

I must go into the matter somewhat at length, because I want it thoroughly realized why this principle of full train loads is so important. It is obviously not easy at first for non-technical officers to understand why it should not be a comparatively simple matter for a railway to convey a few trucks from one station to any other station. Such a course is fairly easy—but—and the "but" is most serious—it means a grave loss of carrying power and running capacity.

As regards utilization of haulage power, it is obvious that reducing the load of a train by cutting off vehicles *en route* means the train running with a light load for a portion of its journey. In such a case, there is consequently a loss of haulage power and the engine is not being used to its best advantage during that portion of the journey when the train is running under load.

Waste of Running Capacity.

But it is in the loss of running capacity, that the most serious objection arises to the working of traffic in trains conveying wagons for several stations—*i.e.*, in trains not running direct from one point of origin to one point of destination.

The capacity of a railway, *i.e.*, the number of trains which can be run over any length of line with any degree of certainty, is strictly limited—and experience has shown that on a double line this limit may be taken as 6 *marches* per hour in each direction, *i.e.*, one every 10 minutes. I use the term *marche*—a French word in constant use, for which there is no single English equivalent. It may be taken as meaning a theoretical timing for a train. You may think this limit low, having regard to the fact that the Tube Railways can run trains every 2 minutes—and of course a much larger number could be worked over short lengths of line specially equipped with short block stations and plenty of sidings—but we have to take things as they are, and for all practical purposes this limit of 6 *marches* per hour on a fairly long length of double line equipped for normal traffic may be accepted as a fact. Even this limit errs on the high side, and would be found in practice impossible to maintain for any lengthy period.

Now having explained the capacity question, I want to make it quite clear how it is that the working of trains in other than full train loads to one destination affects this capacity, and I would ask you to bear what I am about to say particularly in mind, if at any time in the future you are doing the "Q" work of a force.

Loss of Capacity Due to Shunting.

The shunting-off at a station of a wagon or wagons from a train means in practice a minimum detention of 10 minutes to that train, *i.e.*, a *marche* timing, during which the train should be running, has been wasted at the station, and consequently, the capacity of the line beyond that station has been reduced by one *marche*. That *marche* has been lost for ever, and the train when it starts forward again, after having completed the shunt, has to occupy a *marche* which otherwise would have been occupied by another train coming from the base.

The stoppage of that train for the purpose of cutting off one or two wagons has reduced the available capacity of the railway for supplying the forces in the field by one full train load—and there is no getting over that fact whatever the capacity of the line is. I do hope this is quite clear, and though cases must arise where the principle must be departed from, that you will realize the utmost importance of trying to adhere to despatches in full train loads—whether of material or personnel, from one single point of origin to one single destination.

Difficulties of Despatch of Small Consignments.

There is another grave objection in practice to the despatch of single wagons or of small numbers of wagons, and that is the great delay which nearly always occurs in transit, and which cannot be got over.

A full train load can go direct to destination without delay *en route*. A single wagon has to pass through a number of junctions or regulating stations and be there joined up with other wagons to form a train load. The result is a large amount of work and much unavoidable delay. The goods arrive very late and if perishable are often spoiled.

I am not exaggerating when I say that where a train load might take 12 hours for a journey—a single wagon might easily take a week—and this is almost equally applicable to peace as well as to war.

It is infinitely better to hold over loading and despatches for 2 or 3 days, and endeavour to make up as large a number of wagons as possible, than to send off one or two wagons daily.

The fact that demands are marked "most urgent" by the indenting officer

at the front will not, I am afraid, in practice accelerate transport over the railway.

We had the most extraordinary difficulties to cope with in regard to this question of full train loads during our first two years in France—particularly in connection with the despatches of ammunition, reinforcements and R.E. stores.

These difficulties were due to causes over which we had no control—namely, the serious shortage of our reserves—in fact, we had none. It was a case of living from hand to mouth.

Ammunition had to be forwarded to the front—as it arrived—directly off the ship in small consignments to a number of different stations and the railway difficulties and loss of capacity incurred by this course were very great.

As supplies of the various material improved we were able to combine despatches in full train loads for 2 or 3 stations, more or less, on the same line of railway—but it was not until the end of 1916 that our reserves became such as to enable us to despatch in full train loads for individual stations.

The extraordinary simplicity of the ammunition supply, when we were despatching 30 to 40 full train loads a day—each to one destination—was remarkable.

The longer the line of communications, the more essential it is to adhere to the full train load principle. For instance when we sent our troops to Italy, and the bulk of their supplies had to be obtained from our depots in France, it was physically impossible to despatch, with any reasonable hope of getting through, the material and supplies required other than in full train loads.

THE SPEED OF TRAINS.

I have one more point to mention in connection with the utilization of a railway to its best capacity—and this relates to the speed of trains.

Now, apart from the grades of the line and the length of the passing sidings, the speed depends on the load—or the load depends on the speed—whichever way you like to put it.

There is, however, a combination of speed and load for every type of engine, which gives the best economical result.

In France this was found to be a maximum load of 50 four-wheeled vehicles, say, 750 tons—running at some 15 to 18 miles an hour. For the Italian traffic a load of 40 vehicles only was the maximum permitted, consequent on the grades over the Alps.

Now to obtain the greatest output in a given time at the end of a certain length of line, it is necessary to run all trains at the same speed following each other regularly. I tell you this as a fact. If you try to interpolate a fast train between a service of slower trains, the capacity of the line is immediately reduced. The slow train has to be held up at a station, while the fast train passes it—not only for the period of running of the faster train to the station in front but also for the period of running of the faster train from the station behind.

In this way practically two *marches* are lost.

I mention this because you will always find pressure being exerted to run certain trains—as for instance ambulance trains—faster than others. It cannot be done without a serious loss of capacity and considerable delay to other trains.

Accordingly, the time tables over a line utilized for military operations must be framed at the same speed and both the civil and the military traffic must be run at this speed. This was almost the invariable practice followed by the French, and was consequently applicable to us.

CONTROL AND EXECUTION OF TROOP MOVEMENTS.

I shall now proceed to tell you how troop movements by train were controlled and executed in France—and this branch of my subject intimately concerns all staff officers, whether G.S., A. or Q.

These movements while military operations are in progress can be divided into the following categories :—

(i) strategic moves of large bodies of troops—consisting of one or more divisions.
(ii) moves of small bodies of formed troops—such as battalions by themselves—H.A. batteries.
(iii) tactical moves.
(iv) movements of ambulance trains.
(v) movements of reinforcements.
(vi) movements of isolated bodies and individuals.
(vii) movements of leave trains.

It might not be thought so, but the first item of all, *viz.* : the big strategical move is—under the French system, which of course was equally applicable to us—the simplest move of all to make, mainly because it is the only one where regularity of movement can be attained.

The principles on which a strategic move was made in France, are of so simple and practical a nature and so effective in execution that I must explain them in detail. They are radically different to hitherto accepted British practice.

Some of you may remember how the mobilization of the original Expeditionary Force was effected, and how the troops were carried to the embarking ports. They were conveyed in trains of various types of composition, corresponding to the number and nature of the troops to be carried.

I cannot tell you how many different types were actually used—but their number was large. The trains were therefore not interchangeable to any great degree—and this necessitated a great deal of work, both in forming them and then moving them to the desired points of despatch.

In France a totally different system is in force. At the outbreak of war there were only two kinds of trains authorized and available for the carrying out of big troop moves.

These trains were known as—

The *type combattant*, and
The *type parc*.

Each of these trains consisted of 50 vehicles—*viz.* : the economical load to which I have referred before.

The 50 vehicles were—2 brake vans, 1 second or first coach for officers, and 47 flat and covered wagons, the former for guns and vehicles, the latter for men and animals.

The *type parc* contained a larger proportion of flat to covered wagons than the *type combattant*.

The *type combattant* was intended for the conveyance of units such as infantry battalions, where the proportion of personnel to animals and vehicles was large.

The *type parc*, with a larger proportion of flat trucks, was provided for units such as artillery batteries, where the contrary was the case.

A large number of these type trains were in permanent commission—they were distributed among the various *Réseaux*—stabled or garaged at convenient central stations, and their utilization was solely under the orders of French G.H.Q., who moved them from one system to another as circumstances required —or increased or reduced their number according to circumstances.

Such an arrangement ensured the minimum amount of rolling stock being set aside for troop movements, a very important consideration when it is remembered that there is a continual shortage of stock in war time.

You will readily grasp the simplicity of the system—the flexibility or *souplesse* as the French would call it.

A Strategic Move.

A division had to be moved from one point to another. It was known at the outset how many trains of each type were required. The length of journey was also known, and once the rate of movement was fixed, the number of rakes of stock of each type required could be easily calculated. The slower the movement, the fewer might be the number of rakes required, as the first trains utilized could be returned to do additional trips.

The rate of movement would be fixed by French G.H.Q., who would issue the orders to the various Commissions concerned. If there were not sufficient rakes of the types required on the system on which the move originated, G.H.Q. would order additional rakes to be sent from other systems.

The railways were thus never required to make up a number of special rakes of stock at short notice.

The method of demand, so far as the British were concerned, was quite simple.

Our G.H.Q. wanted to move a division from A to B. They advised their Director of Railways, specifying the time at which the division would be ready to start, the rate of movement required, and the entraining and detraining stations required. The latter point was only indicated after consultation with the Director of Railways.

The latter officer immediately communicated the information to his colleague at French G.H.Q.—and in a short time received from this office full information as to the move and the time the first train would be at the first station.

The position and system were such that complete divisions could be moved at very short notice. In fact divisions brought back into reserve were often put on 9 hours' notice (even less in some cases) which meant that on the movement being ordered, the first train would be ready for loading 9 hours after the order was given.

To ensure no delay, the first duty of the divisional staff on being brought back into rest was immediately to get into touch with the Traffic officer of the area, and in conjunction with him prepare an entraining programme for the division.

Alteration in Type Trains—the *Type Universal*.

About the middle of 1917, the French came to the conclusion that this system of having two types of trains was unnecessarily cumbersome, and they further simplified matters by introducing one type only, which was called the T.U. or *type universal*.

It consisted of 50 vehicles as before—2 brake vans, 1 coach and 47 flats and covered wagons—the number of flats being more than in the *type combattant*, and less than in the *type parc*.

I may say that we experienced no difficulties whatever in the first place from having to use only two types of trains for all the units of a division, and latterly from the utilization of only one type. Of course, we were obliged to take full advantage of the accommodation provided in the type trains, so as not to waste train room, haulage power and capacity, and for this purpose units had often to be broken up and despatched in two or even more trains. No real inconvenience was experienced from this cause, so long as each portion of a unit was entrained and detrained at the same station, and this was easy to arrange.

Rate of Movement.

I must now tell you about the rate of movement and the fixing of entrainment and detrainment stations, which is governed by the rate of movement.

First as to the rate of movement. The maximum number of *marches* for a strategic move over a fairly long length of double line can be taken at 1 per hour—*i.e.*, 24 trains in 24 hours. This number may appear small—but even it can only be attained if all other traffic and superfluous trains are reduced to a minimum.

Quite apart from finding the rakes of stock—a more or less simple proposition as already explained—the engine power has to be found. That is always a difficult problem. You can rarely afford to keep sufficient engines lying idle for problematical moves. Consequently, when a move is ordered, a large portion of the engine power has generally to be found by the suppression of other trains.

Moreover, while the strategic move is in progress the daily supply and maintenance of the Army have to proceed as usual.

In any case this maximum of 24 trains per 24 hours over one double line was never exceeded throughout the campaign, even at the most strenuous times, and we may consequently look upon it as the maximum. In England, a division requires some 80 trains to move it. In France, with the type trains, a British division, as finally constituted, required 35 trains only. It therefore follows that if a division was in readiness to move at 9 hours' notice and allowing 3 hours for the entrainment of each train—say, 12 hours for the run and 3 hours for the detrainment of the last train—the whole of the move would be complete and the troops would have left all detraining stations in $9 + 3 + 34 + 12 + 3 = 61$ hours, provided the rate of movement was 24 trains per 24 hours.

The time the movement would be finished if the rate was reduced can easily be worked out.

Entraining and Detraining Stations. Number Required.

Now as regards the entraining and detraining stations.

The number required depends on the rate of movement and the facilities available at the stations.

The majority of stations are not equipped with long high platforms, which afford the easiest and quickest method of loading and offloading troops, animals and vehicles.

They are built mainly for civil traffic and generally speaking are provided with a ground level platform—with possibly a small length of raised platform holding 3 or 4 wagons—and sometimes an endloading dock besides.

Now at such a station, it has been found in practice that a minimum period of three hours must be allowed for the entrainment of troops, animals and vehicles into a type train.

Consequently, only 8 trains can be despatched from any one station during 24 hours.

It therefore follows if the rate of movement is fixed at 24 trains per 24 hours, that three separate stations must be utilized for the entrainment of a division.

If the rate of movement is only 8 trains per 24 hours, the whole division can be entrained at one station.

Similarly, it is necessary to allow 3 hours for the detrainment of a type train, and for the troops to clear the station, and consequently 3 separate stations are required for the detrainment of a division moving at the maximum rate.

In practice, the use of 3 entrainment and 3 detrainment stations will as a rule be found most convenient for a move at a lower rate than the maximum, because sufficient billetting accommodation for a whole division will rarely be found in the neighbourhood of and at a convenient marching distance from any one station, and the use of more than one station saves the troops considerable fatigue in marching to and from their entraining and detraining points.

Towards the end of the campaign, the French found that this period of 3 hours for entraining and detraining was running matters too fine, and they accordingly increased the time to 4 hours, thus reducing the use of any individual station to 6 trains a day, and necessitating the provision of 4 stations for entrainment and 4 for detrainment of a division moving at the maximum rate. As a matter of fact, the British troops established such good records for celerity in entraining and detraining that we were allowed generally to retain the 3-hour principle for our moves.

In selecting entraining and detraining stations it is essential of course to choose stations which have sufficient accommodation, and it will often be found necessary to clear them and close them down to all other traffic while the entrainment or detrainment is in progress.

Of course, the time required for loading and unloading is considerably reduced and the actual operation greatly facilitated by the use of a high level platform. A broad double high platform, the full length of the train, with lines on each side, will permit of a train being received or despatched every hour, but you will easily see that the provision of such facilities makes very little difference in the long run in the total time required for the move of a division.

In fact, the only gain is obtained in the loading of the first two trains, and the unloading of the last two, and the time for the move of a division at the maximum rate, would be reduced by 4 hours, *viz.*: from 61 to 57 hours.

One need not in practice therefore attach very much importance, in the case of a big strategical move, to the provision of good loading and unloading facilities.

At large military centres where the concentration of troops in the neighbourhood is possible, it would be necessary to provide several loading or unloading points, so that 3 or more trains at the same time—4 would be the maximum—would be required at any place where there was only one main line.

When continuous high level platforms are not provided it is necessary however to equip the loading and unloading points with certain apparatus for transferring vehicles and animals from the trucks to the ground level and *vice versa*—and the three necessities are, what the French call, (i) *Rampe mobile*, (ii) *Rampe Volant*, and (iii) *Pont Volant*.

The *rampe mobile* is for animals, from truck to ground and *vice versa*. The *rampe volant* for vehicles similarly. The *pont volant* for bridging the space across the buffers between the flat vehicles.

Flares are also necessary for night working and a supply of ropes and scotches for fixing vehicles.

I think we slightly improved on the French system by providing at all entraining and detraining stations small parties of trained men—Pioneers—say 5 men and a N.C.O. in charge, for the special purpose of assisting the troops in loading and unloading the trains, and these men were of invaluable assistance.

I need hardly mention the utmost importance of troops arriving in time for the entrainment—and of detraining rapidly and clearing the station premises, so that the station is ready for the next troop train.

Additional Stations Required.

In addition to the three detraining stations referred to, for a big strategical move two more stations are required.

The first of these is the detrainment regulating station. This station is generally a separate station, a few miles behind the rearmost detraining station which has been fixed on. It may, however, as was often the case with our moves, be the rearmost detraining station itself.

It is the station at which the troop trains obtain their final destination, as circumstances may have changed since the move started and it may have become necessary to alter the original destinations. This did not as a rule happen with our short moves.

The second additional station required is a Reserve Detraining station. As troop trains almost invariably require a considerable amount of shunting in being discharged, it is quite easy for an accident to occur blocking the yard, or the trains may be running very late and catch up each other. It is therefore advisable to provide for a detraining station in reserve which can be utilized in case of an emergency. Orders for diverting a troop train to such a reserve station would be given at the Detrainment Regulating station.

It should be noted that it is rarely practicable for a station, which is in use as a railhead for supplies, ammunition, etc., also to be used for troop movements—though of course it depends on the accommodation available. If it was essential to use such a station, it would be necessary as a rule to shift the railhead for a day or longer—and this course was often adopted.

Small Troop Movements.

I now come to the second item of troop movements, *viz.*: the move of small bodies of formed troops, such as Battalions or Batteries by themselves.

The *Commission de Réseau* had the power as a rule to arrange such a movement, when the use of only a few rakes of stock was required, and the move was confined to the system on which it originated. If the move was from one system to another, the authority of French G.H.Q. was necessary.

We consequently usually applied to the Commissions direct for such moves. During the crisis of 1918, the powers of the Commissions were, however, extremely limited in this respect—as at that time it was more essential than ever for French G.H.Q. to retain in their hands the most concentrated control over the rolling stock.

Type trains are always used whenever possible for these moves—but in many cases it is necessary to provide trains of a special composition with specially selected vehicles—as in the case of the move of Heavy Artillery Batteries. The formation of such special trains was always an extremely difficult task for the Commission and took a considerable time. Hence the moves of such units always gave a good deal of worry and trouble—and necessitated the use of stations with special facilities for loading and unloading.

Tactical Movements.

The third item is tactical movements. These generally are of two natures. The first is the movement of the personnel of a division short distances to save fatigue to the men, as for instance when going into or coming out of the line to and from their rest billets. Where this can be done, it is obviously a great relief to the men, especially in bad weather, if they are saved a 12- or 15-mile march, and moreover, it is often of considerable advantage in alleviating congestion on the forward roads.

It is not of much advantage, unless the front detraining or entraining station is well forward, and the utility of tactical trains for this purpose is considerably discounted as soon as the forward stations come under long range artillery fire.

The second use of tactical trains is for the purpose of rapidly moving the infantry of a division—either in reserve or from one part of the line to any threatened point, their transport proceeding by march route. Their utilization for this purpose depends almost entirely on the geographical situation of the Railway lines in relation to the Front and the billetting areas. It will be remembered how, in another part of this lecture, I have pointed out that a short distance move materially affects the capacity of a line, and this point must also be considered in relation to tactical moves by train; particularly when the move passes over any section of a through route.

Very often, however, these moves are required in the forward areas, where there is possibly no through traffic—and though they always require a large consumption of engine power and laying up of rolling stock, in any case their advantages are sometimes so obvious, that all other considerations must give way to them.

For the purpose of effecting both classes of tactical moves, the Commission had at its disposal groups of 4 or 5 trains permanently mobilized. Each of these groups would carry a Brigade—3 or 4 of the trains being for personnel only—and the fourth or fifth trains for the 1st line transport. Under no circumstances

can troops be separated from their cookers. Permanent arrangements were made by us with the Commission for running these trains—and the arrangements were such that we could get them on 3 hours' notice.

I may say that in practice the movement of these trains was exceedingly irregular, and nothing like so punctual or good as a big strategic move. They were always in fact exceedingly difficult to run—and it is not possible with such very short notice to rely on troops, particularly those in rest billets, arriving punctually at the entraining stations. The trains were very often detained for the troops—an incident which very rarely occurred in a big strategic move.

Ambulance Trains.

The fourth item—the move of ambulance trains—will not detain you long. Ambulance trains are naturally a varying quantity depending on the number of casualties and the amount of sickness.

Generally speaking they are of two kinds :—

Regular Ambulance trains formed of special corridor stock—specially constructed and fitted, and always in commission, the provision and formation of which is outside the scope of this lecture, and Temporary Ambulance trains formed of ordinary passenger stock mobilized only for special occasions on the demand of the Military Control. Both classes of trains must be treated in the same way as any other trains so far as their running is concerned. As I have pointed out previously it is impossible to give them preference and specially fast timings, without as a rule seriously affecting the efficiency of the Railway. Temporary ambulance trains were always in great demand by the Medical Authorities at the commencement of operations. Their carrying capacity was about double that of the regular train—and they were used for sitting-up cases—lightly wounded and sick. They therefore were invaluable for clearing the Casualty Clearing Stations quickly. In order to prevent trains being run under load, it is always necessary to keep a close eye on the demands of the Medical Authorities, as naturally their great object is to keep clear the Casualty Clearing Stations and Hospitals at the front. In the case of operations, it was invariably found that the Medical estimates of requirements were much in excess of the actual casualties—and we soon were able to calculate to a nicety the number of trains which would be required for any given operation. For obvious reasons this number is less in case of a retirement than in the case of an advance.

Concentrated control of the working of ambulance trains is always essentially necessary—and this is one of the few cases where in France we, *i.e.*, the British, had our own trains and exercised our own control, though of course the actual running was arranged through the French Commissions in the usual way.

Reinforcements.

The next item for consideration is the transport of reinforcements—and this was one of the most complicated Railway problems we had to deal with—particularly during the first two years of the campaign. Naturally the A.G. and every Corps and Divisional Commander wanted the reinforcements delivered as soon as possible and at the nearest station—and this however small in number they were. You can readily grasp how the full train load principle comes into this question. The ideal position would of course have been ability to despatch a full train load for each Divisional railhead—say for a Corps—if not for an Army. Unfortunately we were never in a position to do anything like this for the first two years. Reinforcements were few and far between.

Every possible means was tried of getting these reinforcements forward.

They were put on Divisional Supply trains—run on civil passenger trains—but nothing we could do was satisfactory until we were in a position to run full train loads from the bases to the Armies.

Until this position was reached, the delays in transit were very great—work at the Regulating Stations greatly hampered—and much inconvenience and discomfort caused to the troops concerned.

I should like to mention here, what I have said before, that it is infinitely better and much quicker in the long run—to hold up reinforcements at the Base for 2 or 3 days—and thus obtain bigger loads, than to attempt to despatch them off daily in small bodies as they are ready, and I should like this point particularly remembered.

Isolated Movements.

Whenever there is a large body of troops operating, we shall always find a large number of isolated parties requiring transport on the Lines of Communication.

We had somewhat the same difficulties in dealing with these isolated bodies in France as we had with the reinforcements. The difficulty was to find a train service for them.

The only solution which gave satisfaction was the running of a regular daily train each way throughout the whole of the back area occupied by the British Army. On this train the necessary accommodation was arranged for parties joining *en route*, through the local representative of the Director of Railways.

Leave Trains.

The last item of "Personnel" movement in war time that I shall deal with is the Leave Service. I shall not say much about this. You all probably have had some experience of Leave trains—unpleasant, I am afraid, as a rule.

All I wish to say is that this service in France was without any exception or reservation the most difficult railway problem of all to tackle. The complications which arose in endeavouring to arrange a satisfactory Leave Train Service were extraordinary. The conditions were complicated by many of the factors I have already mentioned—and by many I have not referred to—one of which was the unavoidable irregularities in the cross-Channel service.

We never really arrived at a solution satisfactory to all parties. The nearest we attained was in the conversion of ambulance trains into leave trains for the Army of the Rhine. A long treatise could be written on the efforts made by the Q.M.G. and the Railway Directorate to ensure a satisfactory service.

The main difficulties were always the full train load question and the provision of suitable stock, the former being always the crux of the problem.

The same difficulties will I think be found in all campaigns—and this service and that for reinforcements will I am sure be those which will always give rise to the greatest difficulties.

With the single exception of regular ambulance trains, in all the various kinds of personnel movement to which I have above referred, arrangements must be made to stop the trains at intervals of 5 or 6 hours, for a period of half an hour to an hour for the purpose of feeding the troops and watering or feeding the animals, etc. It is unfortunate that this is a necessity, because it means a loss of capacity—but it has to be done.

The stations, at which this work is carried out, are called in France *Haltes Repas*—and this provision forms part of the French system.

In addition to these halts, we found that the most satisfactory solution for providing food for the troops, on leave and demobilization trains, particularly, was by the provision of kitchen vans run by the Expeditionary Force canteen.

Supply and Maintenance of an Army.

I now propose to give some information as to the methods adopted for arranging and controlling the supply and maintenance by rail of an Army in the field. As

you are aware, the troops in the field draw their supplies by means of M.T. Supply Columns at convenient rail-head stations at which the supplies arrive by train.

This train not only conveys the actual supply pack of one day's food for the division or formation—but also carries all the miscellaneous articles required for the maintenance and comfort of the troops, such as ordnance stores, mails, medical stores, veterinary stores, M.T. stores, petrol, E.F.C. and Y.M.C.A. stores, comforts and similar articles.

For the purpose of secrecy and convenience, the supply pack of each division or formation such as Army Troops or Corps Troops is given what is known as a section number—and the pack is known as a section.

All railway vehicles carrying supplies or stores for this division or formation are consequently labelled with this section number.

Of course what is being sent up depends on the strength and demands of the formation concerned, but generally speaking we found in France that the supplies and stores for 2 sections—say 2 divisions—were sufficient to form a full train load.

The number of sections which can be dealt with at any one railhead depends on the capacity of the station. Usually it was found that 3 sections—we will call them divisions for simplicity sake—were the maximum number which a station could deal with—and in practice it will rarely be found necessary to deal with a greater number. The number depends on the area occupied by the troops—their density—the range of the supply columns—and the extent and situation of the railways.

NECESSITY FOR REGULATING STATION.

Now whether the troops are advancing, or retiring, or in a stationary position, the railhead for any given formation may change from day to day.

Moreover it is necessary for the supply train to arrive at the railhead before noon each day—and it is also most important—for reasons which I shall go into later—not to send up to railheads anything which is not wanted or more than is wanted.

Therefore with the main object of ensuring elasticity, it is necessary to fix on—or even to construct—a station, some distance behind the railheads, at which each supply train can receive its final orders as to destination—and at which the train itself can be finally put together and marshalled, so as to comply with the latest strength and demands of each formation, which vary from day to day.

The station selected or constructed must be sufficiently close to the railheads to ensure supply trains leaving it overnight being at the railheads at a convenient hour next day, say between 6 a.m. and noon. This distance may be taken as not more than 75 miles. This station is called the Regulating station, and in all Military Railway Transport, it fulfils the most important functions of all and is the primary means of ensuring the correct and regular supply of the Armies. In practice I may say that the maximum number of sections which can be dealt with at any regulating station is from 24 to 30, but for this number a very large station is required.

In connection with the use of a regulating station, I might mention the desirability of all stores and supplies for the same formation arriving at the railhead at the same time, as this course greatly facilitates the economical and regular use of the road transport. We thus obtain another advantage for the avoidance of small despatches—and from adherence to the full train load principle, which is gained by the use of a regulating station.

DEPOTS.

Now all the supplies, stores and various items I have mentioned as constituting the daily supply of the Army in the field must come from depots.

These depots would normally be located in the neighbourhood or adjacent to the regulating station—as the correct make up and punctual despatch of the Supply Train from this station depends on the regular arrival of the various commodities—and this can only be ensured with any certainty, when the depot is close by. This would usually be the course adopted in a country where the main portion of the supplies is derived from the country itself, as was the case with the French.

With the British, however, all our stores and supplies were imported by sea—and this would nearly always be the case with our operations.

Consequently when the Expeditionary Force first landed in France, there were no depots available for our use, outside the ports, and we were obliged to occupy portions of the dock areas and sheds therein as depots.

This course, though in theory radically wrong, was forced on us. It was not of grave moment while the Expeditionary Force was small—but as the force expanded, we soon got into serious difficulties.

Fluidity in a dock area is of equal importance as fluidity on a railway. The major portion of the accommodation provided in docks, including the hangars or sheds, is provided for transit purposes only, and must be treated as such. The moment other use is made of this accommodation, congestion is bound to arise, the discharge of ships delayed—and a reaction sets in, the effects of which are soon felt at the loading ports overseas, and at the warehouses and stations of origin in the country of despatch.

It soon therefore became essential for us to establish depots outside the ports both for supplies, ammunition, ordnance stores, R.E. stores, etc., in fact everything which is required for the maintenance of an Army.

In fixing the sites for these depots there are many points which have to be taken into consideration :—

The importing points.
The situation as regards railways.
The line of advance and position of the armies.
The position of the regulating stations.
Considerations in regard to aerial warfare, etc.
Avoidance of cross traffic and port-to-port traffic.
The available land.

As mentioned previously, the most convenient site for a depot is in the neighbourhood of the regulating station, but if at the same time, circumstances permit of the depot being placed close to the importing point, an advantage is gained in celerity of clearance of the material as it arrives at the port and is discharged.

Now as the position of the front line in the case of the Northern Ports in France was only some 50 or 60 miles from the coast, we were consequently able to establish both the regulating stations and the depots served from the Northern ports in the immediate neighbourhood of these ports themselves.

We were not able to follow this in the case of the Southern ports owing to their distance from the front, and so here we constructed depots inland, as close as possible to the regulating station.

The depots for ammunition and R.E. stores would usually be provided with their own regulating stations.

Incidentally I may say that the provision of depots and regulating stations necessitates a very great amount of construction work.

When a depot has to be constructed, otherwise than as an integral portion of the regulating station, it is most important to site it in such a manner as will ensure its contents being worked to the regulating station with punctuality and regularity, as it is on this regular flow that the despatch of the Supply trains depends. It is often better to construct an independent line between the depot and the regulating station, rather than to trust the working of the traffic to the main line of railway.

Moreover utilizing the main line for a short distance for this purpose is equivalent to a short distance move, which reduces the capacity of the main line, as has previously been mentioned.

CROSS TRAFFIC AND INTERPORT TRAFFIC.

In regard to the siting of a depot or regulating station, I have referred to the necessity for considering the site from the point of view of cross traffic and interport traffic.

When a railway is greatly strained, as may be taken to be its usual situation when large military operations are in progress, it is obvious that it saves unnecessary haulage and occupation of the line if the stores are imported at the port nearest the depot for which they are destined, and thence conveyed to a regulating station on the direct line of advance, rather than that they should be imported at some distant port and transferred thence by rail to a depot nearer some other port—or to a regulating station which is not on the direct line to the front.

If ships containing certain commodities in regular fixed proportions could always be brought into the right ports, the problem would be simple.

Unfortunately it is not possible always to effect this in practice, whatever efforts are made.

Moreover the peculiar nature of the shipping conditions during the late war made matters in this respect more difficult than they normally would have been.

Consequently the railways were called upon to carry port-to-port traffic—or depot-to-depot traffic—or depot to the wrong regulating station, in accordance with the position as regards the reserves from time to time. I am afraid the necessity for this will arise in all campaigns.

It must be avoided whenever possible—and can only be reduced to a minimum by the Military Control Officers keeping a constant eye on what is being imported, and working in very close co-operation with the big Directorates.

EXAMPLE OF "BREAD."

I will give a practical instance of what I have said above in explaining how a certain item reaches the troops—and for this purpose I will take "Fresh Bread." The first thing to do is to establish a Bakery. This could be done either at the proposed port of entry of the flour, or at the regulating station.

As a matter of convenience we established our bakeries in France at the ports—one at Dieppe for the Southern Armies—and one at Calais for the Northern Armies.

So long as the ships containing the flour arrived at Dieppe or Calais in the proper quantities the position was simple. The flour is unloaded into truck—conveyed to the bakeries—and turned into bread. The bread is loaded into wagons in correct quantities for the various sections, in accordance with their demands received through the Armies.

The various trucks for the sections based on a given regulating station are then combined together—and despatched in a full train load to that station. On arrival at the regulating station, the train is broken up—and the wagons on it are marshalled together with all other vehicles carrying the various commodities and bearing the same section number.

As soon as this operation is complete, and two sections combined to form a full train load, the train is ready for despatch to the railhead. But if, as often happens, the flour ships arrive at the wrong ports, or reserves of flour at the bakeries get low, flour must be immediately transferred to the deficient bakery from some other port as it arrives thereat, or from some other bakery. For instance, a flour ship often arrived at Havre—it was too large to enter the port of Dieppe—and its contents had consequently to be transferred by rail to Dieppe.

Now this meant at once two movements by rail between Dieppe and Romescamps (Romescamps being the junction on the main line from Havre to Dieppe), one forward of the flour and one back of the bread—and one movement between Havre and Romescamps—whereas if the flour had arrived at Dieppe, there would only be one movement, *viz.* : that of the bread from Dieppe to Romescamps.

This is the sort of movement which has to be avoided.

Depots away from Regulating Stations.

When the depots are close to or form part of the regulating station, the regular daily flow of their contents, in the right quantities to form the sections on the supply trains, can generally be assured without difficulty—but if the depot is some distance away from the regulating station, communication by rail may be temporarily interrupted owing to accident or other cause—and the regular daily flow suspended.

This position must accordingly be legislated for, and in such cases what the French call *En Cas Mobiles* must be formed at the regulating stations.

These *En Cas Mobiles* may consist of supplies—or if necessary ammunition—nothing else as a rule—ready loaded on trucks. These loaded trucks can be drawn on at once if the regular daily supplies from the depot are not coming forward, placed on the supply trains and forwarded to railhead without delay to the latter trains.

Of course one cannot have *En Cas Mobiles* of " Fresh Meat " and " Bread " for instance. Here " Bully " and " Biscuit " would be held in *En Cas Mobiles*.

It is the business of the Military Control to keep these *En Cas Mobiles* down to the lowest possible limit—in order not to waste rolling stock.

Advanced Regulating Stations.

As an Army advances the time arrives when its supply trains cannot reach railheads at a suitable hour the next morning after leaving the regulating station.

Under such circumstances it becomes necessary to establish an advanced regulating station nearer the front. The work at such a station would not usually be on such an extensive scale—though the same principles apply generally to its working. This happened to us during the advance to the Rhine, during which we had to establish two of such stations before finally settling down again.

Under such circumstances the supply depots are not shifted, and consequently *en cas mobiles* have to be maintained at the new stations.

I have now given a brief outline of the main functions of a regulating station and of its relation to the depots. The work thereat is extremely difficult and intricate, and involves an extraordinary amount of hard work both on the part of the Military Control and of the actual technical staff.

I have referred hitherto to traffic going to the Armies—but the same principles apply generally to return traffic from the Armies, of which there is unfortunately with us a great deal. This also is dealt with at the regulating stations, and means an enormous amount of work—which is largely alleviated by adhering to the full train load principle whenever practicable.

Difference between French and British Systems.

I should here like to explain the difference between the French and British systems at the regulating station.

Under the French system, the *Commissaire Régulateur* is in supreme control of both the station and the depots.

The Army in front places its demands on him—not on the depot officers—and he alone is judge of what should and what should not be sent forward—when and how—and how the demands should be regulated and co-ordinated. With us

the depot officer comes under the orders of his own Director, and receives the demands direct from his Director's representatives with the Armies.

He then communicates these demands to the Director of Railways' representative at the regulating station, and the latter does his best to co-ordinate all the demands and place them before the French *Régulateur*—or the *Technique* as the case might be.

KEEPING RAILHEADS CLEAR.

There is another matter, I must mention, in regard to which a Military Control is of great value.

At the beginning of my lecture, in considering the functions of a railway, I referred to the importance of keeping stations clear, and of not holding wagons under load, if fluidity and efficiency were to be maintained.

The latter point only is referred to in our *F.S.R.* and then not quite in a satisfactory way.

I want to explain the reasons for this more fully, as there is a good deal more in it than a casual observer sees.

Quite apart from the necessity for economizing rolling stock by quickly unloading and releasing it—a very important consideration in all Military Railway Transportation—the vital fact remains that one must be prepared to utilize, at very short notice, the whole capacity of practically every station—I speak particularly of railhead stations and stations within 50 miles of the front—for the purpose of the big strategical move.

If, for instance, a station is being used as a railhead for supplies, or for ammunition, we *must* be in a position to close it down for this purpose at practically 12 hours' notice, in order to utilize it for the entrainment and detrainment of troops.

There is only one way of ensuring this fluidity and flexibility, and no other, and that is not to block the entraining or detraining area with material or buildings, or the station lines with vehicles under load or waiting to be discharged.

A contrary course for all practical purposes prohibits the use of a station for a strategical move, and moreover seriously reduces its capacity for the reception and delivery of the ordinary consignments of military material.

Incidentally it also materially affects the turn round and efficiency of the Mechanical and Horse Transport, which comes to take delivery of the material, by restricting and hampering their movements in the station yards.

Throughout the campaign, the French Military Control were particularly insistent on this matter—they had suffered fatally in the 1870/71 war from non-adherence to this principle.

OUR DIFFICULTIES IN THIS RESPECT.

The British Military Control had extreme difficulty—more largely during the first two years—in pressing this requirement on the various departments of the British Army. Here again we may have been hampered to some extent by the shortness of reserves or of road transport, but it is difficult to understand, and I cannot believe that any real necessity existed, for dumping ammunition—in some cases to the extent of 2,000 or 3,000 tons—on station premises at an ammunition railhead—or for supplies and ordnance being permitted to have offices and large dumps in station yards—or to hold reserves on truck at the railheads.

Various reasons no doubt can be urged for this course, but to my mind they can be summed up in two—a mistrust of the means of transport—and a mortal terror of the Army running short or not having any demand met.

It seems to me that it is often overlooked that if the railway is going to break down to such an extent as will prevent supplies going forward, the campaign must either be brought to a close, or the troops retired to a position where they are again in touch with the rail.

Temporary interruptions can always be legislated for by the establishment of Field Supply depots of a reasonable size—but these should invariably be off railway premises and the railheads kept clear.

During the early part of the campaign it was the constant and iniquitous practice to keep the railhead moveable by retaining all surplus supplies and stores loaded in truck, apparently with the object of ensuring mobility—the very last result it gave.

When the truck shortage became acute the contents of these trucks were dumped on the ground at the railhead—again possibly with the idea of mobility—but with exactly the contrary effect.

There is only one way to ensure the mobility of an Army and to render its maintenance and movement by rail flexible at all times, and that is never to send up more than is wanted, or which can be removed from a railhead—to unload it immediately on arrival—and to remove it at once from the railway premises.

I must say that we improved considerably in our methods as the campaign progressed, but certain bitter experiences we had in connection with aerial warfare and to which I shall refer later, were, I am inclined to think, the main reason for this improvement—and not our admission of the fundamental truth of the principle.

I may add that it is the French practice to remove the empty daily supply train complete from the railhead at a fixed time after arrival—say 12 hours. If by that time, any portion of the train has not been cleared, the trucks with their contents are returned by orders of the *Commissaire Régulateur*. Some such action should equally be applied in our case.

I must emphasize the vast amount of unnecessary work which is thrown on the railway, particularly at the regulating station, by the forwarding to railhead of material which cannot be usefully dealt with.

Most of the surplus has to be returned to the depots at some time or other—and it is difficult to realize what this means.

Remember also if the fortune of war goes against you—and it did with us for a time in 1918—and you have mistrusted your railway communication and accumulated vast quantities of surplus material and stores in the railhead area, you are bound to incur great losses—as we actually did at that time.

Distribution of Rolling Stock.

Another and a very important duty of the Military Control, to which I do not think I have yet referred, is the distribution of the available rolling stock between the various services which require railway transport. Very early in my lecture, in discussing the utilization of haulage power and running capacity, I mentioned that it may be taken for granted that both these factors are never equal to meeting all the demands an Army Commander would like to put on them. The position is still further complicated by the almost certain fact that there is always an insufficiency or temporary shortage of rolling stock.

What rolling stock is available has to be distributed to the best advantage among the various loading services—and some central authority is necessary for this purpose. The first distribution has to be between the Civil and Military traffic. It might be thought that the former traffic might be abolished altogether—but a little consideration will show that this is impossible. It may be suspended for certain periods, as for instance during a big concentration—but if suspended it must be resumed later. There is always a large civil population to be fed and maintained—and it may be—as was the case in the recent war—that the economical life of the country must be kept up to as great an extent as possible. Moreover, apparently civil supplies are often needed for supplying the working material required for Army purposes, *e.g.*, coal for munition factories. Therefore the civil traffic must get its share of the available rolling stock, and the balance is then available for distribution between the various Army loading services.

Now I think it is pretty obvious that this distribution cannot be left to the Civil Railway Authorities. There would be an undoubted tendency in favour of civil traffic—and it is clearly impossible for a civil railway official to know how to distribute between the various army services a number of vehicles, whose total is considerably less than the number asked for.

Therefore this work of distribution must be carried out by the Military Control—another very good reason for its existence. The Military Control on the spot obviously cannot make this distribution of its own volition, and consequently when there is a shortage of rolling stock the orders of the highest authority, *viz.* : the Q.M.G., must be obtained as to what priority is to be given to each loading service.

In France, the distribution between the civil and military traffic was of course in the hands of the French—but the distribution between the various British loading services was settled from time to time at the Q.M.G.'s daily train conference, which I have previously mentioned.

REGULATION OF DESPATCHES.

Having now given you some idea of what is meant by a Military Control of Railways, and of the principal duties of such a control, I propose reverting to the subject I mentioned at the commencement of my lecture as being its primary duty, *viz.* : the regulation of all despatches.

I am now in a better position to amplify and explain this great duty, and you, I think, should likewise be more competent to understand and grasp what I am about to say.

You will have noticed how this question has cropped up in practically all the various points I have referred to—

In selecting entraining and detraining stations.
In keeping railheads clear.
In the avoidance of unnecessary haulage.
In the avoidance of unnecessary return traffic.
In the distribution of rolling stock, etc.

The whole theory and practice of the Military Control depends for its functioning properly on this question, with the sole object of obtaining the best military results from the existence of the railway.

I must repeat what I said previously on this subject, as it is impossible to lay too much emphasis on the matter. No loading or despatch of a consignment of either personnel or material must be authorized, unless it is reasonably certain—

(i) That the consignment will get through to destination.
(ii) That the destination station is or will be in a position to receive it.
(iii) That the consignment will be immediately unloaded from the railway vehicles in which it has been conveyed, either into a depot or else will be removed from the station premises within a reasonable time after arrival, and
(iv) That the point of origin and the route to be taken are the best and most economical source of supply.

Now under our British organization, the proper execution of this regulation of traffic is a difficult problem for two main reasons :—

(i) The absence of a sufficient check on demands, and
(ii) Insufficient authority with the Control.

In other words the indenting officer has too much, and the controlling officer too little power.

The first reason contains in reality the crux of the matter.

The remarks I am about to make will extend in some measure outside the scope of my subject, because though they are primarily applicable to railway working,

they are equally applicable to all other means of transport—including the various columns—the first line transport—the gun limbers—and even the very last and smallest means of transport, the fighting man himself.

Certain limitations in regard to these latter means of transport are generally recognized, but when it comes to the railway, limitations go by the board. But as I have already pointed out, the railway facilities are just as liable to limitation as any other means of transport—and even more so—whether one considers haulage power, line capacity, vehicles available or station capacity.

Many of you at some future date will be doing Q work with a Division, a Corps, or even an Army, and the sole duty of the Q.M.G. branch of the Staff is to see that the supply and maintenance of the Army in its various branches is efficiently maintained—or maintained as efficiently as possible.

Now nothing whatever, as a rule, is sent up from the base to a force operating in the field unless it is first demanded from the front. There are certain exceptions to this, but they are immaterial to my argument.

But apart from the general Q responsibility in the matter—a good deal of authority and responsibility for making demands on the bases is vested in the departmental officers at the front, and these are allowed to indent direct on the bases.

Further, the depot officer at the base on receiving a demand from the front—possibly marked "very urgent"—considers it his immediate duty to comply with such demand, and to exercise what pressure he can on the railway or other transport authorities to get off the consignment. Neither the indenting officer nor the depot officer consider, as a rule, the question from the transport point of view—and more particularly when the railway is concerned—whether the consignment is really wanted, whether it will get through to destination, and what will happen to it when it arrives there.

But I can tell you plainly that this method of decentralization does not and cannot work in war time.

In the same way as centralization is necessary for railway control—so centralization is necessary over demands from the front. This centralization can, of necessity, only be done in the Q. office—and you will find that it is one of your most important duties.

Your control must not consist in merely summarizing and sending on to the base or to another Q. office the demands of your departmental officers. These officers do not control the transport services—and it is only human nature to try to be on the safe side—to ask for more than is really wanted—or more than can be dealt with on arrival.

It is your business to check and criticise the demands put forward, and before sending them on to satisfy yourself that they are really wanted and can be dealt with on arrival.

To be in a position to do this, you must have a personal knowledge of the state and contents of all the depots in your command—and obviously a very complete knowledge of the quantity and condition of the road transport at your disposal.

The larger the force, the greater the centralization necessary—the Divisional demands must go to the Corps, the Corps demands to the Army—and the final demands must go from each Army H.Q. to Q. at G.H.Q., who is the ultimate deciding authority as to how the demands are to be met.

Now it was for adjudication on these demands from the Armies that the daily trains conference I have already mentioned was instituted at G.H.Q. France.

At these conferences representatives of all departments were present—and I believe it would have been impossible to carry on without these meetings.

Whatever the size of the force in the field, I feel confident that it will be found essential to adopt a somewhat similar system—and the moment the force becomes greater than one Army, then it is advisable for the Army Q to hold similar

conferences. At these conferences the Military Railway Control should be represented. The Control is almost always in a position to give valuable information which is otherwise unobtainable.

Now if the demands are properly scrutinized and checked at the front, the work at Q.G.H.Q. of allocating the means at his disposal of meeting the demands is much simplified—and, as a corollary, the difficulties of the Military Control considerably eased.

But in sending on your demands to G.H.Q., again I say do not follow the departmental practice of making requests which you know perfectly well Q at G.H.Q. will throw out. It is often done, I am sorry to say, on the principle of shifting responsibility, but such a course simply means you are asking for something which is not absolutely wanted or can be done without, and the Military Control will as often as not catch you out.

Now as regards the second reason I gave, which makes the problem of the regulation of traffic difficult, I want to remind you of what I said about the duties of the *Commissaire Régulateur* under the French system. With us, as I have explained above, the depot officer receives the demands direct from the front and considers his duties satisfactorily ended when he has loaded up the consignment and made it over to the control for despatch. Its further progress does not interest him in the slightest degree.

It is the duty of the control to see that the consignment is not loaded unless it can get through to destination and be properly dealt with there—this is easy under the French system where all demands are placed on the *Commissaire Régulateur*, who is in full control of the depots—but it is difficult with us where the depot officers control their own depots.

I cannot help thinking that the French system is the best—and the most readily workable. It places the responsibility for meeting all demands on one officer, who is in reality in a much better position to know and judge of the situation than the local officers in rear.

It exemplifies in a remarkable degree the essential feature of success in the Military Control of railways—*viz.*: the concentrated and undivided control, and its adoption by us would greatly simplify the work of the daily trains conferences I have mentioned.

Unfortunately we could not adopt the French system unless the British railway controlling officer at the regulating station was a regular Q staff officer directly responsible to Q, G.H.Q., instead of being a quasi-technical departmental officer as he is at present.

EFFECT OF AERIAL WARFARE.

I now want to say a few words about the effects on Transportation of Aerial Warfare and of Aerial Observation, as a consideration of these effects and the measures to cope with them come very largely within the sphere of action of a Military Control.

Some of the views I may enunciate may be considered somewhat heretical, and must be taken as personal expressions of opinion only, but I should like you to remember that they are based on a very extensive acquaintance with what actually happened during the last three years of the campaign.

First of all let me state as a fact, in spite of anything you may have heard to the contrary, that aerial bombardment, even of the most intensive nature, rarely does any practical damage to Railway communications.

Of 100 bombs aimed at a railway, I do not suppose more than one reaches its intended target as a whole, and out of a hundred that do so reach it, I doubt if many more than one does any real serious damage. Aerial bombardments cause delay and inconvenience—serious no doubt at times—and traffic may be held up for a time—but traffic is not going to be permanently stopped, or delayed

other than temporarily, unless a lucky shot destroys some vital point such as a large bridge. There are very few bridges which cannot be repaired, sufficient for the purpose of passing trains, within 76 hours—and when a bomb falls on other places, the repairs can generally be effected in a few hours—often in considerably less time than it would take to clear the line after an ordinary accident.

Traffic must be got through at all hazards. It is the business of the Military Control to see that all reasonable and safe precautions are adopted—as for instance in the way of extinguishing lights and stopping traffic when necessary—the latter course being usually unwise—but it is most important not to do anything which is calculated to undermine or destroy the morale of the railway personnel. On no account for instance, attempt to court-martial an engine driver for what in your opinion is an unnecessary exposure of lights or fire—or a station master for not extinguishing his signal lamps.

Both of these are essential for getting the traffic through—and you can rely on the staff themselves not putting themselves into unnecessary danger.

In the case of big bridges and important junctions, there are certain steps which can often be taken to neutralize the effect of the 100th bomb—as for instance strengthening the bridge—or providing an alternative line or deviation.

At the time of the German advance in 1918, when we practically had the coast line only available—and the enemy were obviously concentrating all their aerial forces on the destruction of the Etaples bridge, we had just completed a deviation and new bridge, when the 100th bomb got the old one—but even in this case, though one span was practically destroyed, temporary repairs were effected under 72 hours.

Similarly at the commencement of 1918, we took in hand the construction of an avoiding line right round Amiens, the main object of which was to meet anticipated constant blocking on the railway running through the centre of the town, which might be caused by aerial bombardment.

But it is the effect of the 99 other bombs, which have been aimed at the railway, which affect transportation in various aspects to a very considerable degree.

They may not hit the railway itself—but they will fall unpleasantly close to it—and it is their work which we have to legislate for. We can no longer have dumps of ammunition or gas shells on or near railway premises. In the first place they are more liable to be hit—and secondly if they are fired by a bomb—though the main line may be untouched and undamaged, through traffic cannot be maintained, and must be totally suspended for 48 hours or more, while a big ammunition dump on or adjacent to the railway is going off.

We had several bitter experiences in this respect until we grew wiser. Nor can you have camps, hospitals, or depots in the immediate vicinity of a main line of railway—or of important works thereon.

Railways have undoubtedly a very great attraction for airmen—they are often their principal guides—particularly, I believe, in night flying—and it is merely asking for trouble if you site your depots or hospitals near the main lines. As I have said before, 99% of the bombs dropped will not hit the object aimed at but some object in the immediate neighbourhood, and if that object happens to be a hospital, it is difficult to blame the airman who is trying to destroy a perfectly legitimate target. I quote Etaples, as a shining example of what should not be done in any future campaign. The bombing of this place by the enemy in 1918 was probably one of the most justifiable military operations by air which has ever been undertaken.

A very important railway junction on what was practically, at the time, the only line of communication of the British Army—one important bridge over a river—three other railway bridges over or under roads—part of the line on a high bank—part in a deep cutting—all within a distance of ¾ mile—and with extensive depots and very large reinforcement camps—and unfortunately

hospitals as well—crowded into this area promiscuously and actually abutting on the main railway lines—an absolutely ideal place for a legitimate bombing operation.

Depots must have railway communication—but the further off from the main line they can be the better, consistent, of course, with reasonable outlay on construction. Aircraft will attack a depot quite independently of the main line—and this involves a very careful layout and planning of the place, especially if it is for ammunition, and a much greater and wider distribution of the shedding or contents than otherwise would be necessary.

The advent of aerial warfare has thus necessitated, in the formation of depots, the occupation of a much larger area of ground and much heavier construction work than was the case previously. The difficulty of finding a site is therefore much enhanced. As regards the siting of hospitals and casualty clearing stations, it has hitherto been the accepted practice to give these places the benefit of railway accommodation as close as possible to them, to and from which ambulance trains can be worked. Though this course is undoubtedly a great convenience, to my mind, it is exceedingly doubtful if it should be allowed in future.

If it must be given, never allow the hospital to be placed close to the main line under any circumstances whatever. Put it half a mile or a mile away, and build a siding to it if possible.

Personally I would not place a hospital or C.C.S. within half a mile of any railway line—siding or otherwise—and would prefer in their own interests to see the sick and wounded conveyed between the hospital and the ambulance train by horse or motor ambulances, or even light railway. With a C.C.S. in a war of movement, there would be no time to build a siding for each change of position, and under such circumstances never allow them to locate themselves within half a mile of the main line.

For similar reasons, never allow a hospital or C.C.S. to be located near a depot or a camp.

In fact, in future wars, it may be necessary to establish certain areas as hospital enclaves only—duly notified to the enemy—and immune from aerial attack. Such an area would of course have to be a long way off any main lines—but under such circumstances railway communication with it would probably be permitted.

THE M.F.O. SERVICE.

I have mentioned the various natures of stores which go to make up the daily maintenance service of an army in the field, and I now wish to refer to a service which it was found necessary to organize for dealing with many of these stores.

I am afraid it will not be very interesting to you, but sooner or later, if you are a Q officer, you are bound to be mixed up with it—particularly if you have to do the Military Control work.

I refer to the Military Forwarding Officers' Service.

The work performed by this service, though of a technical nature, was outside the functions of the Regular Army departments and consequently came under the direction of the Military Control.

The service was originally started by the Home authorities quite independently of the railway organization—though depending on the latter for the liaison work with the French—mainly for the purpose of dealing with the despatch of private consignments of stores and comforts for the troops.

The great difficulties experienced in getting forward small consignments of the regular military stores decided us on extending the M.F.O. organization to the Army depots in general, and accordingly, early in 1915, this organization was placed under the orders of the Director of Railways—*i.e.*, the Military Control—and was largely expanded to enable it to deal with all the departments of the Army. It was, practically speaking, purely a technical railway service—

what is known in the railway world as a collecting or van goods service—and the placing of it under the orders of the Director of Railways and his officers was giving this Directorate its first purely technical work as distinguished from liaison or control work.

It is quite impossible for the civil railway authorities to carry on this work for two reasons, one, their want of knowledge of the location of the troops and, two, the difficulty of getting forward the small consignment.

The advantages of the course followed were very marked. By forming at the regulating stations repacking points, at which all the small and various consignments of goods and parcels were unloaded, re-sorted and repacked we were able to load and make up one or more wagon loads for the daily section trains, thus economizing rolling stock, minimizing delay, and ensuring, what perhaps is most important of all, regularity in delivery.

I am afraid it is quite impossible for me to explain the extraordinary good work this service conferred on the British Army in France and Italy, and also I believe in other spheres of operations. I have felt bound to refer to it in this lecture because—

(i) The service is not legislated for in any of our regulations.
(ii) It is essential wherever we are operating, either in British or foreign territory, and,
(iii) It must come under the orders of the Military Control.

Maintenance of Secrecy.

I want to say a few words on the subject of the maintenance of secrecy in military movements by rail.

You are aware how important it is to conceal from the enemy the location of divisions, the transfer of divisions, etc., and even the actual units in any formation —and the only means of ensuring this is to place the full information on the subject in the hands of as few people as possible. I cannot find much reference to this subject in *F.S.R.*

It is obvious, however, that before personnel or material can be despatched by rail, somebody must know the final destination to which they are to be despatched, in order that the technical railway officials may be placed in possession of this information. It is quite clear that the civil railway authorities cannot be given the full information necessary to ensure correct despatch, which is—

The railhead.
The section number pertaining to each formation.
The actual units in each formation.

The only information the *Technique Régime* require is the name of the station to which the wagons labelled with a certain section number are to be despatched.

It is by no means a difficult matter to ensure secrecy to a very large extent in practice, but the only authority which can do so is a Military Control—another excellent reason for having one.

You will remember my telling you how all formations, such as Army troops, Corps troops, Divisions, etc., were given section numbers for their supply packs. Now the military control alone should be in possession of all the three items, *viz* :

The railheads allotted to the section numbers,
The formations served by each section,
An up-to-date battle order,

and by a combination of these factors, they can at once give to the *Technique* the destination of any particular consignment of personnel or material without disclosing anything else but the absolute minimum information. It is quite

unnecessary for anyone else to have all this information and it should not go outside G.H.Q.—other than to the Military Control.

In France, I consider the information was too widely circulated, though we carried the procedure out to such an extent that a Base Commandant with a Reinforcement Camp of 20,000 men under him often had no knowledge whatever of the destination of the troops he despatched. He merely indicated to the Military Control the unit to which they should go.

With a large body of troops on an L. of C. it is absolutely essential that the railheads, section numbers, and battle order should be in possession of all the the principal officers of the Military Control.

It is only by means of the knowledge contained therein that the large numbers of stragglers and men rejoining their units, who are always wandering about on a long L. of C., can be dealt with and satisfactorily disposed of. One word of warning. Never in your anxiety to do your division or formation well, send a telegram or letter to a private firm such as the following :—

"From Major Jones
D.Q.M.G., Nth Division,
Send 20 barrels of beer to MERVILLE"

This is an actual telegram despatched by a staff officer of a very celebrated division.

It disclosed full information to a private firm in Paris, as to the location of that division in the line.

There are always authorized ways of getting your beer to your railhead without giving away its actual name—and for this purpose the M.F.O's service was an invaluable means of maintaining secrecy during our operations in France.

GENERAL REMARKS.

I am now coming to a close. I should like to have had time to tell you something about the organization necessary for the actual technical military operation and repairs of railways in war time, which work should come largely within the sphere of operations of a Military Control—and hence under the Q.M.G.

I have said nothing about Light Railways or Waterways. Neither of these means of transport is likely to be of any practical value in a war of movement—though the latter, where it exists and can be utilized, is invaluable for assisting and relieving railways—and should be made use of to the fullest extent possible.

I have confined my remarks practically entirely to the working of the ordinary normal gauge railway, and to the control necessary for ensuring its military efficiency. You may have wondered why I have given you so much detail—but I have done this with a definite object in view.

It is you, gentlemen, who, in my opinion, should be qualified to carry out this Military Control in future, and should do it—not I and the class of officer who worked under me in France. We will be there to help you—by all means—but the actual control, which is not a technical service, should be exercised by the Q staff officer, and he must therefore know how to effect it, and the principles on which it is worked.

Take the French system.

The *Commissaires Militaires* of the *Commissions de Réseaux*, the *Commissaires Régulateurs*, and the principal *Commissaires Militaires* were all, practically without exception, officers of the Great General Staff, of exceptionally high ability and training. They had in peace time received special training for their work—and were guided by clear manuals of instructions. For the British Army nothing of the kind existed or exists. In the South African war we improvised a railway control organization—and we were forced to do the same in the last Great War.

At its commencement, we had at our disposal some 6 officers, who had either

passed through this college, or were actually at it at the time, but unfortunately the exigencies of the service soon demanded their release for what was considered their more legitimate work.

From that time onward until the end, the control was incorrectly looked upon as a technical service and was carried out by a body of officers, the majority of whom had no kind of training, either military, staff or technical.

These officers had all to be trained to their duties, which were mainly of a staff nature. In this connection remember what I said on the subject of secrecy.

We fortunately had one good source of supply—though it was by no means unlimited. I refer to the technical railway officer—usually of the Traffic department of the British, Indian and Colonial railways. You will remember that I have mentioned that the control officers had often two functions to fulfil, *viz.*:

The Staff work, consisting of the control and liaison work, and
The duty of giving technical advice to the other Army departments.

We found the technical railway officer quick to grasp the principles of the former function, but this was putting the cart before the horse.

The first consideration is the control and liaison work—the technical duties are not nearly so important and it is on this account that I consider that the higher appointments in the control service should be held by qualified Staff officers as in the French organization.

The control and working of railways and especially railways in war time is not quite the simple problem many people think.

No campaign of any size can be carried on without railways, and the problems connected with their Military Control should probably form as large a branch of a Staff officer's training as any other subject.

There is hardly a single question which will come before you in war time—whether as a G.S., A or Q Staff officer, in which, before you have finished, you will not run up against the railway in some form or other.

If you are in control in operations in British territory, the railway technical officers would be your advisers.

In operations in a foreign country, as in France, you could have, when necessary, British railway technical officers as advisers.

This might mean duplication in some instances, but would be sounder, in my opinion, than leaving the control actually in the hands of technical departmental officers.

I hope I have told you something which has interested you or will interest you, and my object will have been fully met if anything I have said leads to a greater study of the subject than has hitherto been the case.

CANADA'S WAR EFFORT.

(Reprinted from *The Daily Colonist*, Victoria, B.C., of June 7th, 1942.)

AN extended National Selective Service plan for mobilizing Canadian labour was announced by the Prime Minister on March 24th. The plan has been laid down by the Dominion Government to meet the growing demands for manpower in the armed services, war industries and agriculture. In the next twelve months 200,000 volunteers will be required for the armed services, in addition to many thousands for compulsory military service. For war industries another 100,000

men and women must be found. To supply this urgent man-power need, these 300,000 and more must be added to the million Canadians now engaged in some form of war service.

Increasing war material shortages and government restrictions on production and consumption of civilian goods are making an increasing number of workers available for other employment, as "non-essential" output is progressively curtailed. The Selective Service policy is to direct these surplus workers into the war work they can do best, while maintaining essential civilian services by employing women as far as possible or men unfit or too old for military service.

The organization and administration of the plan is necessarily complex. It involves several departments of government. A Central Registry for compiling the necessary data on manpower needed and available will be set up in the Department of Labour, and the Minister of Labour will be primarily responsible for carrying out the plan. Under him will be a Director and Associate Director of National Selective Service. Regional Officers will be appointed and they will be advised and assisted by voluntary unpaid citizens' committees.

FARM LABOUR MOBILIZED.

Emphasizing the vital rôle being played in this war by food, farmers, their sons and farm labourers are granted an indefinite postponement of compulsory military service if they are doing essential farm work. They may enlist as volunteers in the armed forces, but they cannot accept any non-agricultural work except seasonal employment in a primary industry like fishing or lumbering, unless granted special permission. Only those returning to agriculture after March 23rd, 1942, or those doing non-essential farm work will normally be called for compulsory training and service.

A number of measures are being taken to recruit a greater number of women in civilian work and in war service. Training centres and placement services will be established. Transportation may be paid to another area, and every effort will be made to provide housing, medical care and recreation. Married women may enter many positions formerly closed to them.

OCCUPATIONS RESTRICTED.

Men that are physically fit and of military age, 17–45, are barred from accepting employment, without special permission, in a long list of restricted occupations, including: book-keepers, typists, clerks, salesmen and taxicab drivers; wholesale and retail trade; advertising and real estate. Such recreational occupations as theatres and clubs are restricted, and such personal service as barbering, hotels and cafés. Also barred are any occupations such as the manufacture of bread, liquor, furniture, printing, and games; and any occupation in the repair of clothing, shoes, furniture, jewellery and musical instruments. Men now employed in these occupations are not required to quit their jobs.

Besides these numerous restrictions, the Selective Service plan will continue, on a considerably increased scale, the compulsory calling-up of men for training and service in the Army in Canada. Its scope will be broadened by raising the age limit from 24 to 30, making all fit men from 21 to 30 subject to call if they were unmarried or childless widowers prior to July 15th, 1940. In place of calling-up by age groups, lots will be drawn over the entire field. Residents of Canada that are not citizens will soon be made liable for service.

Free medical treatment, with compensation for time lost, will be made available for the above trainees if they have some physical disability that can be cured within a reasonable time. Volunteers for the Army or Air Force that are rejected for similar remediable defects may also receive this treatment by agreeing to enlist as soon as fit.

Because of the urgent need for professional engineers, it is provided that—if an engineer is willing—the Minister of Labour may require his employer both

to release him and later rehire him when his work is completed. This practice may be extended to include other categories of skilled workmen. The Government policy is co-operation, rather than compulsion. The Minister must also approve the employment of any technical worker and be kept informed of those hired or released, so that their location may always be known.

As increasing the number of men and women available for war work is not in itself enough, the Government has co-operated with industry to train 120,000 unskilled workers for the munitions factories. This training will continue on an increased scale. Other steps taken are to train partially skilled workers so as to replace those highly skilled and free them for the most exacting tasks.

The Government is also co-operating with Canadian universities to train suitable candidates as supervisors and personnel experts. Later, foremen may also be trained. This training should improve labour-management relations and thus increase output by raising morale.

The National Selective Service regulations affect every Canadian, as it is the policy of the Government to employ compulsion only when the voluntary method fails, and it is relying on the people of Canada to do everything they can to swell the ranks of the million and more now in the services or doing some form of war work essential to the greatest possible national war effort.

Enlistment Programme.

Like the nature of warfare itself, the type of armed forces trained by the Dominion has changed vastly from the First Great War. In 1914–18 Canada's military manpower was overwhelmingly earth-bound, foot-slogging infantry. This time there are three large and important services making their demands upon Canadian manpower; calling for an infinitely greater quantity and variety of equipment and a much greater degree of technical training than the Canadian forces of a generation ago.

This time there is a much larger navy; growing rapidly, and limited only by the number of ships available. The navy can use many more keen and young men.

This time the Great War rôle of infantry is all but a memory. Canada is raising, equipping, reinforcing and maintaining the most highly mechanized and mobile army in the world.

This time air strength is the third arm of military might. Its presence is essential to the successful operation of the other two arms. From the outset Canada has concentrated on making the British Commonwealth Air Training Plan one of the Dominion's most important military contributions. By nature of geography and resources in young manpower, Canada has been a highly suitable place for the development of this Empire enterprise.

The Navy.

The ensign of the Royal Canadian Navy is a familiar and welcome sight these days on the stormy, hazardous sea routes of the North Atlantic, as an increasing number of grey-clad fighting vessels shepherd their cumbersome convoy charges to Britain.

In September, 1939, the Canadian Navy responded to the command of "Action Stations!" with fifteen vessels, of which six were destroyers. Now it has about 400 ships of all kinds in operation.

Many of its personnel came from the prairies or central provinces, had never seen the sea before. Landlubbers, in fact, comprise the bulk of Canada's navy of 30,000, but they are fast becoming veterans of the grim battle at sea. The British Admiralty has lauded Canada's naval rôle.

Only occasionally do Canadians receive any intimation of the drama that is being enacted in the North Atlantic. Late last Fall the Admiralty issued a terse, factual *communiqué*:

"*H.M.C.S. Chambly* with *H.M.C.S. Moose Jaw* in company recently sank a German U-boat in the North Atlantic. This successful action fought by two Canadian-built corvettes is a splendid demonstration of the protection given to convoys by ships of the Royal Canadian Navy. *Chambly* attacked with depth charges which forced the U-boat to the surface. *Moose Jaw* opened fire but after a single round had been fired the U-boat crew abandoned their ship, which then sank. *Chambly* and *Moose Jaw* picked up forty-seven survivors, who were made prisoners."

This is one of the few times that the "Silent Service" has broken its silence since war began to give the news of an action at sea.

R.C.N. personnel is the nucleus of Canada's navy, but all recruits are now brought in through the Royal Canadian Volunteer Reserve. They comprise the bulk of navy personnel. There has been no shortage of recruits for the service, and at present there is a waiting list of about 4,000. The navy, however, is seeking men with special qualifications.

Experienced sailors from the R.C.N.V.R. have been enlisted for duty, while out on the Pacific Coast the Fishermen's Reserve has done much to lighten the task of the navy, particularly since war broke in the Pacific.

Canadians with scientific training are performing special tasks with the Royal Navy. In addition, over 500 young Canadian naval officers are serving in many ships of that service in all parts of the world.

Training Organization.

Men for the navy are trained in eighteen R.C.N.V.R. divisions across the Dominion. From these divisions they are sent to coastal centres for more advanced training and special technical training is given at other centres.

The following establishments are maintained:

R.C.N.V.R. divisions (recruiting and preliminary training of naval volunteers)	18
Training establishments	2
Technical training centres	4

The ships of the Canadian Navy—chiefly of small tonnage—have seen action on many oceans. The long shorelines of Canada are being constantly guarded against growing threats to the North American continent.

One of the navy's most important tasks is the convoying of Canadian and American supplies to Britain. More than 9,000 ships have sailed from Canadian shores for Great Britain since the outbreak of war, carrying more than 55,000,000 tons of cargo. A substantial share of this vital convoy work has been borne by Canadian ships and men.

The Canadian auxiliary cruiser *H.M.C.S. Prince Henry* captured the German freighter *Weser* in the second year of the war. During patrol work in the South Atlantic, *H.M.C.S. Prince Robert* caused the crews of the *Muenchen* and *Hermonthis* to scuttle their ships off Peru. In all, the navy has captured five enemy vessels.

Early in the war the Canadian Navy helped convoy Australian troopships. During Dunkerque, Canadian men and ships performed many feats of endurance and heroism. Canadians also participated in the naval battles at Greece and Crete. Our troops to Hongkong were escorted on the major part of the long trip by ships of their own navy.

Convoy Operations.

Corvettes of the Canadian Navy have saved the lives of many United Nations seamen. In March this year, the R.C.N. and the R.N. effected a spectacular rescue of thirty-eight survivors from an Allied freighter off Sable Island in the North Atlantic.

Early in 1941 a Canadian destroyer helped rescue 857 survivors of the *Arandora Star* after she had been torpedoed.

The only limit imposed upon the size of the Canadian Navy is that of ships available for duty. When navigation reopens this year on Canadian inland waterways, numerous corvettes, mine sweepers and smaller vessels will go down the slipways. In Great Britain two *Tribal* class destroyers for the Canadian Navy are nearing completion. Two more vessels of the same type are being built in Canada.

Back of the operations of the navy is a complex land organization, arranging in detail the movement of convoys, maintaining, servicing and provisioning ships. Before war broke out, the machinery for convoys had been placed in operation. Under the general head of Naval Control the movement of merchant ships was placed under supervision, with the result that six days after war started the first convoy steamed from an Eastern Canadian port.

The navy has incurred losses in men and ships in the performance of its duty. At the end of March this year it had lost 466 men. In addition, many Canadian seamen have lost their lives on Allied merchant vessels. The loss of the Canadian corvette *Spikenard* brought the number of vessels lost by the Canadian Navy to seven. Canada has lost two other corvettes, the *Windflower* and the *Levis*. The destroyer *Fraser* was sunk off France in June, 1940. Another destroyer, the *Margaree*, was sunk while on convoy duty in the Fall of 1940. The armed yacht *H.M.C.S. Otter* exploded while on patrol duty in March, 1941. The *Bras d'Or*, an auxiliary mine sweeper, was also lost late in 1940. Scores of their sister vessels carry on the fight, with more to come as the shipyards make deliveries.

The Army.

At home and abroad the Canadian army is undergoing a programme of expansion and reorganization to meet the requirements of total war, in what is believed to be the most critical period of the war.

Canada is building an army overseas, which is described as " a well-balanced, highly effective fighting force, co-ordinated from the front line to the rear echelons—a weapon forged and sharpened to play a great part when the time comes to strike."

In 1942-43, $1,000,000,000, will be spent to fulfil the army programme. When it is complete there will be a Canadian active army overseas of two army corps. Necessary ancillary troops will be provided, and a division now in Canada will be equipped as an armoured division, trained and sent overseas. Another army tank brigade will be created for use with the infantry divisions.

There are approximately 300,000 men now in the active army, approximately half of whom are outside the country. Besides the troops in the United Kingdom, there are others garrisoned in the West Indies, Newfoundland and Gibraltar.

Regarding the army programme for the year, Defence Minister Ralston stated :

" The objective has been, and is, to raise and equip, to reinforce and to maintain, highly motorized and mechanized forces, hard-hitting and complete. In this way we take advantage of our resources and materials, as well as of the qualities of initiative and fighting skill which Canadians in battle have always shown. We also have the obligations for defence in Canada, which are more prominently before us than ever before. Under the army programme for 1942, the Canadian army overseas will be, in proportion, probably the most highly mechanized and mobile army in the world. It is obvious, of course, that a country of 11,500,000 people could not raise armies comparable to the forces of other nations, and particularly it could not attempt to do so when the army is just one part of the general pattern of food and weapons, air strength and navy."

Programme for 1942.

Enlistment programme for 1942 is described by the Defence Minister :

"The 1942 programme is to organize, equip and maintain an army of two corps overseas. That programme requires the enlistment of a further 90,000 to 100,000 men during the present fiscal year. That figure is, in the opinion of general staff, the maximum number of new men who can be effectively trained during that period for service overseas. That will put an exceedingly heavy strain upon the instructional staffs and equipment, because, in addition to these new men for overseas, we must train the overseas units still in this country, and also about 40,000 to 50,000 for service in Canada; and already arrangements are being made to bring back a large number of instructors from the other side for that purpose."

Since the outbreak of war with Japan, Canada has accelerated the *tempo* of defence preparations. The defences of the East and West Coast have been placed under two commands. The air, sea and land services in these areas, as well as in Newfoundland, have been placed under the single command of the senior officer in the area.

Two new divisions are being mobilized to give depth to existing and projected defences. The two new divisions will be composed largely of men called up for compulsory military training under the National Resources Mobilization Act. The number of men available for home defence has been substantially increased by extension of the age group liable to military service under national selective service. The age range for compulsory military training for men, unmarried or widowers without children at July 15th, 1940, has been widened from 21-24 to 21-30. Men will be selected by drawing lots over the entire age field, and liability for military service is being extended to all residents in Canada, whether citizens or not.

RECRUITING SYSTEM.

The voluntary system of recruiting is being overhauled to place recruits in the branch of the army for which they are best fitted.

Previously a recruit was sent to the branch of the service in which he professed an interest. Otherwise he was assigned to a unit whose recruiting quota had not been filled. The result was often "a square peg in a round hole." Men who would have been excellent artillerymen might have been sent to the dental corps or infantry.

With personnel selection officers now being used by the army, the aptitudes and potentialities of each recruit will be scientifically determined. If he has special mental or physical qualifications he will be placed in a branch to give them the utmost scope.

Army cadet training has been given encouragement and enlistments in cadet corps are at record high levels. Opportunity will be given to about 50,000 Canadian boys between the ages of fifteen and eighteen to attend camp this Summer as part of the cadet corps training. The course requires two hours' study per school week on such subjects as parade ground training, instruction in small arms, map reading, internal combustion engines, first aid and other subjects.

The two-year course to be given to the cadets is equivalent to the basic training given soldiers in the Active Army. This corps will create a reserve of partially trained men for the army and will provide potential officer material.

REORGANIZATION OF RESERVES.

Reserve units are now only allowed to enlist fit men under nineteen and over thirty-five years of age. They may, however, enlist men of any age up to fifty who have been rejected for overseas service because of low medical category or who are key men in industry and have been granted postponement.

Membership in reserve units will no longer exempt from compulsory military service men who are liable to call under the N.R.M.A. The reserve units of the

army have been formed into eleven brigade groups across the Dominion, equivalent to four divisions.

This organization provides that a brigade group in each of the eleven military districts will be placed under full-time commanders of the active army. Modern weapons will be provided, and annual periods will be extended.

War Service Badge.

Henceforth, members of any one of the armed services who have been honorably discharged will be entitled to wear the war service badge "General Service Class" to signify that fact.

Reinforcement Training.

Canadian reinforcement training is based on a great chain of training centres across Canada. These are of two types—basic and advanced. At the basic training centre the recruit is taught the fundamentals of the military art. He learns to be a soldier. From the basic centre he goes to an advanced training centre and there he learns the work of his own arm—artillery, engineers, signals, or whatever it may be. And when this training is complete he graduates to a holding company and in due course he goes overseas to a holding unit, where he stays, continuing to train, until his arm or unit needs him.

Capacity for training army tradesmen in Canada has been almost trebled. One army trade training centre—the (Advanced) Army Trade School at Hamilton, to which specially picked maintenance men are sent on completing their vocational or industrial courses—has an annual output of about 6,000. The (Advanced) Mechanics' Training Centre at London turns out about 2,400 a year. These capacities are in adddition to the output of the vocational and industrial centres.

From the advanced centres men go to the advanced training centres of their different arms and learn to apply their trade in practice.

A correspondent writes: "Certain areas in the Queen Charlotte Islands have been proclaimed prohibited areas in order to prevent sabotage of the Sitka Spruce Forests, as Sitka spruce is being used for the manufacture of aeroplane propellors. Certain large gold-mining firms are closing their lesser gold mines with a view to taking up the mining of ores used in war-time productions."

U.S. CONSTRUCTION OF MILITARY AIR FIELDS.

(From the *Journal of the Institution of Civil Engineers.*)

The Air Corps and the Corps of Engineers of the U.S. Army co-operate closely in planning and constructing permanent military aerodromes. The choice of site and layout of the aerodrome are the responsibility of the Air Corps, while the construction work is done by the Corps of Engineers. To meet the need, under war conditions, of temporary aerodromes that must be rapidly constructed, an Engineer Regiment (Aviation) has recently been organized. It is equipped with modern machinery for all types of construction work, and with mechanical transport for rapidity of movement. The unit is armed. In peace time these units are trained in the construction and maintenance of aerodromes. In wartime their main duties are as follows: (1) Improvement or provision of advanced aerodromes. (2) Improvement or provision of roads to such aerodromes. (3) Provisions for gas- and bomb-proofing essential parts of installations. (4) Camouflage of advanced and other aerodromes. (5) Assistance in the defence of advanced aerodromes from ground and air attack. (6) Maintenance and repair of aerodromes, especially after air attack.

"MEN WHO BUILD."

By CAPTAIN S. P. JORDAN, R.E., A.R.I.B.A.

THE Corps of Royal Engineers now contains a larger number than ever before of men who have achieved qualifications and distinctions in mental and physical fields very different from, and in many cases may I say more advanced than, those required for the average peacetime Officer, and amongst these, many of whom have served in the Territorial Army or Supplementary Reserve for some time, are many Architects and Engineers.

Our Corps, in the course of its very distinguished career, has given the breath of life to many new formations, and it must be occurring to many of its members that the time is surely coming for the greatest opportunity that it has ever had and probably ever will have, to be in at the birth of a great enterprise.

We maintain an Army in time of peace not for offensive reasons but in order that a sudden outbreak of hostilities will not find us unprepared and that we may put trained troops into the field at short notice. These troops however are merely the spearhead and we are all well aware that the bulk of the Army which is required to fight a major war has to be formed from the mass of people who are normally engaged in " peaceful " pursuits. The new Army is therefore representative of the many scores of such activities, and being composed mainly of the young men with the initiative and adventurous qualities of youth, it not only has the right but it has the duty to express its opinion on matters which affect its individual and collective existence and way of life in the future: matters which more often than not have been ordered in the past by the State " Elders " without further reference.

It must be realized too that there are many of us in this new Army who have a very great interest in the ordering of the future and we propose to make use of the influence that is inherent in our youth and expressed by the strength of our purpose and the achievements of our minds and bodies, to make ourselves responsible for the greater part of this work.

This war has produced many new evils, and amongst them the mass bombing of cities, perhaps the most vulgar method of waging war that has ever been evolved : but evil is apt to be changed into good, and so it must be in this case.

The first task in our home policy at the beginning of the new peace will be the reconstruction of our cities and the reorganization of our existing system of land ownership, by degrees and without hardship, to make reconstruction possible. Let me say at once that by reconstruction I do not mean partial or purely local rebuilding : I mean the planning and construction of new cities, to be built over a period of years to an ordered plan. There is great danger in too much sentimentality over the past, though it has become clear to me that only to very few is this quality pure. In a good many cases it is indistinguishable from self or vested interest but far more often it is a corollary to mental sterility and ignorance

Any possibility of immediate gain for our own generation, which could be obtained only at the expense of future generations, will have to be eliminated from our minds and one of our most powerful weapons to this end will be propaganda. Our enemies have successfully put over by propaganda a policy which is in fundamental disagreement with the natural way of life and instincts of man. Theirs is a sterile and hypnotic propaganda. What can we not do with this weapon, having such a cause ?

There are two reasons why, at the moment, the building industry is quiescent. Certain restrictions against uncontrolled building are in force—restrictions which

exist mainly as a result of these reasons and not, unfortunately, in spite of them—but apart from these the first reason is shortage of materials and the second shortage of labour. When peace is signed it will not take long for the materials to be available once again in sufficient quantities: but what about the labour? Where are the trained Architects and Engineers, the Contractors, the Bricklayers, Concretors and Steel-men, the Carpenters, Joiners, Plumbers, Electricians, Plasterers and Painters whom the Industry must have to be able to function? THEY ARE IN OUR CORPS. Let us consider how the best use can be made of them.

Since the new Army includes so much of this technical labour, it is clearly by no means without power to oppose those who seek only their own immediate gain, but as the cutting of Samson's hair reduced his strength to that of an ordinary man, so assuredly would the indiscriminate demobilizing of the technical branches of the Army play into the hands of the "interested" men, the self-seekers and the compromisers. The pleadings of Delilah were strong and we too shall be tested, but this strength must be retained until it is clear that it will be directed by the minds and hands of "disinterested" men.

As I have already said, we have a citizen Army, and the responsibilities of the citizen leaders towards their citizen members are very great. The leaders have recently shown unmistakably that they are not blind to these responsibilities and a certain amount is being done in the right direction. Examples of this are the many and varied activities of ABCA*, one of which I will refer to now.

Not many months ago the Royal Institute of British Architects displayed an exhibition, admirably designed but not widely enough advertised, called "Living in Cities." The young designer of this exhibition, who recently published a booklet with the same title crystallizing the ideas put forward in the exhibition, is now touring the country under the auspices of ABCA and showing his exhibition to troops, propagating new ideas and encouraging and receiving active interest and discussion.

It is a good beginning, but I would like to suggest a widening of the scope and a far more active interest taken in civics and culture by the whole Army. To obtain this I propose either that the powers of Army Education should be extended or that a new group should be formed in order to maintain very close contact between the fighting Services, the Ministry of Works and Planning, the Ministry of Labour and the civil Directorate of Education. This liaison group should be in a position to put forward to the Services for consideration—and itself to act as Adviser—the proposals of the Ministry of Works and Planning, and *vice versa*: and it should be formed soon, for there is not too much time. The release of technical labour from the Services should be directed by this group and must run parallel with the planned national requirements: this must be the only consideration and none will grudge it if the reasons are well explained and the results to be achieved are apparent to all.

The men who are chosen to represent the Services and the Ministries in this group must have great imagination and public spirit and they must be men who can look to the future in the same way that our ancestors did when they planted their wide avenues of young oak, beech and chestnut saplings and began to build their great Cathedrals. Those men had a purpose and they knew what they were doing: they were not stampeded and nor must we be.

The Modern Architectural Research (MARS) Group have recently published what they call a Master Plan for London. There are no half measures in their suggestions and no compromise is made with any but absolutely essential factors, such as the location of the Thames Valley, the Port of London and certain other topographical and physical features. The designers have worked out a system by which the plan could be put into operation with the minimum of disruption and they propose that the work should take twenty years. They are careful to add that there is no question of this particular plan being the only answer to this

* Army Bureau Current Affairs

vast problem, but it is nevertheless a valuable contribution and in the breadth of its imagination might well form a basis for other ideas. It is enough to show at least that trained planners and designers are under no delusions and that they will not countenance any compromising of the future of England by those who have their own reasons for being able to see less far.

I repeat then that the Services and the general public must be kept informed of the progress that is being made in formulating plans for the future by those who are concerning themselves with the problem in official capacities and who will be answerable in this connection to the whole nation.

The Services must speak when the time comes and they must prepare now, so that they will be in a position to do so. It might almost be said that the golden key to the future of England is in the right hand of the Sapper. Let him retain it then until it is certain that the door he will be called to open will be the one which the key fits.

KNOW YOUR ENEMY.

By LIEUT.-COLONEL D. PORTWAY, T.D., R.E.

IN Britain we never take enough interest in our prophets to stone them—we prefer to ignore them and the results are equally unfortunate. Such a prophet was Professor J. A. Cramb, who in the early part of the present century and for 20 years (1893–1913) taught modern history in a seminary for young ladies in Harley Street, London.

There he delivered lectures to his gentle auditors, explosive in their force and stark in their realism, dealing with the rising Power in Central Europe with whom Britain was so soon to cross swords. Cramb died in 1913, but the lectures—reconstructed from the script of a diligent and enthusiastic student—were published early in 1914 by Mr. John Murray under the title *Germany and England*; this book, in spite of the lapse of nearly 30 years, is still worthy of serious study.

Cramb was the first to interest the British reading public in the life and writings of Heinrich von Treitschke, until then an almost unknown personage. Cramb realized how little the British public understood the typical Prussian arrogance, the glorification of war and the hate of Britain which the writings of Treitschke reflected and which is now a part and parcel of the Nazi creed.

It is perhaps significant that Treitschke, in company with many potent writers on this and cognate topics, was himself no Teuton, being (as his name suggests) of Slavonic origin. Even the Jews have swelled the number of this band of writers, and an Englishman has made a notable contribution, to his discredit, in the person of the renegade, Houston Stewart Chamberlain.

The lectures of Treitschke (he was a Professor of Political Science) were in the main poor stuff; much was obviously borrowed straight from Aristotle and Machiavelli, and there is no single reference to any great political theories, nor indeed to Germany's own philosophers, Kant and Hegel. The lectures are in the main a high explosive compound of hatred of England and France and of fulsome flattery of the alleged incomparable superiority of German civilization.

It is time that some new prophet arose to teach our young leaders to understand German mentality as developed by Treitschke, by Bernhardi and by countless others who were harping on this same topic long before the Nazis were

even thought of. With this end in view a course of some 20 lectures has been arranged at the Sapper field O.C.T.U. so that for one period a week throughout his course the budding Sapper Subaltern can get a picture from various points of view of the enemy whom he is so soon to meet.

The lectures, by kind collaboration of the Army Educational Corps, are all given by men who can claim some competence in the subject that they teach. The cadet is very prone to regard Nazism as something new, whereas he must be taught that this is far from being the case. No surprise, for example, need be felt at the atrocities committed by the Germans along the length and breadth of Europe. The surprise would really be if such atrocities were *not* committed, so deep-seated is beastliness of this type in German mentality and German tradition.

There is also a real necessity for teaching young officers the value of British freedom and of our free institutions. Modern youth has none of the Victorian faith in democracy, which is regarded in the main as outmoded, ineffective and decrepid. Fascist leanings are widespread and all the more so as being quite unconscious.

Many officers regard a benevolent dictatorship as the ideal, without pausing to think of the dangers of such a form of government and of the unlikelihood of such a dictatorship remaining benevolent. The peril to free institutions is within as well as without—one of the outstanding causes of the fall of France was that French officers had no faith in the political system which it was their duty to uphold.

The series starts with three historical lectures on Germany, in which the cadet is shown that Prussia missed the main stream of Roman civilization and, being a poor country surrounded by powerful neighbours, she learnt at an early age to regard war as an instrument of policy and bad faith as a part of her creed. The rise of Prussia under the Great Elector and Frederick the Great is next described, together with her misfortunes at the hand of Napoleon and her rise and triumph in the era of blood and iron. The failure of the Weimar republic after Germany's downfall in the last war is traced and the reasons for the rise of Hitler are explained.

The last of these historical lectures gives the cadets some idea of the trend of German philosophy and mysticism, the Wagner tradition and the Gospel of force and of the Herrenfolk, foreshadowing the racialism of Hitler.

Other lectures deal with the many nations under the Nazi jackboot and the students learn something of the special problems that such countries as Russia, Poland and Czecho-Slovakia will face in their future relations with Germany. One lecture deals with Italian problems and another with the Japanese aggression and the special features of the Japanese Army. Economics is also the subject of one lecture, as it is outstandingly important that the young officer in his administrative capacity should know something of the Services' part in the National Economy and the simple causes of inflation. He will thus secure a general awareness of the nature of the enemy whom he is going to defeat. Every effort is made to present the various topics objectively and without bias and it is only fair in the condemnation of German militarism to emphasize that it is merely an extreme form of a common disease.

Napoleon was impregnated with it quite as much as Hitler, and Alva in the Netherlands was the very counterpart of the Nazis in Norway. Japan has perpetrated atrocities quite as bad as the Germans and, if she gets away with it, she will reorganize all the coloured peoples of Asia in a common effort at world domination. We shall indeed need to be tough in our dealings with the German and the Jap after this war and their punishment must be condign, but the real problem is the breakdown of civilization through its own inner conflict. Religion comes intimately into this picture and though this side cannot be introduced into an official course of lectures at an O.C.T.U., the story is lamentably incomplete without it.

But much more is wanted in teaching this knowledge of the enemy. Our young Sapper Officer must know a good deal about enemy methods and enemy technique; he must appreciate their ant-like diligence, their efficiency, their unquestioning obedience to the dictates of Government and their contempt of democracy.

Every interest must be taken in German tactics and German methods of fighting. Much is taught about this at the Battle Schools, which in their simplicity and their stark realism are bringing about a revolution in minor infantry tactics. Quite rightly we have cut out the blood and hate from our battle teaching—there will be plenty of hate on the battlefield when casualties are being received—but we must bring the precision of the parade ground on to the battlefield in a flexible form, and the officer must learn to use his weapons far more efficiently and far more ruthlessly than he does at present.

All this takes time, and time for training is all too short, but we shall never face up to the enemy with the confidence that is so necessary until we are fully acquainted with him, both in his strength and in his many weaknesses. Only thus shall we learn to emulate his own tactics and to strike at the softest spots and thus to achieve victory at the smallest cost.

COLLABORATION BETWEEN MILITARY AND CIVILIAN ENGINEERS.

By MAJOR-GENERAL A. E. DAVIDSON, C.B., D.S.O., M.I.MECH.E., M.I.MAR.E.
Colonel Commandant, R.E.

THIS question has received a good deal of thought, from senior engineers at any rate, both in and outside the Corps, for they have realized that in war sufficient regular soldiers do not exist to meet all the engineering needs of the army. The Civilian engineer has to join forces with his *confrères* in the service, and the more they know of each other's ways and outlook on engineering problems, the more rapidly will they link up as a team to produce maximum results.

At a meeting of the Institution of Civil Engineers (President:—Professor C. E. Inglis, O.B.E., M.A., LL.D., F.R.S.) held in London in May, 1942, this subject was given considerable prominence in speeches delivered by the Secretary of State for War, and the President.

As but few regular R.E. Officers are likely to have heard an account of what took place at this meeting, it seems to be desirable to give a brief record of what was said, and to note the very real desire for *rapprochement* evinced by members of the Institution of Civil Engineering.

The Right Honourable Sir James Grigg, K.C.B., K.C.S.I., *M.P.*, Secretary of State for War, after referring to the assistance given to the War Department by many members of the Institution of Civil Engineers and his meeting with Major-General C. J. S. King (Engineer-in-Chief, War Office), in connection with the rebuilding of Quetta after it had been flattened by the earthquake in 1935, went on to say that he gathered that for more than a century the members of the Institution had observed certain aloofness from their military brethren, and only recently had Royal Engineers been eligible for membership. That opening of the gate had been much appreciated, and now that the "goats might mingle with the sheep" he hoped that the contacts and associations would steadily develop,

certainly for the benefit of the Royal Engineers, and he hoped for the benefit of Civil Engineers also.

The present war, with its multitude of disadvantages had produced this advantage, that the civil and military engineering professions had been set closely together once again.

He had been told that more than 2,600 of the Institution's members and students were serving with the Forces, and about two-thirds of them in the Royal Engineers. (The corresponding figures for the other two Senior Institutions are as follows:—Institution of Mechanical Engineers, 1,700 members in the armed forces, over 300 in the R.E.; Institution of Electrical Engineers, 2,500 members in the armed forces, 400 in the R.E.)

The demands of modern war on military engineers had grown out of all recognition. To perform their war time task the Corps had expanded in officers to more than ten times its pre-war establishment figure and it was still expanding. He was glad to say that in this expansion they had the closest liaison with the Institution and every possible assistance from it.

It was, of course, not only from the absorption of its members into the Army that they had obtained help from the profession. They were being helped by eminent consultants over some of the larger constructional works, and one member was helping greatly as chairman of the Advisory Committee on army buildings. Sir James gathered that in spite of the close contacts which developed between the military and civil engineers during the last war, they did drift apart at the end of it, and the President played a noble part in preventing the rift from becoming a definite cleavage.

The University courses which the President had conducted had been of untold advantage, and the Army could never be sufficiently grateful for what he had done in building that particular bridge. It must never be destroyed, and after this war was over, military and civil engineers should remain in the closest contact not only for the benefit of the community in times of peace, but also in order that, should another state of war break out, the whole experience of both would be thrown instantly into the common pool.

The President, Professor C. E. Inglis, in reply, expressed the profound appreciation and gratitude of the Institution to Sir James Grigg for having found time amidst his multifarious duties to come and give such an inspiring speech, which showed a most encouraging knowledge of the activities of the Institution.

Sir James had referred to the alliance of the Institution with the Corps of Royal Engineers. The closer that alliance, the better the Institution would be pleased. On its part it would do all that it could, and it looked for a certain help from the Military authorities in ensuring that in the future, more than in the past, all Royal Engineers should be given the opportunity of acquiring that moderate amount of practical experience which was an essential qualification for corporate membership of the Institution.

The Institution had its roots very firmly planted in the ground, and it was their bounden duty to maintain a high standard of professional qualification, because where they led others would follow.

The President then referred to the way in which the three senior Institutions had worked in close contact during the past session. Joint conferences on several subjects had been held, attracting large and variegated audiences. Closer co-operation between engineering institutions, which everyone agreed was most desirable, has thus made a considerable advance.

The President gave out the hope that in the near future the Institution would provide refresher courses in subjects which came within the scope of its more general activities. Senior engineers often felt the need for such refreshment in post-graduate courses.

He would like to see an engineering staff college set up and endowed, to which

young men earmarked by their firms for responsible positions in managerial or production activity should be seconded for, say, a period of six months. Living together and exchanging ideas, they would get to know those who in days to come would be their opposite numbers in engineering and allied organizations. The presence at such a college of some selected Royal Engineers should be a great step forward in cementing the desired alliance of civil and military engineers and should tend to widen the outlook of all the participants.

In order to show how cordially members of the Profession concur with the views expressed by the President, the opinions of two of them on this subject have been obtained.

Sir Alexander Gibb, G.B.E., C.B., LL.D., F.R.S., a representative of the consulting engineering profession writes :—

"As a Past President of the Institution of Civil Engineers and as an officer who served as a Colonel in the Royal Engineers with the British Expeditionary Force in France and Flanders in the last war, I give my whole-hearted support to the views expressed in the speeches of the two distinguished speakers referred to above.

The closest alliance between the Institution of Civil Engineers and the Corps of Royal Engineers is clearly in the interests of the nation and should be firmly and permanently established.

That vital professional co-operation between civil and military brethren, so greatly needed in this war, as it was in 1914-1918—or in any other war—cannot be developed to its utmost with the speed and thoroughness that is essential to ensure the fullest immediate advantage of benefit without the closest collaboration in times of peace.

Apart from the requirements of war, nothing but good for Engineering as a whole can come from intimate contacts and association at all times between the civil and military engineering professions.

I have advocated these principles ever since the last war and I will gladly assist in any way I can to implement them.

I hope sincerely that such steps as are necessary to cement the alliance will be taken now."

Sir Henry Brand, a Past President of the Federation of Civil Engineering Contractors, adds :—

"The Corps of Royal Engineers as Military Engineers is second to none, but there is a weakness when it comes to the practical direction of works of a Civil Engineering character, due entirely to the lack of experience and training in this field in times of peace.

This could and should be obviated in the future by attaching, as part of their training, young R.E. Officers and N.C.O's to the staffs of Contractors engaged in large Civil Engineering Works for periods of at least two to three years. The tradition of carrying out works which the Corps is now gaining through its new Companies, *i.e.*, General Construction, Tunnelling, Mechanical Excavation, Railway Construction Companies, etc., would thus be fostered and maintained. Most of the members of these were Civil Engineers and Civil Engineering Contractors before the war, and will return to their civilian occupations when hostilities cease, and the Corps will again lose, as it did after the last war, the benefit of the experience now being gained.

University courses and close collaboration between the Corps and the Institution of Civil Engineers are admirable, but much of this benefit will be wasted unless it is based on the solid rock of practical experience, in peace time, of modern methods of construction."

CORPS OF ROYAL ELECTRICAL AND MECHANICAL ENGINEERS.

By MAJOR D. R. JOHNSON, O.M.E., R.A.O.C.

ON the 11th March, 1942, Mr. Duncan Sandys, Financial Secretary of the War Office, announced to the House of Commons that it had been decided to form a new Corps in the Army, the title of which was not then fixed, to take over the responsibility for the repair and maintenance of electrical and mechanical equipment in the Army. This announcement was received with acclamation and was given wide publicity both through the medium of the national press and by the British Broadcasting Corporation. At the time of the announcement the only indication given was that the repair and maintenance of electrical and mechanical equipment was to be brought under the control of one Corps.

Committees of experts were appointed to draw out the details and charter of the new Corps and a considerable amount of work has already been done. The title of the new Corps is The Royal Electrical and Mechanical Engineers.

The possibility of the formation of such a Corps has been considered many times in the past with a view to obtaining the maximum efficiency in the repair of mechanical and electrical equipment within the Army, compatible with the maximum economy of man power and, at the same time, to form within the War Office a technical focus so that the skilled knowledge of the engineer could be made directly available to the Army Council.

As long ago as 1928 a Committee was set up under the chairmanship of Field-Marshal Sir George F. Milne, G.C.B., G.C.M.G., D.S.O., D.C.L., LL.D., Chief of the Imperial General Staff at that time, together with Major-General W. H. Bartholomew, Major-General C. Bonham-Carter and General Sir Walter P. Braithwaite as members.

It is interesting to note that their recommendations were briefly :—

(i) That the functions of the Military Members and the corresponding staff in the War Office and in the field should be divided between four Members, the fourth Member of which should be responsible for all duties in connection with the production and maintenance of all warlike and technical material.

(ii) The R.A.O.C. should become a Corps of Mechanical Engineers and should be responsible under the Master-General of Ordnance for all warlike stores, excluding only general stores and clothing.

(iii) R.A., R.E., R.A.S.C., etc., officers now employed in connection with production and maintenance of war material should be seconded or transferred to the newly-constituted R.A.O.C.

The recent appointment of the Deputy Chief Imperial General Staff to control the General Staff branches of the W.O. has, together with the formation of the Royal Electrical and Mechanical Engineers, in effect gone a long way towards the implementation of the recommendations made by the Milne Committee, the main difference being that, whilst D.C.I.G.S. controls the General Staff branches, the new Corps remains under the Quartermaster-General.

The continual increase in both the complexity and the number of types of electrical and mechanical equipment used within the Army has, by the laws of simple proportion, necessitated the continual increase in the number of specialist

officers and tradesmen who are responsible for the equipments' continued efficient operation.

The problem of supply of skilled technicians has, since the beginning of the war, been a problem which has only been solved by the most intensive comb-outs within the Army itself and also within industry. No longer is the engineer able to, or even expected to, repair all the multitudinous types of equipment used within the Army but rather specialization is resorted to, to ensure that the minimum amount of time is expended in training the engineer in his new duties, thus permitting the field force units to be brought up to strength without delay.

This specialization has, with the formation of R.E.M.E., become a matter of great importance. Instead of transferring to R.E.M.E., the whole of R.E. personnel previously engaged on the repair of such electrical and mechanical equipment as is being handed over to the new Corps, the repair load can be added to the existing load carried by R.E.M.E. with very little increase in the personnel required, as specialists who are expert in equipment similar to that being handed over are already available in R.E.M.E. As an example of this, certain armoured fighting vehicles are now fitted with Diesel engines and transmissions which, in principle at least, are similar, if not identical, to those fitted to certain types of excavators and therefore the engine and transmission assemblies of the excavator can be efficiently repaired by the personnel normally engaged on tank engine and transmission overhauls.

Whilst it will be necessary for certain specialist personnel of the R.E. to transfer or be attached to the new Corps, in many cases R.E. personnel will be able to be employed on other pressing R.E. work, for which they are ideally suited.

The scope of the Corps of Royal Electrical and Mechanical Engineers is as follows :—

It will be responsible for mechanical maintenance and repair throughout the Army and will absorb—

(1) The complete responsibilities of the R.A.O.C. engineering side.

(2) Responsibility for vehicle maintenance and repair of all R.A.S.C. vehicles, with the exception of work for which R.A.S.C. workshop platoons or sections are now provided within the *War Establishment* of the R.A.S.C. Transport Companies.

(3) Responsibility from R.E. for the repair and maintenance of mechanical equipment of engineer origin, *e.g.*, tunnelling equipment, pumping machinery, etc., together with responsibility for work on metal and structural steel.

(4) Responsibility from R.E. for erection, repair and inspection of Coast Artillery machinery and ancillaries, R.E. retaining responsibility up to the junction boxes of the lead-in of the central power supply.

R.E.M.E. officers will be fully responsible for the administration of their personnel in addition to their technical responsibilities.

The system of repair to equipment used throughout R.E.M.E. is one of repair by assembly exchange rather than repair of individual items, which latter, in many cases, necessitates the equipment under repair being out of action for a considerable period.

The system can be illustrated as follows :—

In the event of a tank in a forward area developing, owing to a mechanical defect, a broken piston, the engine is removed from the tank as far forward as possible and a new or reconditioned engine assembly is put into place, the engine

with the broken piston being returned to the next rearward echelon workshop where the piston is replaced as soon as convenient, or, if extensive damage has been done internally, the engine is returned to base workshops, where a complete overhaul and re-assembly is carried out. This system enables a tank to be back in action within a matter of a few hours only, whereas if an endeavour was made to replace the piston on the spot it might easily take several days.

R.E. equipment will be dealt with on similar lines and major repairs will only be carried out in base workshops, the minor repairs being dealt with by assembly exchange, thus ensuring that the maximum amount of equipment in efficient operating condition is available at any one time.

To those who have long been part of the Royal Engineers, the possibility of leaving their own Corps for a very new one may give rise to a certain feeling of despondency which is quite understandable, but the terms of service of the new Corps have been drawn up with this well in mind. Further, no regular R.E. officer will be compulsorily transferred, even if employed on duties which will become a R.E.M.E. responsibility. Such officers, owing to their vested rights of promotion and conditions of service, will be attached to R.E.M.E. for the duration of the war. Should they wish to transfer outright to the new Corps, they may be assured of the warmest of welcomes from their brother officers in the R.E.M.E. In such circumstances they would, of course, come under R.E.M.E. terms of service and rates of pay, the details of which have been, or will shortly be, promulgated by means of an *A.C.I.*

It should be noted, in conclusion, that the above remarks apply to regular, including retired regular, officers only.

RUBBER BALLOONS AND HOUSE CONSTRUCTION.

From *Building Science Abstracts*, published by the Department of Scientific and Industrial Research.

DETAILS are given of the construction of houses, near Washington, U.S.A., in which a canvas balloon with a rubber coating inside and out is used as a pneumatic form. The balloon is erected on a circular concrete floor (23 ft. diameter), inflated and then covered with 2-inch 16-gauge welded wire mesh. Door and window frames are placed in position against this pneumatic form and a 1-inch layer of concrete sprayed on to the form by the gunite process. This is followed by a layer of asphalt compound and then 1½-inch cellulose-asphalt insulation with a final outer wall of concrete 2-3 inches thick. The construction of the entire hemispherical wall takes 7½ hours and when the shell is set the form is deflated and used again. The houses may be either hemispherical, barrel-shaped or domed, and the same method of construction is being considered for hangars, barracks, bomb-proof shelters and concrete barges.

MEMOIRS.

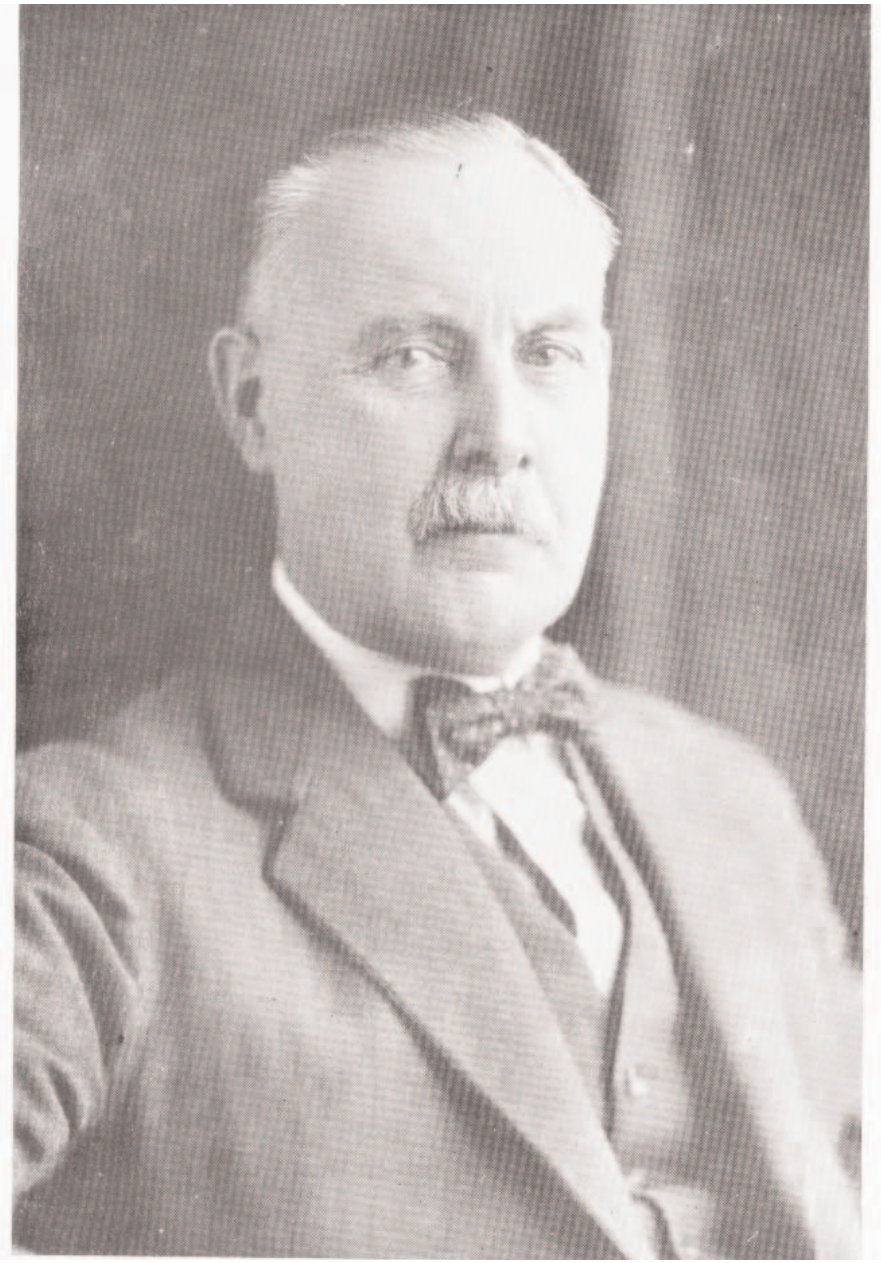
LIEUT.-GENERAL SIR GEORGE M. W. MACDONOGH, G.B.E., K.C.B., K.C.M.G., Barrister-at-Law, COLONEL COMMANDANT, ROYAL ENGINEERS.

DEATH takes a heavy toll of men in the seventies, and amongst those who have been recently called away we have to record, with deep regret, the name of George Mark Watson Macdonogh, an officer who had served his country well in several varied capacities, as a staff officer holding high positions in the Army, as a worker in the field of international law, and, after retirement, in the world of finance and business affairs. He was born at Sunderland on the 4th March, 1865, and was the son of Mr. G. V. Macdonogh, a Deputy Inspector of Hospitals of the Royal Navy. His father was a Roman Catholic and he himself was educated at Beaumont and remained throughout his life a devout adherent of that faith, and in later life was in touch with some of its most eminent ecclesiastics. But he was by no means narrow-minded, never obtruded his own beliefs, and maintained a considerable breadth of view.

He passed into the Royal Military Academy, Woolwich, in 1882, and was commissioned in the Royal Engineers on the 5th July, 1884. Of those who then obtained their commissions in the R.E., one other cadet, Harper, also made his mark in the 1914–18 War, on the Western Front, and also became a Lieut.-General. Harper died as the result of a motor accident whilst he was G.O.C.-in-C. Southern Command. Macdonogh continued his active service until 1925, when he retired, with many years of intellectually active life still before him.

In 1895 he passed second into the Staff College, Sir James Edmonds passing in first. It is noted in *The Times* that he was one of a notable batch which included two future field-marshals, Haig and Allenby. Before going to the Staff College he had served in submarine mining units at Hong Kong and Harwich. This service gave little scope for his special abilities, and it was not until he joined the Staff College that his exceptional capability began to be noticed. Here, although he was no great horseman, and riding well with the Drag was considered in those days the first qualification for the budding staff officer, his good work was soon appreciated by the staff, and even more by the fellow students whom he helped. Whilst at Camberley he ate his dinners and was called to the Bar, and there is no doubt that he was an apt student of the law as affecting military matters, and was at home in dealing with legal technicalities. His early staff appointments were D.A.A.G., Ireland, 1898–9; Brigade-Major, School of Military Engineering, 1899–1903; D.A.Q.M.G. Thames District, 1903–5; Staff Officer and Intelligence Officer at Gibraltar, 1905–6. He had thus had several years of experience of Minor Staff Duties before he was posted to the War Office.

In 1908 there was a vacancy in the Far East Section of the Intelligence at Army HeadQuarters, and perhaps it is not indiscreet to mention that one who had been a fellow student in that remarkable batch at the Staff College, namely, Sir James Edmonds, suggested that Macdonogh would be a suitable man to fill the vacancy. And, later, when there was a vacancy for an officer to take charge of the special section, then known as M.O.5, Macdonogh was selected to



Lieut-Gen Sir George M W MacDonogh CBE KCB KCMG

fill the appointment. *The Times* mentions some of the duties dealt with by this section, but for Macdonogh the most important duty was the general intelligence preparation for war and it was in this work that he found his *métier*. When war broke out in August, 1914, and the B.E.F. went to France, he went out with G.H.Q. as head of the Intelligence Branch of the General Staff. His extraordinarily successful services in this capacity have been acknowledged on all hands. The German Official History has since confirmed the accuracy of his forecasts and his maps of the distribution of the German divisions in the early part of the war. The following story may serve to indicate some of the trials of a Director of Intelligence. When, in October, 1914, Macdonogh took his daily tracing to the Commander-in-Chief, to put over Sir John French's map, he showed for the first time, on the tracing, 3 new German Reserve Corps coming up. Sir John said "How do you expect me to carry out my plan if you will bring up these b—y divisions!" When Sir William Robertson became C.G.S., in 1915, and made many changes amongst the rest of the General Staff at G.H.Q., he retained Macdonogh and his personnel, and informed him that his work had been entirely satisfactory; and when Robertson was called to London at the beginning of 1916 as C.I.G.S., he took Macdonogh home with him to be Director of Military Intelligence at Headquarters.

In this position, again, his work gave great satisfaction, and the War Cabinet rewarded him by appointing him Adjutant-General to the Forces in 1918. It is at least doubtful whether this removal of Macdonogh from the charge of the Intelligence, although to a higher post in the military hierarchy, was to the national advantage, for the Prime Minister lost the benefit of his assistance at Versailles during the settlement of the peace terms. He ceased to be Adjutant-General in 1922 and might a few years later have looked forward to being appointed C.I.G.S., in which position his knowledge of continental affairs would have been of great advantage to the State. He was only too well aware of Germany's preparations for war, and his opinion would have carried great weight. However, it was not to be.

As Adjutant-General, after the Armistice, he was chiefly concerned with the problems of demobilization, difficult and sometimes delicate problems. He was Adjutant-General to the Forces during the last three months of the war, and, for the first four years of peace, was responsible, in addition to demobilization, for recruiting, re-organization of the Army, discipline, personal services and all the multifarious duties of that office, including the registration of war graves, and military law. He was able to carry out all these duties without undue strain, in fact he enjoyed having plenty of work. He became Colonel Commandant, R.E., in 1924, and retired from the Army in September, 1925.

But his retirement by no means involved any material relaxation of labour, as the following list of some of his activities may serve to show. He became President of the Anglo-Finnish Society in 1926; Chairman of the Association for International Understanding in the same year (this Association was afterwards absorbed by Chatham House); Member of Council of the Royal Institute of International Affairs in 1928; President of the China Association, 1930–35; Chairman, China Flood Relief Committee in 1932; President of the Federation of British Industries, 1933–4; Member of Council of the London Chamber of Commerce, 1937–40; Member of the War Emergency Committee to the Federation of British Industries from 1939. And this is only a selection from a much longer list of useful activities in which he was engaged after his retirement.

A very interesting side of his character was his attachment to the law. He became a Barrister-at-Law of Lincoln's Inn in 1897, and in later years found his connection with the legal world of real value. In 1928 he was selected as Chairman of the "Government of Occupied Territories" Committee at the Conference of the International Law Association, at Warsaw; Chairman of the Nationality of Companies Committee, and of the Aerial Law Committee, and other

committees of the same Association, of which he became Vice-President and Acting Chairman of Council. In 1930, he was selected by the International Red Cross Society as British jurist to write a monograph on "The Protection of the Civil Population from Aerial Bombardment."

He also became a figure of importance in the world of business. He was adviser of the Shell Royal Dutch Group from 1922; was Chairman of five companies for many years in some cases to the time of his death; and was a Director of five other companies and of the National Provident Institution. He was also a Member of the London Committee of the Hong Kong and Shanghai Bank.

This recital reads rather like a page from *Who's Who*, but it could be considerably extended. It may serve to give some idea of the many interests with which Macdonogh was connected, official, legal, business. He did indeed live a busy, useful life to the end. A friend who knew him well says that he had a genius for finance and organization and that he differed from the average man in that, instead of his powers falling off as his age increased, his wisdom and judgment continued to grow and improve. He was sound and level-headed, with a remarkable memory. He was not witty or ready of speech, but thorough and reliable. He was, indeed, very reticent and reserved and so had few great friends, but his sterling qualities and great abilities made him much respected by those who knew him. Some striking tributes to his memory have appeared in *The Times*; Lord Astor, Chairman of the Royal Institute of International Affairs has written of his "lovable presence, his wisdom of judgment, and his wide knowledge"; Lord FitzAlan of Derwent describes his devotion to duty in connection with the management of St. John's and St. Elizabeth's Hospital, of which Macdonogh had been for many years the Chairman.

In 1933, he underwent a severe operation and in a letter to the writer of this memoir, said, with reference to the fact that there were still six of his R.E. batch in the land of the living, "We are getting a very small group and it was the nearest possible shave that I didn't reduce our numbers to five . . . As you say, I keep very busy with a very miscellaneous lot of jobs. I was afraid I was going to have far more to do than I can manage, as I was appointed a member of the Treasury Advisory Committee on Clearing Offices, but as an agreement was signed with the Germans yesterday the Committee will not now be required. . . ." He recovered from the operation and lived for nine more years, but he was pulled down by it and he was never quite the same man, physically, after it. His death, at the age of 77, which took place at Teddington on the 10th July, 1942, was sudden and unexpected. He was spared a long illness, and that is the sort of end that most of us would desire.

He married in November, 1898, Aline, daughter of Emil Borgström, of Helsingfors, Finland. The only son of the marriage died in 1915. Lady Macdonogh survives her husband.

C.F.A-C.

Brig-Gen Charles M Carpenter CMG DSO

BRIG.-GENERAL C. M. CARPENTER, C.M.G., D.S.O.

THE passing away of Brigadier-General Charles Murray Carpenter, C.M.G., D.S.O., known to hundreds of his friends as " Chips ", has removed a great personality whose cheerful spirit, even in most trying times, was a tonic to everyone.

Being a wonderfully good " mixer " himself he was a strong believer in " getting together," and in mixing up all sorts and kinds of people, seniors and juniors in the fighting services, and mixing them also with people in many other walks of life, however humble.

He had an outstanding talent for music, and was a most accomplished pianist. As an accompanist he could help the most unmusical singers through their task. He used this talent for the purpose of mixing people at cheerful entertainments, either improvised, *e.g.*, guest nights, or organized. On these occasions the principal item in his programme was the chorus " Have you seen the muffin man ? " the performance of which necessitated that everyone should frolic round the room. Finding that this item suited his mixing procedure well he worked it very hard, so that those who had heard it many times were not quite so energetic in their frolic as those to whom it was a novelty.

To anyone who has not met him I should explain that as a musician " Chips " was not of the type of long-haired highbrow, although his natural talent for music was great.

On the contrary, he was outstanding as a sportsman, notably a first-class horseman. He was a light weight, physically wiry and as hard as nails, with an unusual capacity for endurance of fatigue and hardship. On our point-to-point cups at Aldershot for both light and heavy weight races, his name appears. As a young officer he was a very fast outside left wing forward at association football. As a senior officer, and afterwards as a retired officer, he regularly won the officer's race in the Aldershot sports (with the usual start for age) although many subalterns did their best to overhaul him.

From Harrow he passed into " the Shop " top of his batch and out second into the Corps, apparently with the minimum of work. " Chips " was not one of those who appear to look for work, but when it came to him he did it quickly, thoroughly, and with unusual efficiency. While the average plodding officer at the same kind of duty might find himself overworked, " Chips " always had plenty of time for his outdoor pursuit of sport.

He thoroughly understood the men in the ranks of the Corps, and they liked him and worked for him, so that he was an excellent regimental officer.

After finishing his course as a Y.O. at Chatham, he was posted to the 17th Field Company, commanded by that great trainer of officers and other ranks, Major (afterwards Lieut.-General Sir) Ronald Maxwell. In his 31 years on the active list he spent 21 years in Field Units in every rank from Subaltern to Lieut.-Colonel, including 5 years with the Bengal Sappers and Miners, with whom he went on active service to China in 1900.

At home he spent most of his service at Aldershot, the Curragh and Cork, where he had plenty of opportunity for sport.

In 1906 he married Christelle, daughter of A. J. Nicolson, Esq., of Wokingham, Berkshire. They have one son and two daughters.

In the Great War 1914-18 he started in 1914 as O.C. of a bridging train in France, then for two years was C.R.E. of a Division in the battles on the western front and then Chief Engineer of the IV Corps in France. For his services in that war he was rewarded with the D.S.O. and C.M.G. and the brevet of Lieut.-Colonel. He retired in July, 1921, but was prominent every year as the judge at the winning post at the R.E. Aldershot point-to-point races.

When the present war began he was 69 years old, but became a district warden in the A.R.P. service of the Borough of Westminster, where as usual he made a new circle of many friends, who much appreciated his sound work and cheerful companionship.

In 1940, a painful illness compelled him to give up his work after sticking it out as long as possible with his usual pluck. He maintained his cheerfulness throughout this long illness which carried him off on the 18th March, 1942.

A host of real friends have sent their sincere condolences to Mrs. Carpenter.

H.L.P.

BRIGADIER-GENERAL R. A. GILLAM, C.M.G., D.S.O.

BRIGADIER-GENERAL REYNOLD ALEXANDER GILLAM, who died on the 26th January, 1942, after a short illness, had an active and varied career in many parts of the world. As a man his outstanding characteristics were his modesty, his capacity for real friendship, and his unselfishness. With his ability, hard work, and experience a less modest man would probably have gone further up the Army ladder.

Those who worked under him, and those who were fortunate in having him under their orders, fully appreciated his value. There is abundant evidence of their confidence in and affection for him.

As a regimental officer in each rank from Subaltern to Lieut.-Colonel with Sapper and Miner and British Units (a total period of 16 years) his men, British and Indian, at once discerned his modest and conscientious nature always working for their interest and care and for their efficiency as soldiers and engineers. They gave him their confidence and responded whole-heartedly to his command.

He was the second son of F. A. Gillam, Esq., late of the Bank of Bengal, Calcutta. At a private school he received an exceptionally sound education, which enabled him to pass into Woolwich in a high place in his batch at an unusually early age. Having been born on 23rd October, 1872, he was only 16 years and 1 month old when he sat for " the Shop " Exam. in November, 1888, and only 18 years, 3 months, when commissioned as a Second-Lieutenant R.E., in February, 1891. His batch ironically christened this infant " Dad," but later he was known to all his friends as " Rag " (his initials).

After finishing his Y.O. Course he went at once to India. Within a few months he began his regimental career in the 3rd Company, Queen's Own Madras Sappers and Miners, which he joined in the Chin Hills in Burma, where they were very actively employed on the frontier.

From December, 1897, to April, 1898, he went with this company to the N.W. Frontier of India on active service in the Tirah expedition, for which he received a medal and two clasps. He always expressed gratitude to his C.O.—Major (afterwards Major-General) H. B. H. Wright—for the training he gave him.

In 1899, he returned to England and, in April 1900, went to the South African war, in which he was employed on general duties, including the building of a considerable mileage of blockhouse lines. For that war he received 2 medals and 4 clasps. After the conclusion of peace he remained in South Africa and in May, 1903, became Adjutant of the Transvaal Engineer Volunteers.

Brig-Gen Reynold A Gillam CMG DSO

In 1905, he returned to England as a Captain and was posted to command the 37th Field Company, R.E., at Stobs. The next year, 1906, he married Gladys, daughter of T. Lindsay Watson, Esq., of Briery Yards, Hawick, Roxburghshire. Their daughter is the widow of the late Captain R. F. J. Onslow, M.V.O., D.S.C., R.N., of H.M.S. *Hermes* (killed in action), their eldest son a Captain in the Border Regiment, their younger son a Second-Lieutenant in the Mahratta Light Infantry (5th Battalion).

From 1906–11 Gillam was Adjutant of the 1st Bedfordshire R.E. Volunteers (later East Anglian Divl. Engineers).

Having been promoted Major in February, 1911, he spent two years as Chief Commissioner delimiting the boundary between Rhodesia and the Belgian Congo. On the conclusion of this arduous work in an unhealthy climate he was obliged to take sick leave for some months.

In 1914, he took over 250 civilians and trained them into the 62nd Field Company, R.E., which he took to France in 1915. A letter from one of his Officers gives a particularly genuine testimony of the Company's esteem of their C.O. as a man and a soldier. He was wounded near Hooge in the Ypres salient in June of the same year and evacuated to hospital in England. After coming out of hospital he went to the Engineer Training Centre at Newark.

In 1916, he was appointed C.R.E., 62nd (West Riding) Division, and was with them through the heavy fighting of the long-drawn-out battle on the Somme.

In 1917, he was appointed Chief Engineer, VIII Corps, whose Commander was exceptionally active and untiring and demanded the same qualifications from his Staff. Gillam, as usual, won his confidence and it was said that he could say things to him that no one else could say.

After the Armistice he was Chief Engineer, IX Corps, in the Armyof Occupation on the Rhine. The Commander of that Corps has frequently expressed his appreciation of Gillam's work and his hold over his officers and men.

For his services in the Great War, Gillam received the C.M.G., D.S.O., and *Croix de guerre*, and in January, 1919, a brevet Colonelcy.

In 1920, he took over command of No. 1 Group, Depot Companies, at Chatham, but was soon moved to the newly-created R.E. Board at the War Office (a descendant of the old R.E. Committee). He worked under its first President, Brigadier-General A. G. Stevenson, at a time when a great deal of research work was in progress on R.E. equipment to give effect to the lessons of the Great War.

As a result of the promotions and brevets in the war, the full Colonels' list of the Army, on which Gillam's brevet had placed him, was exceedingly long and Colonels' appointments in peace were few. He remained on the R.E. Board until 1923, when he was appointed Chief Engineer, Malta, and held that post till 1927.

After leaving Malta it appeared likely that he might have to wait some time on half-pay before a vacancy for re-employment would occur. The strain of the war had begun to tell on him. He decided to retire.

His friends will remember his sense of humour. He heartily enjoyed telling or hearing a good story. It has been said that he never made an enemy. He certainly made good friends because he was such a good friend himself.

H.L.P.

All Reviews of Books on military subjects are included in the provisions of K.R. 547(c) *1940*.

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library at Brompton Barracks, Chatham.)

MAPS AND SURVEY.

By ARTHUR R. HINKS, C.B.E., M.A., F.R.S.
(Cambridge University Press, 1942. Fourth Edition. Price 16s.)

In the Preface to the Fourth Edition of this useful work it is stated that " In the midst of a second World War it is not possible to give the expiring Third Edition that thorough revision which the passage of eight years demands." It was therefore decided to re-issue the book unchanged, except that a chapter has been added containing additions and corrections to the former chapters, which remain as they were, but for a few pages on Ordnance Maps.

The most original chapter in the Third Edition was that entitled Geodetic Survey. This valuable sketch contains clear accounts of the Pratt-Hayford theory of compensation and Airy's flotation theory, with brief notices of the various measures of arcs which have been made use of in determining the figure of the earth. A list of the elements of these figures is given, and it will be seen that the length of the semi-axis major has varied from 6,377,304 metres by Everest's computation, to 6,378,388 metres by Hayford's. Hayford's value for this and for the flattening, 1/297, were adopted as the standard by the International Union of Geodesy and Geophysics, at Madrid, in 1924; but the Author shows that this decision cannot be looked upon as an altogether happy one. In this chapter Mr. Hinks has included five ingenious and original diagrams which show graphically the effects, on the lengths of meridian arcs, of changes in the length of the major axis and of changes in the flattening; and other comparisons of interest to geodesists. In the additional chapter, in the new edition, a diagram is given to show the lengths of degrees of latitude, derived from early measures, mostly of the 18th century, as compared with those derived from the present international standard figure.

The interesting discussion in Chapter II, on Style in Lettering, remains without material alteration. Most of us admire the alphabets which were designed for the One-inch Ordnance Map, by the late Captain Withycombe and Mr. Ellis Martin. The use by the Royal Geographical Society of letters drawn freely, in single strokes, with a quill, has shown that considerable success can be attained by this rapid and cheap method, though perfect agreement on this point is hardly to be expected.

Two of the most helpful features of the Third Edition were the chapters on Photographic Surveying and on Survey Instruments. Not much alteration has been found necessary to these two chapters. The few additions include a short note on Wild's Autograph A5; one on Bubble Sextants; and one on new patterns of Geodetic Pendulums.

It is interesting to see in Chapter XIV, which gives brief accounts of the additions and corrections necessary to bring the previous chapters up to date, how much information about recent developments in mapping and surveying is to be found in the pages of that excellent publication *The Geographical Journal*, which has remained under the able editorship of the Author of the book under review. C. F. ARDEN-CLOSE.

ELECTRICAL TECHNOLOGY FOR TELECOMMUNICATIONS.

By W. H. DATE, B.SC., A.M.I.E.E., Senior Lecturer in Electrical Engineering, The Polytechnic, London.
(Longmans, Green & Co. Price 5s.)

This little book of 158 pages is written, as its name implies, primarily for students proceeding to the study of electrical signalling, but it is a very clearly written treatise on elementary Electrical Technology and as such it is equally suitable for engineers generally who require a simple introduction to Electrical Engineering. The mathematics used are simple but adequate and there is no padding of descriptive matter. About half the book is devoted to elementary Alternating Currents and the treatment should prove helpful to those students who find an initial difficulty in the study of this subject.

The book as a whole covers the City and Guilds of London Institute syllabus in Electrical Technology.

A minor criticism is that the author continues to use the obsolete term " pressure " when he means " voltage."

A few more numerical examples with answers would have added to the value of the book. W.M.

MAGAZINES.

THE MILITARY ENGINEER.

(*March*, 1942.)—*Our Army Engineer Troops.*—In an address delivered in January before the Washington Post of the Society of American Military Engineers, Major-General E. Reybold described briefly the function, organization and equipment of the Army Engineer Troops. The American army possesses about fifteen different types of Engineer units. Each one of them has been completely redesigned during the past year and a half, in the light of lessons learnt from the present war and from manœuvres at home. As an example, the "combat regiment," formerly attached to each infantry division, was 2,000 strong, it employed horse and mule transport, and marched on foot. It is now 750 strong, completely motorized, and heavily armed.

Corregidor.—Colonel J. F. Bell explains the importance of the island of Corregidor in the defence of Manila Bay. In the Spanish-American war of 1898 it was very inadequately fortified and offered hardly any resistance to Admiral Dewey's fleet. It has assumed a great importance in the present struggle with Japan, but the writer has no knowledge of the extent of its fortifications. (The article was, of course, written before the capture of the island by the Japanese.)

Manœuvre Notes of Aviation Engineers. (Continued from the November, 1941, number.)—By Colonel D. F. Johns.—A description of the work (mainly camouflage) carried out by aviation engineers (21st Engineer Regiment) in the First Army—IV Corps manœuvres.

Japan.—By Colonel J. F. Bell.—A brief description of the Japanese Empire, its present extent, population, surface features and climate, agriculture, mineral resources and industrial production. There is no bond of sympathy between Japan and Germany, but Japan has taken advantage of the international situation during the second World War to grab all the land within range, in order to secure more territory and the natural resources of which she is deficient.

Pyrrhic Victories.—A comparison between Hitler's campaign in Russia and the victories of a despotic king of Epirus twenty-two centuries ago, ending with a warning to Americans not to underestimate the strength of their present enemies.

Eighth Engineer Squadron in Manœuvres.—By Lieut.-Colonel D. M. Dunne.—An account of the work carried out by the 8th Engineer Squadron, which formed part of the 1st Cavalry Division, in the Louisiana manœuvres held in August and September, 1941. The great tactical mobility of the Army presented engineering problems of a very special nature not found in most other divisions. Their successful solution required extensive application of improvisations and hasty expedients and the fullest use of local materials.

Old Fort "Blunder."—By Captain W. H. Gill.—Fort Montgomery, known facetiously as Fort Blunder, was built by the United States about 1812 on an island in Lake Champlain, on the boundary between the Canadian Province of Quebec and the American State of New York. The boundary between the two countries had been fixed at the 45° parallel, but, owing to an inaccurate survey it had been marked out about a mile north of that line. A dispute as to the ownership of the site of the fort continued for about 30 years between Great Britain and the U.S.A., and was finally settled amicably in favour of the latter country.

(*April*, 1942.)—*South America's Vital Road.*—By Captain S. A. McMillion.—This article, accompanied by a map of South America, draws attention to the Pan-American Highway, which has a special importance during the present war, when so much of the American maritime trade has been disorganized.

There is only one railway line spanning the continent; it links Buenos Ayres with Valparaiso. A second line, connecting Rio de Janeiro with Arica in Chile, will be completed in about three years' time.

Of the main highways, the principal route begins at Acandi, in north-west Colombia, follows the west coast to Valparaiso in Chile, then turns almost due east to Santiago and across the pampas region of the Argentine to Buenos Ayres. The Uspallata pass, over which it crosses the Andes, is, however, not passable during the winter months.

An alternative route, which leaves the coast at Vitor, in Peru, crosses the Andes by Lake Titicaca, and reaches Buenos Ayres via La Paz, in Bolivia. The road is open all the year round.

Other important roads are (1) the Simon Bolivar Highway, which connects La Guaira, Venezuela, on the Atlantic, with Guyaquil, Ecuador, on the Pacific Coast; (2) the Rio de Janeiro—Montevideo—Buenos Ayres Highway.

A Simple Combat Range. By 2nd-Lieut. R. M. Tarbox.—A description of a firing range, constructed and used by the 13th Engineer Battalion at Jolon, California. Firing was done at ranges varying from 150 to 400 yards. The arrangement of the silhouette

targets is described, as well as the method of scoring, and the materials required for constructing the range.

Soil-Cement for Army Airports and Runways. By M. D. Catton.—Soil-cement construction consists of mixing the existing soil, or selected local soils, with proper amounts of cement to produce a hard, durable structural material. The soil is the aggregate of the mixture, forming about 90% of the whole, exclusive of water. Survey and identification of the soil are therefore an important preliminary step.

The fundamental control factors are: (1) Proper moisture, (2) Proper density, (3) Proper cement content. (1) and (2) are determined by tests used by the Corps of Engineers and others in earth dam construction. The cement contents are determined by tests on soil-cement specimens moulded to their required density at the proper moisture content and then subjected to alternate wetting and drying and freezing and thawing processes.

The construction procedure consists of a series of operations, beginning with the pulverization of the existing soil and extending through to the final finishing of the soil-cement surface. All the operations are continuous.

After the cement is spread uniformly over the pulverized soil, it is mixed with the soil by means of disc harrows, field cultivators, or other similar equipment. Water is then added gradually and mixed in with the same type of tools. When the correct amount has been added, the mixture is compacted to a uniform density with sheep's foot rollers. The finishing surface is obtained by the combined use of flat wheel rollers, pneumatic rollers, nail drags, and broom drags.

Soil-cement has been used extensively for roads and for air-port runways, other than those taking very heavy traffic. The usual thickness is six inches. Its use is being extended to all parts of the globe, and it is interesting to note that the Chinese National Government has built sections of soil-cement by hand labour on the Burma Road.

The Battle Fronts.—A review of the situation on the different fronts in April.

The Reorganization of the Army.—An order for the reorganization of the American Army, signed by the President, became effective on the 9th March, 1942. It provided for an army under the Chief of Staff, consisting of a ground force, under a Commanding General, Army Ground Forces; an air force under a Commanding General, Army Air Forces; and a service of supply command, under a Commanding General, Services of Supply. The functions, duties and powers of each are laid down.

Map Makers Aid National Defence. By Major W. C. Hall.—The lack of adequate maps in the United States has presented a serious defence problem, especially as regards the coastal and strategic areas. Strenuous efforts are being made to make good the deficiency, and Congress has recently appropriated five million dollars for the initial portion of the programme, which is being undertaken by various agencies.

The Royal Engineers.—By Colonel F. I. de la P. Garforth, R.E.—In an address given before the Washington Post of the Society of American Military Engineers, Colonel Garforth has made a brief comparison between the training, organization and equipment of the Royal Engineers and those of their *confrères* in the American Army.

Simplified Stream-Crossing Equipment.—Major A. J. McCutchen explains a design that he has evolved for combining the assault boat, the foot-bridge and the light assault bridge in a single type of equipment which would enable each successive operation to contribute directly to the next. The assault boats have a pointed bow and a slightly curved bottom, and are a modification of the type now in use. Each boat is 14 ft. long, 5 ft. wide, and 1 ft. 8 in. deep. When in bridge, they are used in pairs, stern to stern; the piers are spaced at 12 ft. distances, centre to centre.

By the adoption of a single type boat and bridge a considerable amount of transport could be saved.

A 1½-ton truck can carry 240 running feet of foot-bridge duck-board or 60 ft. of treadway for a light assault bridge.

The writer considers that the next step after the light assault bridge should be a maximum load bridge. Intermediate sized bridges are unnecessary.

Camouflage—Then and Now. By Greville Rickard.—This is a short review of the history of camouflage procedure as it was known in 1917 and 1918, and as it is to-day. Camouflage was not taken very seriously in the American Army at first. A factory was eventually started at Dijon, and the principles on which the science worked were two:—

(1) Creating deception through making an object seem absent, non-existent or unimportant.

(2) Creating deception through making some other object seem important with the idea of attracting away the attention of the observer.

The principles remain true to a certain extent nowadays, but with a difference.

In marine camouflage the aim was to deceive the observer on the sea and in the submarine. To-day it is of great importance to give low visibility from the air as well.

The wide use of the aeroplane has caused camouflage to expand in three ways since 1918. It has brought it

(1) From activity in the realm of the military into activity in the realm of the civilian as well.

(2) From concealment from aerial photography to include also concealment from observation by the naked eyes of the bomber.

(3) From protection by day-time to protection by night-time to an increased degree.

A.S.H.

REVUE MILITAIRE SUISSE.

(*July*, 1941.)—*Manœuvre de rupture d'un régiment allemand de chars.* By Lieut.-Colonel Perrot. A description of a tank operation on the 5th and 6th of June, 1940, on the Somme, gathered chiefly from German sources, against the 19th and 29th Divisions of the French I Corps. A German tank regiment, consisting of two battalions, started off from Peronne, covered by infantry and an artillery barrage, with the object of piercing the French defence zone, which at this point was some 20 kilometres deep. The zone defences consisted of numerous villages hastily prepared for defence. The French resistance was already crumpling up, after the disastrous three weeks of fighting further north.

The German infantry had established a bridgehead across the Somme, and the tanks passed the river under cover of this screen. Then they dashed forward. Here and there the French anti-tank guns checked their rush, inflicting losses; but the defence was too disorganized to stop them, and the supply tanks in rear had no difficulty in coming up at the end of the afternoon to refill the fighting vehicles.

No conclusions can be drawn from such one-sided odds.

Commentaires sur la guerre actuelle. This is the first commentary on the opening of the German war on Russia. It points out that the opening phases were all on the lines of the previous lightning strokes, but on a wider scale. There were the massed air attacks on the Russian Air Force to destroy it on the ground; the bombardments of the lines of supply to paralyse the mobilization and concentrations, and the heavy bombardments of the rear zones to break-up civil morale. Parallel with this air assault were the deep thrusts of the *panzer* divisions into the enemy's front zone to form pockets which endeavoured to break up the defence systematically.

By the middle of July, the Germans had advanced some 400 kilometres into Russia.

(*September*, 1941.)—*Commentaires sur la guerre actuelle.* The situation on the Russian front had not undergone any decisive change during the period mid-August to mid-September. A winter campaign was not beyond a possibility; indeed there were signs that the Germans expected it and were preparing for it. The guerilla fighting was still going on in the rear. The Swiss commentator was beginning to feel doubtful that the Germans could obtain the decision just yet.

The Finns became more active, and after capturing Viborg, moved further forward and helped the Germans to complete—or almost complete—the encirclement of Leningrad. Actually the Russians were able to keep open one sector of the circle and used the frozen lake Ladoga later on to re-victual the fortress.

In the centre, Marshal Timoschenko, who had not yet been transferred to the south, was putting up a strong resistance and even counter-attacking in the region of Smolensk. In the Ukraine, the Germans were advancing rapidly. Kieff fell on September 20th, but Odessa was still holding out. New Russian armies were forming in the rear, but their equipment was hindered by the great dislocation of the munitions factories.

(*October*, 1941.)—*La question de la neutralisation du Canal de Suez et du Canal de Panama.* By A.B. A short reminder of the original guarantee for the complete neutrality of these two international Canals. Any Power which damaged the Suez Canal or endangered it would be called upon to make the damage good. Those were the days when some respect for treaties was counted on from all civilized Powers. In the case of the Panama Canal the concession was granted to M. de Lesseps by the republic of Colombia, but as its construction was delayed until the situation of the young republic had become totally different, and the United States had become a Great Power, it was the latter which became the custodian of the Canal and the guardian of the fortresses at either end. To-day, the importance of the Panama Canal to American strategy is scarcely less vital than that of the Suez Canal to Great Britain. Let us be thankful that both these great waterways remain at our disposal.

Commentaires sur la guerre actuelle. This month, the commentary is confined to the guerilla aspect of the struggle on the Eastern front. Some of the guerilla fighters are regular soldiers, left behind through the misfortunes of war, or left behind for the express purpose of organizing resistance in rear of the enemy lines; the others are the peasantry, gallantly striving to do the utmost damage to the enemy. All suffer the same terrible fate if they fall into German hands.

The Russian is a born guerilla-fighter; he is capable of causing endless damage when supported by a nucleus of soldiers trained in demolition. Such assistance can nowadays be dropped behind the lines.

(*January*, 1942.)—*La bataille des Alpes* (concluded). The end of the fighting on the Alpine front brought no sort of glory to the Italian arms, indeed, if the increasing threat

from the German forces closing in from the direction of Lyons had not suddenly become decisive, the French would have had little difficulty in holding the Italians. For scarcely anywhere had the latter crossed the frontier when the Armistice put an end to the operations. The French position of resistance was intact. The first attempt to hold up the German advance against the Army of the Alps was based on the Rhone between Bellegarde and Lyons, but on June 18th, by orders of General Weygand, Lyons was declared an open town, and no demolitions or defensive works were permitted inside the city. The seven bridges left intact at Lyons by this order rendered the whole position untenable, and General Olry, Commander of the Army of the Alps, had to hastily organize another position on the Isère. Much was done in the short time available, and the Germans were checked, but in three days' time the Armistice was declared.

The Army of the Alps comes out well, and has reason to be proud of its resistance against overwhelming odds.

Commentaires sur la guerre actuelle. The war in Russia to date is reviewed in three phases. The first phase was the surprise and complete initiative in the conduct of the operations by the Germans. Their objective was the destruction of the Red Army. To this end were fought the great battles of Bialystok, Minsk and Lemberg; Lake Ilmen, Smolensk and Kieff. Having failed, in spite of huge captures of men and material, to annihilate the Russian forces, the Germans opened the second phase, the attacks on Leningrad, Moscow and the Ukraine. By the capture of these great centres of industry and munition production, the Germans hoped to put the Red Army out of action. But none of these objectives were reached before winter fell.

The third phase was the German suspension of the offensive, and the holding of a line of strong points to cover the winter quarters while preparations for the renewed offensive in the spring were made.

The Russians, in December, took advantage of the German unpreparedness for a winter campaign, and, using specially trained winter troops, made counter-attacks which had considerable success in the softer sectors of the line between the German strong points. A large number of Germans were killed or captured during these operations, and the pressure on Moscow and Leningrad was greatly relieved.

(*April, 1942; February and March missing.*)—*Questions du Génie.* By Colonel Lecomte. The transcript of an article of the same title published in the January number of the *Journal Militaire Suisse* by an anonymous young engineer officer. Colonel Lecomte is the senior of the Swiss engineer officers, and he gives an abridged version of the article with a few of his own remarks.

The Swiss engineer troops are now divided into troops of "construction" and communication troops. Roughly speaking, these correspond to our Field Companies and Army Troops companies.

The *troupes de construction* are charged with demolitions and obstacles, repairs and fortification. There are no points of special interest in the article, which relates chiefly to the problems confronting the training and equipment of these troops, owing to their paucity and their short periods of training.

Commentaires sur la guerre actuelle. A review of the situation in the various theatres of war at the middle of April. In Libya, there was another deadlock. Rommel had recovered nearly all the ground he had lost. While he had received substantial reinforcements, the British force had been reduced by the withdrawal of the Australians.

At any moment, Rommel might be expected to renew his offensive towards the Suez Canal—as indeed he has done.

In Russia, the article remarks that although the German front line was further back than in December, 1941, its key-points, Schlusselberg, Rjeff, Smolensk, Orel, Kharkoff and Taganrog, still held. These firm rocks were subsequently of great assistance to the German offensive. What was doubtful was the extent to which the Russian counter-offensive in the spring had drawn in the reserves upon which the Germans were counting for their summer offensive. The annihilation of the Russian Armies still remained the primary German objective.

The victory would fall to the side having the last reserves.

The Battle of the Atlantic is waged with increasing intensity with a view to preventing Allied help to Russia. The attacks on shipping have been gradually shifted across to the American coast, where anti-submarine measures are far less developed than on the British side.

In the Far East, the Dutch islands had fallen to the Japanese, their defence having been considerably weakened by the aid given to Singapore by the Dutch air forces. The fragments of the naval and air forces barely escaped to Australia.

In Burma, the Allied cause had also suffered a heavy defeat, and the road to China was lost.

An attack upon Australia sooner or later was regarded as likely, in order to forestall the development of an allied base for a large scale offensive against Japan. Madagascar, which had not yet been captured by the Allies, came into the picture owing to the likelihood of its use by the Japanese in their attacks upon the shipping coming up to east coast of Africa. A coup-de-main against the island was considered likely.

W.H.K.

ARMY EDUCATION.

(*July*, 1942.)—This issue, which completes the first year of the reappearance of this Journal, contains two articles on the general subject of Education in the Army, both from Members of the Directorate, which, while agreeing as to the end being sought, appear so fundamentally to differ as to the means, that they are of particular interest.

The articles in question are: *The Progress of Army Education* by Major-General H. Willans, C.B.E., D.S.O., M.C., T.D., Director General of Welfare and Education, and *Education and the A.T.S.* by Senior Commander C. M. James, A.T.S., of the Directorate of Army Education.

Major-General Willans, after reviewing the progress made to date, states that the spirit of Army Education is being directed "along the line of interest rather than the line of schooling" and that "anything that may inspire mental development or self expression comes within its orbit." He is working to create in soldiers "a spontaneous desire to widen his interests and improve himself," by satisfying their "demands."

It is true that he definitely mentions this as being the necessary line for the "average soldier"; but as it has been so often repeated that the "80%" provide the problem, presumably this elastic and very voluntary method must be his plan to reach them as well.

Senior Commander James, while agreeing that freedom of choice should be given to the minority (presumably the 20%) who have genuine interests, says that "If they have the duty of learning, we have the duty of deciding what they should learn." Her argument being that, as many of the women have had no formal education for ten or more years, it is more than unreasonable to ask them to determine for themselves (presumably the 80%) what they should learn.

General Willans, in describing the progress made, draws particular attention to the ever growing success of A.B.C.A. (which the writer understands was not created as a result of "demand" from below); thus appearing to support Senior Commander James' argument by showing that a sound decision as to what they should learn will bring success. He attributes the success of A.B.C.A. mainly to the fact that it depends ultimately on the interest, enthusiasm and good sense of the ordinary junior officer, but does not try to explain why this humble individual has been able to get such good results. One possible explanation is that the Regimental officer is in a position to "induce" his men to take some part in the educational scheme, and many of the "80%," finding it of interest (probably to their surprise), have been reached. There may be many difficulties in the way of compulsory education in the Army, but "Diseases desperate grown, by desperate appliance are relieved or not at all," and the condition of the 80% has indeed grown desperate.

Colonel A. C. T. White, V.C., M.C., contributes an article:—*A Note on the History of Army Education.*

Education in a Reserve Artillery Regt. by Serjt.-Instructor D. G. Reigate, A.E.C., and *The A.E.C. Comes to a Coast Artillery Regt.* by Serjt.-Instructor J. T. Browne, B.A., A.E.C., give their authors' experiences and show what can be achieved by keenness and hard work.

Running a Soldiers' Library by Lieut. A. Vesselo, B.A., A.E.C., is a most valuable article which should certainly be studied by anyone connected with a unit library. It contains valuable advice on how to choose the books to make up a library.

A.R.A.I.

THE INDIAN FORESTER.

(*February*, 1942.)—One item in *Forest Administration in the U.P.* concerns the development of roads. In the last 15 years, a system of unmetalled roads, totalling 300 miles, suitable for light motor traffic, has been made in the dry areas immediately below the foothills of the Himalayas, with the result that the subordinate staff is now a cyclist and not a mounted corps. Some of these roads are being made fit for lorries. The plains divisions have, during the same period, added 200 miles to a previous figure of nearly 800.

There is *A Note on the Parlakimidi Forest Division*, which contains an interesting note on the Savaras inhabiting the district, which lies near the extreme north of the Madras Presidency. They are animists of a somewhat primitive type. Their treatment of a sick man is interesting. "When a Savara gets ill he uses all the roots of trees and shrubs known to him." When the disease does not yield to this treatment, his neighbours take to sacrificing animals, beginning with fowls, and ascending, as the disease worsens, to goats, pigs and finally buffaloes. When the patient seems to be incurable they begin to fire guns at intervals. "Perhaps the poor patient dies in the meantime of heart failure, as on hearing the gunfire, he thinks he must die."

Punjab and Colonization points out the financial value of plantations in irrigated land, often accruing by indirect methods. Thus, a plantation yields small firewood, which is sold at a nominal price to the population. Since this firewood is available as fuel, less cowdung is used for the purpose, and the balance can be used for manuring fields; this again is an advantage, because manured fields need less water to irrigate them than untreated ones. Mention is made of the sports goods industry, and we learn that a Punjabi child's first toy is a hockey stick!

(*March*, 1942.)—As might be expected, the subject of war supplies bulks largely in this number. The exertions of the forest staff, almost unaided, in one forest area, Pilibhit, U.P., are detailed. Tracks were made over ground thought to be impassable in winter with fellings, debris, slash and other refuse lying in the forest, so as to enable bullock traffic to cart timber to the railway. Here the only stations were often mere halts, with no lifting appliances; nevertheless, the railway staff played up nobly.

At Dehra Dun, the problem of rendering bamboos, largely used for tent poles and for many other purposes in the army, insect-proof, is being studied. Wood for lasts for the annual manufacture of a million and a half pairs of boots for the army has to be found. The research for more timbers suitable for aircraft goes on. A wooden insulator for wireless aerials on army vehicles is being prepared to replace china ones which fail badly when the aerial bends in passing under trees. Finally, Army doctors are being given bamboo substitutes for pill-boxes.

It is noted that the C.R.E. Sind area has approved a plywood lampshade for electric lamps.

An indent for timber, amounting to Rs. 2,89,00,000 (£2,170,000 approx.) has been received by the Timber Directorate for wood for Army and Air Force purposes.

(*April*, 1942.)—*Supply of Timber for the War from the Punjab.*—A special Army Timber Supply Circle has been formed to deal with the enormous war demand for scantlings and poles. The activities of this body comprise supply, purchase, organization and working of sawmills, despatching and accounting. The source of the timber is almost exclusively the remote forests of the lower Himalayas, between 8,000 and 10,000 feet above sea level, but we read of some purchased as far afield as Kabul. Each piece bought is stamped with the personal hammer of the purchaser, the species and specification, while in addition each log has its passed length, class and cubic contents marked in white paint.

A large number of sawmills has grown up, where the timber is sawn into some 2,000 different lengths and sizes, to say nothing of specials. The specifications for all the different classes, fifteen in all, must be some of the most meticulous, as well as the most comprehensive, that the trade has ever had to work to.

The question of the percentage of wastage permissible in sawing a log into scantlings sometimes crops up in Sapper work, and the following table may be useful:—

	Deodar	*Kail*	*Chir*	*Fir*
Conversion of logs into hutting sizes ...	40	50	—	60
Conversion of sleepers into hutting sizes ...	30	35	45	45
Conversion of sleepers into *karris* by two saw cuts	10	10	10	10

For the benefit of readers unacquainted with Indian timbers, it may be added that the nearest Home equivalent to deodar is cedar, while kail, chir and fir approximate to Scots and other pines and to spruce. A *karri* is a small scantling.

A letter to the *Journal* records the shooting of a tiger at an altitude of nearly 10,000 feet above sea level; this is an unusual elevation, *Notes for Officers proceeding to India* gives 7,000 to 8,000 as their ceiling.

F.C.M.

CORRESPONDENCE.

MOTOR CYCLES FOR MILITARY ENGINEER PURPOSES.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

As an old-time motor-cyclist who has had no opportunities to indulge in the sport in recent years, Col. Bowen's article on military motor-cycles in the June, 1942, *Journal* interested me greatly, by the evidence it provided (confirmed from other sources) that in two important respects, viz., weight and petrol consumption (two important factors affecting economy), motor-cycle design has not advanced, but gone back, in the last twenty years.

For a given cylinder capacity, performance and sturdiness have no doubt greatly improved, and of course improved and more elaborate equipment accounts for much of the weight. But with improved design and materials, surely we should expect improved performance and strength without increase to running costs. It does not seem to me that we have got it.

Owing to the improved performance, the 350 c.c. machine of to-day has to be compared with the 550 c.c. Triumph which was the D.R.'s. stand-by in the 1914-18 war (though the 350 c.c. Douglas also acquitted itself well in those days). The modern machine can probably stand rougher handling, but the old "trusty Triumph" had a great reputation for reliability on *pavé* roads and shell-torn tracks in France. I did not have occasion to ride one under active service conditions, but in 1920 I purchased an ex-W.D. Triumph in Cologne, and rode it for the next two years, and I offer the following figures for comparison with Colonel Bowen's :—

Weight (fuelled)	250 lb.
Petrol consumption	80 m.p.g.
Cruising speed	30–35 m.p.h.
Range on full tank	120 miles.

The weight is not strictly comparable, as it was without extras such as lamps, but even so the difference seems excessive. The fuel consumption was quite normal for those days; it could be improved 20% by using benzole (pure, not mixture, which I have found to have no advantage over petrol), with a better performance.

A 350 c.c. Douglas of 1910 model weighed 112 lbs. and averaged 120 m.p.g. or more. This was single geared and its maximum speed was 40 m.p.h., but it was an efficient machine, suitable for long runs and not to be compared with the motor-assisted bicycles of to-day, as evidenced by the fact that though it was provided with pedals to assist the engine, I soon took these off and never missed them.

Cannot designers now give us the economy of the old machines with the performance of the new ones ?

Yours faithfully,

P. A. LEWIS, *Major, R.E. (retd.).*

15, Prospect Row,
Brompton.

THE FLAME OF THE FOREST.

15th May, 1942.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

Under the heading " The Indian Forester " on page 379 of Vol. LV of September, 1941, reference is made to the tree Semal (*Bombax Malabaricum*) being better known to the layman as the Flame of the Forest.

There still exists a great deal of confusion in India as to which tree is the Flame of the Forest. *Bombax Malabaricum* may be called the Flame of the Forest by some laymen, but its better known name is The Silk Cotton Tree from the Silk Cotton pods it produces.

The Flame of the Forest is " *Butea Frondosa,*" quite a different tree both in structure, flower, and fruit.

There seems to be little doubt that the existing confusion is simply due to the " flaming " appearance of several of these beautiful flowering trees, all of which one freely hears described as Flame of the Forest. Additional to the above two, I would mention The Gul Mohur (*Poinciana Regia*), often called Gold Mohur, which is the tree by far the more frequently mistaken for the Flame of the Forest than any of the others, the Coral Tree (*Erethryna Suberosa*), the Scarlet Bell Tree (*Spathodia Capanulata*), and the Coloured Sterculia (*Sterculia Colorata*).

All of these have profuse but quite different blooms-not all flowering before the new leaves—of the most brilliant shades varying from bright orange to the most vivid brick reds, giving a flaming appearance at a distance, but not often mistaken by a discerning eye. Surprisingly enough from the colour point of view the Silk Cotton Tree is less " flaming " than any of the others as its fleshy cup-like flowers have a decided pink mauve tinge, and nothing like as " vivid a red," for example, as the Coral Tree. Seen alone however, *Bombax Malabaricum*, in flower, stands out brilliantly. The Flame of the Forest flower is decidedly orange coloured, and the blooms have a hirsute silkiness which might be likened to the " bloom " of a peach. They are nothing like the Silk Cotton either in size, shape, structure or colour. Silk cotton is known locally as " *Kapas* " and is used to a great extent for filling cushions, pillows and the like. None of the other trees mentioned produce anything of this nature. It may be of interest to note that partly ripe silk cotton—dried before fully ripe—is used by nearly all the villagers and jungle people with a flint and steel, forming a most useful and efficient " lighter."

I am, Sir,

Yours truly,

F. HESSLING,
Associate Member.

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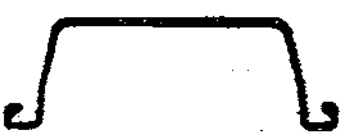

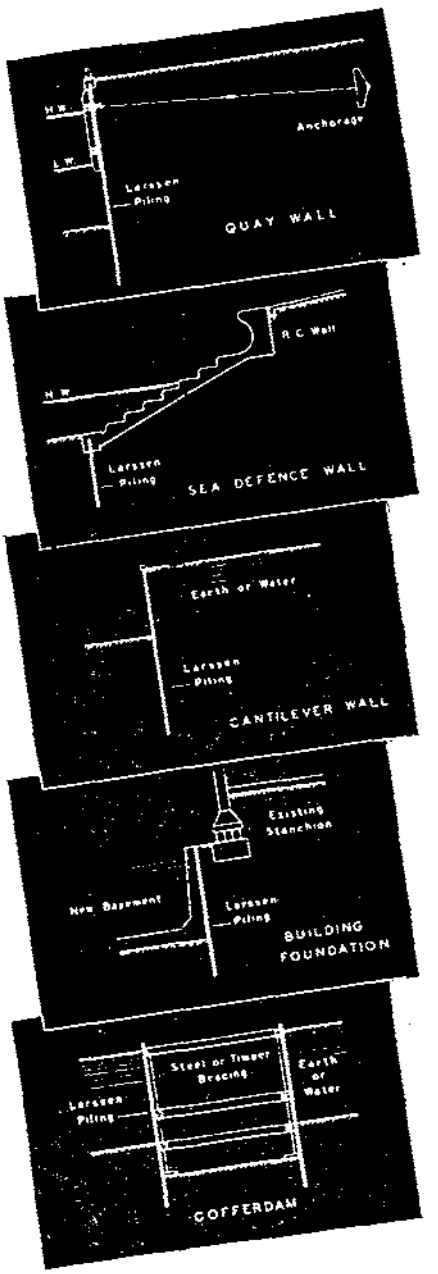

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