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THE ROYAL ENGINEERS JOURNAL.

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ATTENTION is invited to the conditions under which this prize, in value about £10, is offered for competition each year.

1. The Prize shall be awarded by the R.E. Institute Council in the manner considered best for the encouragement of contributions on professional subjects, by R.E. Officers, to the Corps publications. From the beginning of 1920 it has been decided that the Prize shall be confined to Officers on the Active List not above the rank of Substantive Major.

2. The Prize shall consist of (*a*) a book on Survey, Exploration, Travel, Geography, Topography, or Astronomy; the book to be whole-bound in leather, and to have the Montgomerie book-plate with inscription inside; (*b*) the remainder of the year's income of the Fund in cash.

3. The name of the recipient of the Prize shall be notified in the Corps publications; and copies of the contribution for which the Prize was awarded shall be presented to the representatives of the donors.

The following are suggested as subjects for contributions:—

(*a*). Descriptions of works actually carried out in peace or war.
(*b*). Inventions.
(*c*). Design (excluding works of defence).
(*d*). Labour organization on work.
(*e*). Scientific investigations generally.
(*f*). Accounts of exploration work and surveys.

CAMOUFLAGE VERSUS CAMERA.

By MAJOR G. MACLEOD ROSS, M.C., B. ENG., LATELY O.C. 227TH FIELD CO. R.E., B.E.F., FRANCE.

IN April, 1918, when Germany was making her final effort to break through to the Channel Ports, it became necessary to construct additional defensive positions on the Second Army Front. These were multiplied unceasingly—a large amount of concrete, both mass and in blocks (both reinforced), was put in, and large lengths were revetted.

Each system consisted of 3 lines connected by communication trenches:—An outpost line, where the main force of the attack would be broken, and which would ensure employment of enemy reserves at the earliest possible moment; a support line, close up, but, as far as possible, providing good shelter from shell fire, in which were housed our close reserves, and a reserve line, 600 to 1000 yards in rear, where Divisional reserves could be deployed under cover. The lines were conceived solely for a one-day battle, hence their multiplicity. This fact should be borne in mind when criticizing the following efforts to bluff the enemy.

It was never expected that the devices employed would stand the wear and tear of a drawn out battle, much less "trench" warfare in the accepted sense. The sole idea was to inflict maximum loss on the first day's attack; to break up quickly a large and highly organized attack and so gain time. If success was achieved, all cunning would have to be cut out and the old tactics resumed. The deception would have then justified the highly skilled labour and extra time employed on it. To-day, so many things are called camouflage that it may be interesting to examine the "invisible" trench described below, which, I submit, is an example of real camouflage. Efforts have been made with painted canvas, etc., to conceal the position of a trench, but never successfully. For real camouflage over a large area reliance cannot be placed on any artificial aids such as canvas or paint. The trench in question was unfortunately never tested by war, but I venture to express the opinion that it would have justified our hopes.

Now, hiding an object in war is really only one half of the problem, the other half is supplying the enemy with something else to play with. The enemy in the late war had well-known characteristics. If you puzzled him he lost his temper and got "windy" at once. If you

even apparently began to spread your cards on the table, he waited until you had, as he thought, fully developed your idea. We thus arrive at a system known as "multiplication of objects."

The country in which the work was done was, save for a few bomb holes, untouched by war. The ground was under cultivation by the farmers, and glancing at an aeroplane photograph of the district, we find that save for villages here and there, we have a very regular chess-board effect. This was constantly changing its texture as the corn and other crops matured, and were finally harvested. Nevertheless the different crops, whatever their condition, still retained their own characteristics.

It was study of the aeroplane photograph which suggested the utilization of the drains or junction lines of the various plots for the course to be taken by the trench itself. This, and the fact that it was easier to hide a straight trench than a traversed trench, as employed to date. All the same, traversing the "invisible" trench had to be dealt with. This was overcome by arranging to cross and recross a plot or to "step back" on a series of plots.

Fig. 1 shows the ground taken from some 5,000 feet. It will possibly be simpler to follow if I proceed to enunciate the proposition in this particular instance. A communication trench dug to depth ended at Pt. A. Along C.D.E.F. ran the reserve line of the position.

Required to (1) proceed from A to D by an invisible path and (2) to provide between A to C a blind on which the enemy could focus all his attention. Possibly I should explain that "invisible" means invisible on aeroplane photographs taken at 13,000 feet and upwards by enemy 'planes.

Requirement (1) was fulfilled by digging a trench 3 feet wide, 3 feet deep and 2 feet wide at bottom along the line shown from A to D (in white.)

Requirement (2) by digging a dummy trench from A to C. The enemy plane would come over, take his photograph and read it incorrectly. He would not notice the real trench, but only the dummy which cries out to heaven, consequently this would be shelled.

I may quote here the Intelligence Officer, R.A.F., in conjunction with whom this work was carried out:—"Direct observation "from the air is of little value so far as trenches are concerned. "From a high altitude the observer is distracted by a vast range "of view, and, even supposing he did spot the trenches he could "not make out sufficient detail to determine whether the trenches "were dummy or real—the observer flying low passes over objects "too quickly to give any one object more than a few seconds' "attention. The camera is the real enemy. Photographs taken "low show good detail and the objects are large, therefore "interpretation is comparatively easy . . . . the enemy would

"plot them on his maps and would have every reason to believe "that they would be occupied, so that his fire would be directed "on them. Any attack by the enemy on such a trench system "would result in disaster for the attackers."

So far then, so good, but this was not sufficient for a first rate job.

Referring to *Fig.* 1 again it is clear that whilst A to X is dug 3 feet deep, X to W is possibly only the original depth of the field drain say 6 to 18 inches. These two will obviously not throw the same shadow, and a bad photograph will result. Further, the splitting up of a long plot by a trench crossing it at 20 yards intervals necessitated by the traversing will draw attention. It therefore became necessary to subdivide the adjoining country skilfully by means of dummy drains, so that for an appreciable area, suitably "shaded" off small plots abounded. This was done.

Fig. 2. shows the job practically complete from only 2,000 feet. The dummy runs from A to O. A to P is ordinary trench to standard depth and width. A to Q.R.S.T.U.V.W.H.J.K.L.M.N.G.A1.B1. C1. D1, is the concealed trench. Q to T is cleaned drain. S to O is dummy drain.

The result of the dummy "treatment" as regards drains is clearly shown by looking at *Fig.* 2:—

1. H to J which is 3 feet deep.
2. J to B which is 6 in. deep "treated"
3. B to a which has not been "treated" yet.

Fig. 3. is a horizontal photograph of point A.

Fig. 4. shows standard dummy trench.

Fig. 5. shows a deep trench merging into dummy by an incline.

I will now describe how these results were obtained. It is all a question of obtaining the same shadow by different means. The shade of any particular colour does not play a very important part in aeroplane photographs. Shadow and texture are the things to watch.

Fig. 6. shows the section of a dummy trench. Points to note are:—

1. All sides to be vertical so as to cast maximum shadow.

2. The drain is put in on the Southern side and increases the shadow thrown by some 6 to 9 inches.

3. Brushwood accentuates the shadow: it dies black.

4. In fire bays the width of brushwood is increased.

Fig. 7. shows a section of the concealed communication trench. The parapets are of course not bullet-proof. This I agree is opposed to the "old traditions," coming down to hard facts, in other words the man who has to use the trench, we find that he prefers to be immune from fire owing to invisibility rather than to draw fire which the parapet is designed to withstand. At least this holds for a purely

battle position on which the fine arts of stationary warfare are not going to be employed.

Fig. 8. shows a section of the cleaned drain. *See Fig.* 2. Q to T. It might occasionally be necessary to make the parapet on the south side higher than that on the North to increase the shadow.

Fig. 9. gives section of dummy drain. *See Fig.* 2. S to O.

Fig. 10. shows the concealed trench where it traverses across a plot. *See Fig.* 2. S to T.

I am not giving any figure as to man-hours for this job, but I would remark that the supervision required is of a very high order.

This particular trench system was further elaborated by putting in a complete dummy system about 150 yards "out of phase" with the real.

So much for the invisible trench.

Ground which appears in the form of plots on a photograph readily lends itself to the concealment of wire. The method is to put a belt of wire entanglement symmetrically cutting off the end of a plot or down one side of it. This then merely looks like a different crop in an aeroplane photograph, and is consequently left alone. However something must be provided to reassure the enemy. Studying aerial photographs of wire, we find that they look like furrowed or spitlocked ground with a very well defined path down either side where the wiring party has walked. The method of obtaining dummy wiring is very quick and effective. It consists merely in drawing a harrow irregularly in front of the position in a wavy line with numerous sharp salients and re-entrants, lastly marching men to and from work on the outside and inside of the harrow marks and always parallel to it, and you have a most perfect representation of wire entanglement. A refinement for trench digging is also suggested by this "plot" method and has been tried with success. It becomes necessary, suppose, to dig a trench (full depth of course, not dummy) along a row of trees. It should be so arranged as to be on the south side of the trees provided this gives the required field of fire. Then the shadow cast by the trees, especially when in leaf will easily blot out all sign of trench. However at midday, at any rate, it will be found impossible to wholly eliminate all show of the spoil in the shape of the parapet.

Even if it is in ploughland the earth last excavated which will now be on top will not be the same colour as the plough, *e.g.* it may be white chalk. If it is in crops the texture will be different. So some earth from the parapet should be scattered from the edge of the parapet forward along the whole front of the trench, the line of intersection of scattered earth and plough or crop being at right angles to the two sides of the field, which are at right angles to the line of trench. Thus a new sub-plot is formed which looks quite natural from the air.

We now come to a model village defence—St. Sylvestre Cappel on the Cassel-Bailleul Road. These are the examples of the other form of camouflage where "props" are employed, and, I consider legitimately, on small specific objects.

Fig. 11. is an aeroplane photograph of the village; the arrows denote machine gun emplacements. I will confine myself to the machine gun emplacements. Their internal design was standard, being pit prop cubes heavily sandbagged all round and with a bag, "Elephant" steel, and concrete burster, roof. When I say "cubes" I mean that the framework is so braced as to give the frame the resisting properties of a solid cube.

Fig. 12. shows an emplacement in a field arranged to look like a natural mound. For this, knots of grass on wire netting were employed; suitably painted. By this means a very large loophole, 18" high × 5 feet wide at the muzzle, was obtained without the use of a box loophole which constricts fire so much. The gun is fired through the netting, which is quite transparent from inside, but externally, reflects as much light as the surrounding grass field.

Fig. 13. shows an emplacement surrounded by a dummy wall only one brick think. The loophole is canvas painted. Vision is possible through the canvas. In action the gun is fired through the canvas, destroying it.

Fig. 14. shows a close view of a canvas (painted) loophole in the wall of a house (photograph taken from 2 yards).

Fig. 15. shows a dummy sandheap on a roadside. This consists of a frame of expanded metal raised on pickets then covered with a 1" coat of cement and sand and pebble blasted. This was so realistic that I had to put up a railing to keep lorries, etc. off it. In this particular instance the pit prop cube was dug in so as to be 18" only above ground level, *i.e.*, the height of the loophole above ground.

Fig. 16. is an emplacement arranged to similate a ramp from the road to a field. I have seen men resting against the loophole quite oblivious to the fact that they were on top of an emplacement with a "Baby Elephant" shelter dug in under the bank to house the gun team.

Fig. 17. shows the exterior of an emplacement built in a house with shuttered window. The loophole is covered with zinc gauze which is painted. Vision from inside is very good indeed and the gauze is quickly shot away in action.

In conclusion I would reiterate that none of this work is feasible in the—for the time being—battle line. It is only possible on a prepared position, where, when the system comes into action, time has to be gained while reserves are organized and a breakthrough is to be prevented. All this work was designed to fulfil very clear and special conditions only holding in March and April 1918. An

attempt to employ it universally would be a failure, but the general ideas are capable of adaptation to other conditions.

My acknowledgements are due to the assistance afforded by the O.C. Squadron, R.A.F. All horizontal and aerial photographs were taken by his squadron. Also to 2nd Corpl. G. F .Senior, 227th Fd. Co. R.E. who did all the painting, colour matching, etc, the excellence of which is clearly apparent from the photographs and who was "mentioned" for his skill. Perhaps I may also be allowed to say that this was all original work for which the officers and men of the 227th Fd. Co. R.E. we resolely responsible as regards ideas, design, and execution.

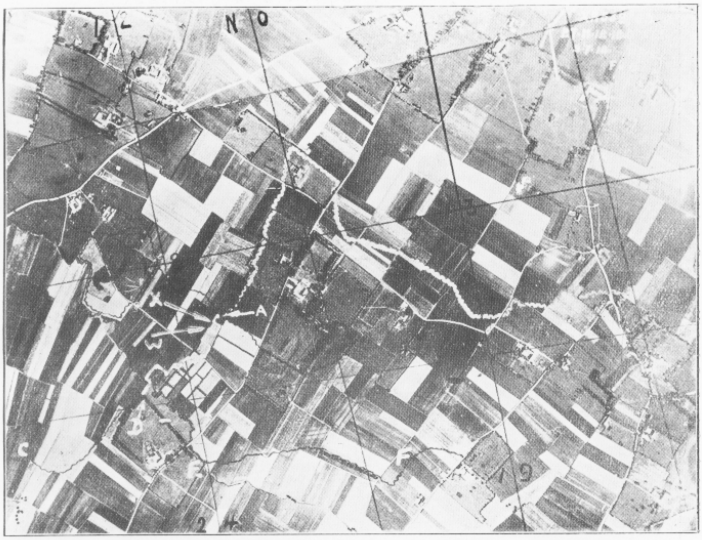


Fig. 1.

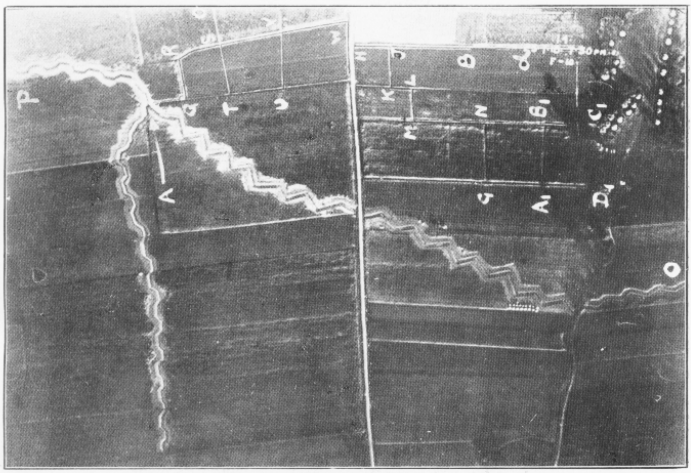


Fig. 2.

PICTURE I & 2

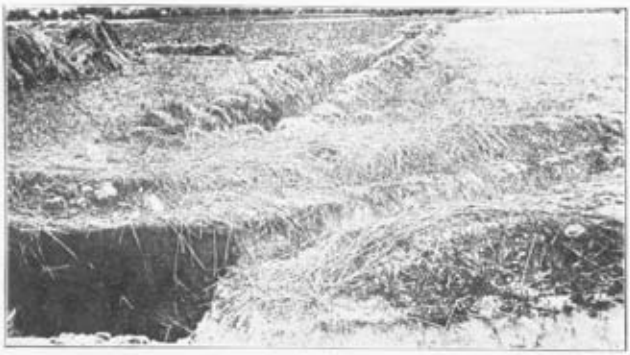


Fig. 3.

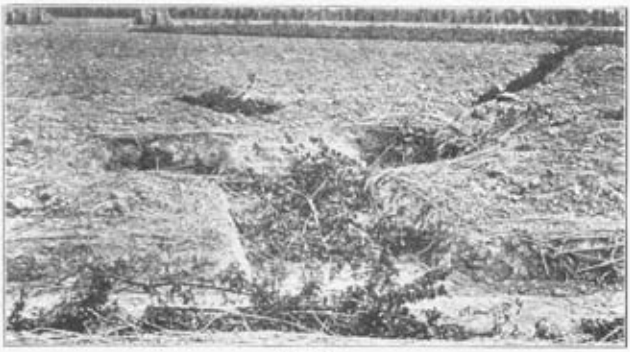
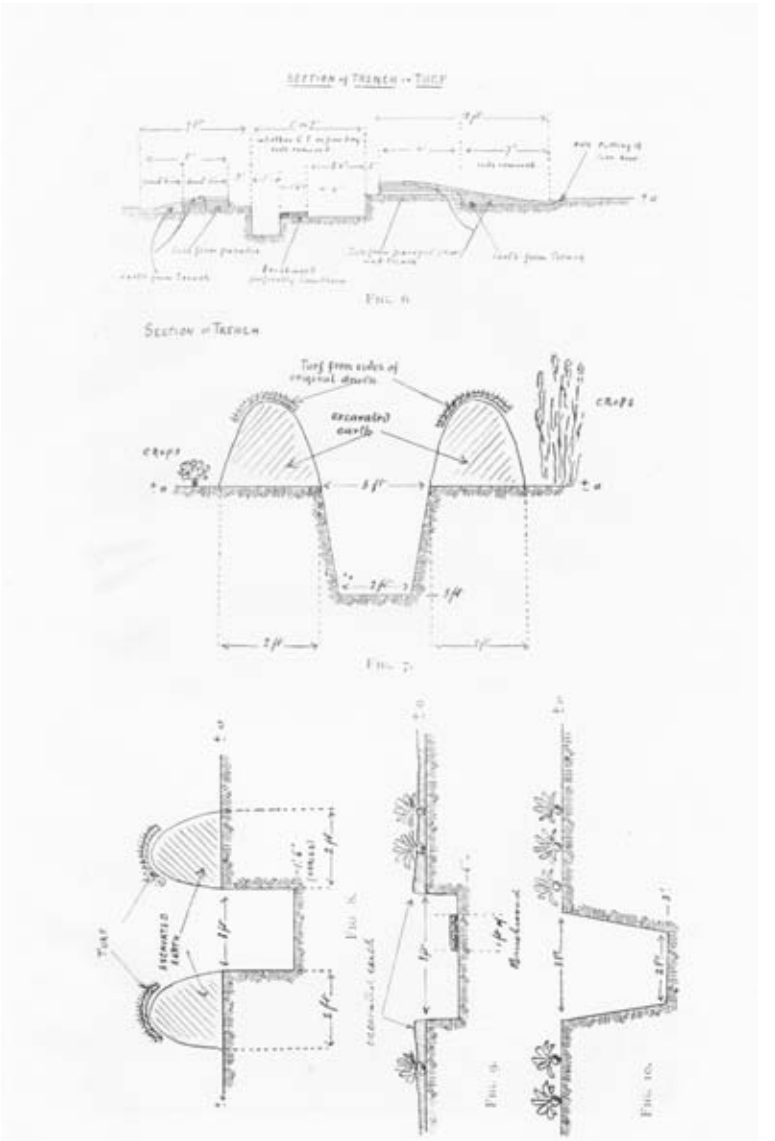


Fig. 4

Fig. 5.

PICTURE 3, 4 & 5


SECTION of TRENCH with TURF
SECTION of TRENCH
Turf from sides of original depth
Excavated earth
CROPS
CROPS

PICTURE 3

Fig. 11.

Fig. 12.

PICTURE 4

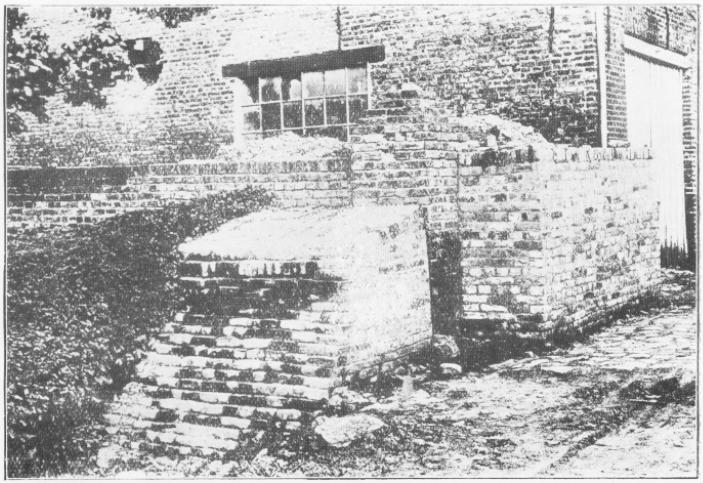


Fig. 13.

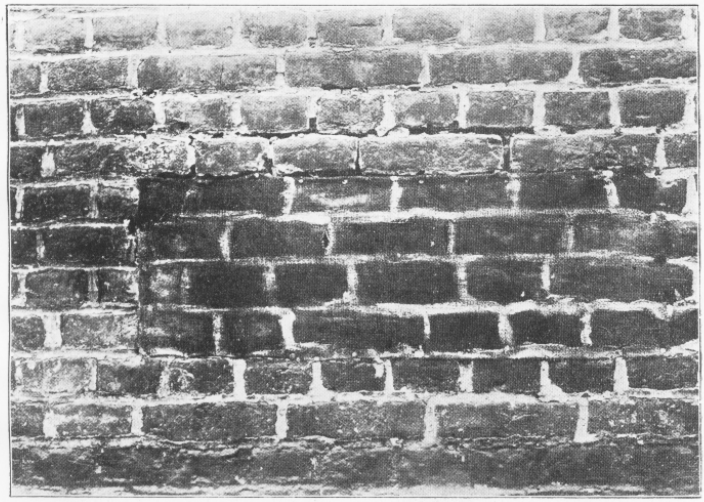


Fig. 14.

PICTURE 5

Fig. 15.

Fig. 16.

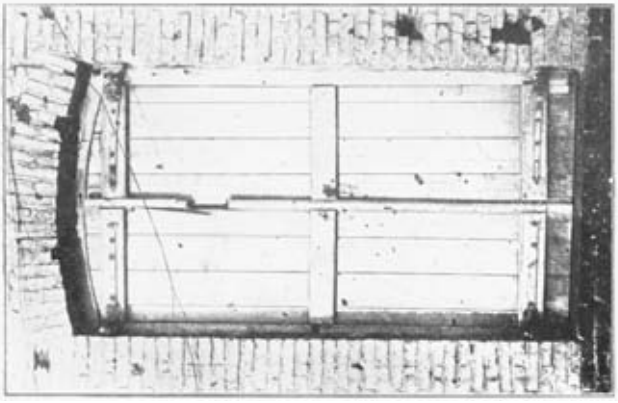


Fig. 17.

PICTURE 6

THE WORK OF THE ROYAL ENGINEERS IN THE EUROPEAN WAR, 1914—1919.

PART IV.

WORK IN THE FIELD UNDER VARIOUS BRANCHES OF THE STAFF.

SECTION 3.

FORESTRY.

Causes of Formation of Directorate.—Forestry in France, 1916.—Relations with Canadian Forestry Corps, March 1917.—Convention of 1917.—The Comité Interallié des Bois de Guerre.—The Comité Interallié d'Achat de Bois.—Relations with French Forest Service.—Consolidated Indents.—Director.—Formation of Directorate.—British Organisation.—Canadian Organisation.—Armies Area.—L. of C. Area.—Canadian Forestry Corps Area.—Development of Canadian Forestry Corps Central Area.—Canadian Forestry Corps Statistics.—Results.—Machinery.—Light Railway.—Ropeways.—Transport.—Water Transport.—Shipping.—Railways.—Construction.—Traffic.—Metre Gauge.—Distribution.—Special Work.—Development.

APPENDIX A.—Revised Sawing Instructions.—Logging.—Standard Gauge Sleepers.—Standard Gauge Crossing Sleepers.—Sixty Centimetre Gauge Sleepers.—Metre Gauge Sleepers.—Road Slabs.—4in. Road Planks.—Sawn Defence Timber.—Hardwood Boarding.—Offcuts.—Poles and Pickets.—Telegraph Poles.—Round Timber and Brushwood Supplies.—Hurdles.—Fascines.—Brushwood Bundles.—Continuous Revetting Bundles.—Poles.—Bayonet Sticks and Blob Sticks.

1. *Causes of Formation of Directorate.*—The loss of shipping in 1916 made it impossible to continue the import into France of the large quantities of timber required by the Armies which had hitherto been obtained from Sweden, Russia, and Canada. It was known that France possessed valuable and extensive resources in standing timber which were being exploited on a small scale by the British Army. A convention was accordingly made with the French Government by which, in return for shipping facilities and assistance, *coupes* (felling grants) were granted to the British Army sufficient to maintain two battalions (2200 strength) of Canadian Foresters, and, in the event of Canadian personnel becoming available in excess of 2 battalions, the French Government undertook to supply other *coupes* either on payment in cash or in kind, as might be deemed desirable by the War Timber Committee which was created to carry out the provisions of the Convention. This Committee was required to examine in detail the requirements of the Allied Armies upon a basis of not less than a three months' indent, and preferably on a six months' indent, and, with this information, and with the knowledge of the resources and production of the Forestry operations in France, to arrange with the Admiralty for the shipping required to bring to France what timber was required to meet the needs of the Allied Armies, over and above that produced

by Forestry. The Convention laid down that except with the consent of the French Authorities, the purchasing power of the British Army should be limited to the acquisition of small quantities of local timber in the Armies zone by Chief Engineers of Armies and Corps and C.R.E.'s of Divisions.

2. *Forestry in France in* 1916.—At the date when the Convention came into force (15th November, 1916) Forestry operations were being carried out on a small scale in Army Areas and on the L. of C. The personnel employed consisted in the Army Areas of working parties drawn from the Infantry under the orders of Chief Engineers of Armies and Corps, and in the Lines of Communication Area of two R.E. Labour Battalions, 2½ Army Troops Companies R.E. and attached details, working under the supervision of the Forests Branch of the Directorate of Works.

The British Forestry Mission had made arrangements for two Canadian Forestry Companies to work in Central France, where they commenced work on the 27th November, 1916. Advantage was taken of the opportunity afforded by the conclusion of the Convention to take steps for the formation of an independent Directorate to deal with the many problems ancillary to extensive development of forestry operations for the Armies in France.

All British skilled personnel was accordingly formed into recognised Royal Engineer units under the control of the Directorate of Forestry, which came into active operation on the 10th March, 1917. This Directorate, with others, was taken over for administrative purposes by the Quartermaster General during the summer of 1918.

3. *Relations with C.F.C.*—As regards the Canadian Forestry Corps, the Directorate was required to indicate to the C.F.C. the location of forestry operations and the requirements of the British Army as to the sizes and types of the products therefrom, while the actual operations were left to the C.F.C. to be conducted by them entirely under the direction of their own staff.

4. *March*, 1917.—Forestry operations were in active progress in the following areas by the end of March, 1917 :—

1. Army Areas.—Forest of Nieppe, State Forest, and minor operations.
2. L. of C.—Eawy, State Forest ; Brotonne, State Forest ; Haute d'Eu, State Forest ; Basse d'Eu, State Forest ; Crecy, State Forest ; St. Evroult, Private Forest ; Rouvray, State Forest.
3. Central Area.—Blanchelande, Private Forest ; Parc de Conches, Private Forest ; Forêt de Conches, Private Forest ; Bois Normand, Private Forest .
4. Jura Area.—La Joux, State Forest ; Boujaille, Communal Forest.

5. *Convention of* 1917.—Early in 1917 it was perceived that the needs of the Armies were larger than could be provided for under the Convention of 1916, and that there was foundation for the French claim that the advantages which they were to secure under the Convention had not in fact accrued to them, and could not accrue to them. The Convention of 1916 was replaced after negotiations by a Convention which came into effect on the 1st October 1917. The British Government had to maintain 56 companies of the Canadian Forestry Corps. Ten of these companies were to work exclusively for the British Army in forests provided by the French, at the expense of the British Government. The product of the labours of the 46 remaining companies, who worked in forests provided by the French Government free, was to be divided between the two Governments under the conditions of exploitation which the experience of previous months had shown to be necessary on economic grounds. The question of tonnage was excluded from this Convention and remitted for solution to the Ministers of the two Allied Governments, who were primarily responsible for shipping matters.

The provisions of this Convention rendered possible the development of the operations of the Forestry Directorate, and from that date to the conclusion of hostilities the association of the British Forestry Service with the French became more intimate and easy.

6. *C.I.B.G.*—The Comité Interallié des Bois de Guerre was formed, and controlled the acquisition of standing timber in France for the Allies. It was most successful in this, and was able to check the inflation of prices due to profiteering.

7. *C.I.A.B.*—The above Board was distinct in origin, function and composition from the Comité Interallié d'Achat de Bois, whose operations extended to the acquisition of timber from Scandinavia, Canada, and Switzerland, for the purposes of the Allies.

8. *Relations with French Forest Service.*—As is well known, the importance of forests as a national asset is vividly recognised in France, where, since the days of Napoleon, admirable efforts have been made to conserve the State Forests on sound scientific lines.

Forest exploitation in times of war has to go faster and more extensively than is allowed in the leisurely times of peace. But rich and extensive as are the forests of the State, it would be impossible in the interests of the future to allow reckless felling uncontrolled by regard for sylvicultural conditions. Clear felling has only been permitted in artificial (pine) forests, and then sometimes only on the condition of resowing. In natural forests, private as well as public, the trees to be felled are marked. Reserves are kept and the interests of the future zealously safeguarded by the Commission Forestière d'Expertise. Within these limits operations have been conducted, and though in early days there was criticism well founded, the relations of those engaged in forestry work with

the French Forest Officers were marked by great cordiality and reciprocal esteem.

9. *Consolidated Indents.*—The policy of forecasting the requirements of the Army on the basis of six months' supply, has been followed throughout. An indent over a long period is necessarily on generous lines. All possible combinations of circumstances, all possible permutations of policy are reckoned on, so that, whatever may happen, provision will have been made by the provision of the services against every eventuality that war may force upon the armies.

The indents were always scrutinised closely, discussed with the Directors of the Services, and approved by the Q.M.G., after the fullest consideration of the possibilities of production, in estimating which it was essential to bear in mind that the organisation of forestry exploitation is by no means simple. Apart from the many factors which have to be considered in planning the working scheme for a big forest, such as problems of mill and camp sites, railway facilities, water supply, and methods of extraction, it is not an easy thing when once exploitation has actively started to modify specifications without seriously diminishing production. Trees when felled in the forest have to be cross-cut to proper lengths before being hauled to the mill. The lengths are fixed after expert consideration of the commodities which have to be produced. Any change of policy and of specification retards production until all the new adjustments have been made. Production had to be kept up at full rates. It was therefore impossible to undertake fancy work, and the value of standardisation as the essential condition of production on a large scale is admirably illustrated in the case of timber from the forests. Appendix A. shows the scheme of sawing which was in force, as illustrating the policy of standardisation.

PERSONNEL.

10. *Director.*—Brigadier-General Lord Lovat, K.T., K.C.M.G., K.C.V.O., C.B., D.S.O., A.D.C., assumed duty as Director on March 10th, 1917, and remained in charge throughout. The Headquarters Staff consisted of 14 British and 4 Canadian Officers.

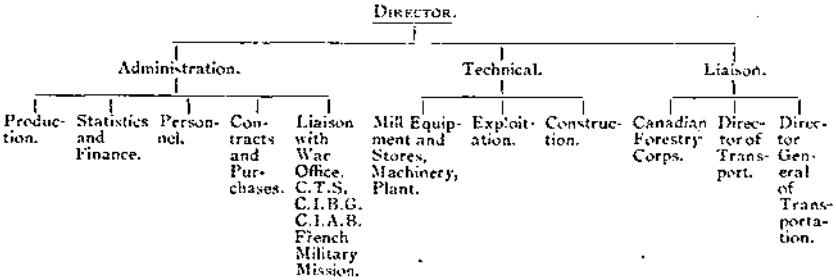
11. *Formation of Directorate.*—The Directorate was formed of two main divisions—(1) General Administration, and (2) Technical Equipment and Organisation.

Under the heading General Administration were comprised departments dealing with Production, Statistics, Contracts and Purchases, Personnel, and *Liaison* with the War Office, Controller of Timber Supplies, French Military Mission (Forestry Section), Comité Interallié des Bois de Guerre, and Comité Interallié d'Achat de Bois, and the co-ordination of the work of these departments with the technical departments.

Under the heading "Technical Equipment and Organisation" were departments dealing with the purchase of machinery and equipment, installations of mills and technical engineering, and forestry exploitations. Special officers were appointed as Liaison Officers with the Canadian Forestry Corps and the Directorates of Transportation and Transport.

With this organisation, at every stage effective control was exercised by expert officers over the work in the forests, and to secure closer co-operation and the exchange of ideas, weekly meetings of heads of departments were held with the Director, at which problems were discussed in common, the progress of operations surveyed, and policy shaped according to the requirements of the military situation.

The organisation of the various groups followed on similar lines.



12. *British Organisation.*—(1). British Organisation was divided into three groups:—

(*a*). *Armies Areas Group*, consisting of a Forest Control attached to each Army Headquarters and 5 skilled R.E. Forestry Companies. The Group Headquarters controlled all forestry operations in Army Areas, and supervised through the controls and skilled companies a large force of unskilled labour (P. of W., Chinese, and Indian) which ultimately numbered 9,000 strong. Seven Canadian Companies also worked in this group.

(*b*). *Lines of Communication Group*, consisting of six forest districts situated for the most part in large state forests in the Seine Inférieure, and six R.E. Forestry Companies with the Group Headquarters at Rouen. The Forest of Castets in Les Landes was taken over by the L. of C. on its evacuation by the A.E.F. in 1918. The maximum strength of the unskilled labour employed in this group was 13,000 (mostly Prisoners of War and Chinese coolies).

(*c*). *Paris Staff*, under an Assistant Director, who acted as British Representative on the Comité Interallié des Bois de Guerre, and Comité Interallié d'Achat de Bois, with Subordinate Staffs:—

(i) For estimation and purchasing duties in Central France, and at a later date in the Landes and Gironde, and

(ii) For despatching work at Bordeaux and Bayonne. This organisation was responsible for the entire purchase, estimation, and valuation of timber bought outside the British zone, and for the despatch of forest produce from the Landes Forests by sea to Northern Ports.

13. *Canadian Organisation.*—(2). Canadian Organisation consisted of a Headquarters controlling three main groups :—

Central Group.—2 Districts, 14 Companies, operating in a large area south-west of the Seine.

Jura Group.—3 Districts, 19 Companies, operating in the Vosges and Jura Mountains and in the department of Haute Marne.

Bordeaux Group.—2 Districts, 18 Companies, operating in the departments of the Landes and Gironde, together with seven companies working in the Armies Areas.

The total personnel numbered 425 officers, and 11,225 other ranks, and supervised up to 6,500 labour (Prisoners of War).

Each of these divisions formed a separate entity with peculiarities and characteristics due both to their previous history and to the natural features of the area in which they worked. Each division had to deal with special problems and each therefore deserves separate note.

14. *Armies Area.*—In the Armies Area the organisation had grown out of, was part of, and always remained in close contact with the Armies. This intimate association was of peculiar advantage to the Directorate, as it enabled its operations to be appreciated and understood by those for whose benefit and assistance they were carried on. The Armies Area is poor in State Forest resources, and it was necessary to supplement the grants made by the French authorities, through the French Military Mission, in their State Forests, Nieppe, Clairmarais, Tournehem and Crecy, by extensive purchases from private owners. A staff of expert timber buyers was maintained to this end, and, while from time to time serious difficulties were encountered, in the main the supplies of standing timber were well secured. It was laid down that recourse was not to be had to requisition unless it could be conclusively shown that a fair and reasonable price had been offered, that it had been unreasonably refused, and that the standing timber was in fact required. Various devices, maximum and minimum scales of prices, etc. were proposed and tried from time to time to meet the difficulty of fixing a fair price, but the industry, patience, ingenuity, and tact of the expert purchasers obtained the trees which were needed to keep the mills going at a cost which, regard being had to the special difficulties of this Area, must be regarded as eminently moderate.

Brushwood Supplies.—In the Armies Area the following quantities of hurdles and fascines were made for the Northern Armies for the

maintenance of their trenches and forward roads, during the period May 1917 to November 1918 :—

Fascines	85,098 Tons.
Hurdles	24,145 Tons.
Pickets	92,570 Tons.

15. *L. of C. Area.*—In the L. of C. area where operations had been commenced by the Director of Works, conditions were more stable.

The French Forest authorities conceded *coupes* in the rich State Forests, and the supply of forest produce to the depôts was steadily maintained by an efficient and economical administration. Unskilled labour was employed in this area in large numbers with marked success.

16. *C.F.C. Areas.*—The areas exploited by the Canadian Forestry Corps were rich in standing timber and suitable for the vigorous methods, the skill and mechanical genius of the professional lumbermen, who tackled with characteristic ingenuity and with complete success the difficulties of work in the rolling uplands of the Central plain, in the rich pine forests of the Landes, and the fir-clad slopes of the mountains of France's Eastern Frontier.

17. *Development of C.F.C. Central Area.*—The first operation entered upon by the C.F.C. was Bois Normand in the department of the Eure. At the end of 1916 two operations were in progress in the Central Area, South of the Seine. At the end of 1917 fourteen operations were in progress. The total number of operations in this area was 28, of which 9 were State Forests (Perseigne, Andaine, Belleme, Ecouves, Bourse, Senonches, Rouvray, Bord. and La Trappe).

Jura and Vosges.—The first operation in the Jura was commenced by the C.F.C. in March 1917 at La Joux, a State Forest.

At the end of 1917, ten operations were in progress. The total number of operations which was entered upon in this area was 17, of which 6 were in State Forests (La Joux, La Fresse, Levier, La Vologne, Noiregoutte, and Gerant) while the remainder were owned by the Communes.

Les Landes.—The C.F.C. operations in this area commenced in July 1917 at La Saussouze. By the end of 1917 six operations were in progress, and in all 16 operations were carried on in this richly-timbered area, none of which were in State Forests.

Forests.	1917 March.	1917 Dec.	Total number of forests exploited.
Armies Area	2	4	4
L. of C.	7	7	7
C.F.C.—Central	5	14	28
Jura and Vosges ...	2	10	17
Les Landes	—	6	16
	—	—	—
	16	41	72

In the Armies Area there were over 20 minor operations not counted as forests.

Personnel.	March, 1917	Dec. 1917	Nov. 1918
Number of Companies at Work:			
R.E.	—	4	11
C.F.C.	3	56	58

18. *C.F.C. Statistics.*—It is estimated by the C.F.C. statisticians that, excluding operations in Army Areas (British and French), they felled 1,898,267 metres cub. of standing timber as under:—

Central Group	714,075
Jura Group	463,600
Bordeaux Group	720,592

which yielded the following quantities of produce:—

	Sawn.	Round.	Fuel.	
Central Group ...	385,580	145,616	169,463	tons
Jura	276,624	2,956	110,577	,,
Bordeaux	379,077	10,687	162,970	,,

Their operations in all comprised the conversion of 2,199,067 metres cube of standing timber into 1,246,947 tons of sawn timber, 225,508 tons of round timber, and 616,396 tons of fuel.

19. *Results.*—The extent to which the Forestry Directorate succeeded in reducing imports of timber and releasing shipping for other purposes is shown in the following table:—

TABLE P. 1.

Period.	INDENT.	DELIVERIES.				
			From French Forests.		Imported by Sea.	
	Tons.	Total. Tons.	Tons.	Percentage.	Tons.	Percentage.
April 1917—Sept. 1917..	752,231	774,822	426,208	55%	348,614	45%
Oct. 1917—March 1918.	753,928	748,126	669,735	89½%	78,391	10½%
April 1918—Sept. 1918..	782,027	815,885	752,038	92%	63,847	8%
October and Nov. 1918..	294,278	231,869	217,093	94%	14,776	6%
	2,582,464	2,570,702	2,065,074	—	505,628	—

These figures include indents of a special nature which could not be met from France.

The production from French forests rose steadily from 51,330 tons in April 1917 to a maximum of 278,077 tons in July 1918. (Table P.2).

2,570,702 tons were supplied to the British Army, 399,147 tons to the French Army, 19,932 tons to the American Army. Reserves which at the end of September 1917 amounted to 172,465 tons, little more than five weeks' supply, had by the end of November 1918 been built up to 692,457 tons, nearly six months' supply, and were adequate to meet all contingencies and fluctuations of the military situation.

As will be seen from Table P.3 that in twenty months over one million tons of sawn timber were supplied to the Director of Works and Director of Engineering Stores. 5,780,000 slabs were provided for road making. 24,000 tons of telegraph poles were delivered for the Signals Service. The supply of sleepers was 4,171,000 standards, 1,315,000 metre, 3,050,000 60 cm. for light railways, and 356,000 tons of fuel wood were delivered to the Armies.

TABLE P. 2.

PRODUCTION.

Summary.

April 1917—November 1918.

	Sawn	Round.	Fuel.	Total.
1917.				
April	16,191	20,028	15,111	51,330
May	24,259	25,085	19,201	68,545
June	40,735	25,401	28,559	94,695
July	39,654	15,383	19,583	74,620
August	52,093	10,881	24,264	87,238
September	85,574	18,939	45,227	149,740
October	76,609	16,758	44,353	137,720
November	90,095	21,650	62,188	173,933
December	65,684	18,988	50,160	134,832
1918.				
January	75,200	28,949	50,088	154,237
February	102,885	41,629	69,068	213,582
March	86,334	52,850	53,931	193,115
April	81,785	43,890	51,872	177,547
May	119,710	32,507	74,166	226,383
June	111,915	36,725	59,307	207,947
July	148,944	41,187	87,946	278,077
August	129,737	36,226	69,011	234,974
September	120,527	37,173	70,383	228,083
October	132,063	39,312	84,513	255,888
November	74,612	8,427	60,688	143,727
Total ..	1,674,606	571,988	1,039,619	3,286,213

TABLE P. 3.

STATEMENT SHOWING INDENTS AND SUPPLIES TO THE VARIOUS DIRECTORATES.

April 1917 to November 1918.

Material.	Total for Twenty Months. Indent. Tons.	Delivery. Tons.
Through D.W. D.E.S.		
Sawn Timber, incl. Forest Plkg, Offcuts, and Stayblocks, Road and Mining Slabs	1,041,942	1,035,604
Split Poles, Poles	375,574	289,118
Pickets	170,346	180,822
4 in. Planks	33,333	48,143
Offcuts for Stable Floors	—	6,208
Telegraph Poles	21,426	24,544
,, Arms	1,750	1,211
Fascines, etc.	—	92,709
	1,644,371	1,678,359
Through D. G. T.		
S.G. Sleepers	324,580	347,608
60 cm. ,, ...	49,500	76,227
M.G. ,, ...	66,962	62,630
Crossing Timbers	10,648	9,456
Pitch Pine	37,097	34,316
Hardwood	2,641	5,396
Barge Poles	100	20
	491,528	535,653
Through D. Supplies.		
Fuelwood	358,496	273,135
Fuelwood for conversion to Charcoal ..	88,069	83,555
	446,565	356,690

20. *Machinery.*—The type of machinery installed in the mills varied considerably to suit the local conditions and the specifications which had to be produced.

In large State Forests, where extensive 'cuts' had been allotted, modern Canadian mills capable of high production were erected, and, where considerable quantities of small size timber, hutting, etc., were required, special saws to cut this supply were installed.

In the Armies group where, with one or two exceptions, the available timber only provided for a mill remaining in a wood for a short time, a more portable type of mill, the Scotch mill with Campbell attachment, was used.

Whenever possible Dutch ovens were used so that sawdust might be used as fuel. Mills were invariably lighted by electric light to permit of work being continued at night.

During the withdrawal in March, 1918, 10 mills had to be abandoned in the Armies areas, and while much of the machinery was ultimately recovered, a certain quantity was lost.

21. *Light Railway.*—Decauville track (60 cm. with 9-lb, 15-lb. and 20-lb rail) was largely used in the forests, operated where possible by mechanical means. Complete light railway systems, well equipped and operated by skilled personnel, were constructed at Brotonne, Rouvray, Conches, Senonches and Crecy. 26 locomotives, 2 tractors, 287 trucks were provided, with personnel amounting to 4 officers and 220 men, under Director of Light Railways.

22. *Ropeways.*—A ropeway was installed in the forest of Colembert (Armies Area) in combination with a 60 cm. mechanical system, and was most effective in delivering produce to the French railway station yard.

A second ropeway of nearly five miles in length was being installed when the Armistice was signed. Its capacity has not been fully tested, but there seems to be little doubt that this means of transport is economical in use, can be constructed rapidly by unskilled labour, with a modicum of skilled supervision, and is of considerable practical utility.

23. *Transport.*—Seven Royal Army Service Corps units were allocated for the use of Forestry (No. 929 Company R.A.S.C.; 55th Auxiliary Petrol Company; 57th Auxiliary Petrol Company; 77th Auxiliary Petrol Company; 78th Auxiliary Petrol Company; 117th Auxiliary Steam Company; 118th Auxiliary Petrol Company.). The strength of this force was 46 officers, 1513 men, 225 petrol vehicles, 45 steam vehicles, 6 travelling workshops with store wagons and 542 horses.

In addition, in the Army Areas, and on the L. of C., transport was provided from the local pools, inclusive of 3 Auxiliary Petrol Companies, and 2 Auxiliary Horse Companies in the Rouen Area, which were specially provided for work in the forests.

Further, a composite Petrol Company was temporarily provided from the Rouen pool in April, 1918, to ensure the delivery of pickets from Crecy forest for the construction of defence lines.

Each Canadian Forestry Corps Company was equipped with transport on Establishment Scale, viz. :—1 lorry, 1 car, 1 cycle with side-car, 73 horses, 5 G.S. wagons, 2 tip-carts, 2 water-carts, 2 travelling kitchens and 12 logging wagons.

Horsed vehicles of many types were used. The principal types were 4-wheel logging wagons, Canadian type, French *binards*, G.S. wagons and sloops for log-skidding.

Steam tractors were used, but were found to be of inconsiderable value, owing to the excessive damage caused to roads.

Petrol vehicles formed the bulk of the M.T. transport. A number

of lorries were converted into logging lorries by removing the bodies and constructing bolsters to carry the logs.

In many operations where Decauville systems could not be installed, either because the operation was too small, or because local conditions did not permit it, all transport from the bush to the mill and from the mill to the dump was provided by the R.A.S.C. companies.

24. *Water Transport.*—It was possible to develope the use of Inland Water Transport to a very important degree only on the Seine, where a steady and most useful service of barges was maintained. The I.W.T. barge service on the northern canals was used as circumstances permitted, and on the Somme a local service was also employed.

25. *Shipping.*—The produce of the Forests of the Landes and Gironde was shipped to northern ports under arrangements controlled by the Principal Naval Transport Officer. The service was most satisfactory, and as much as 38,000 tons of timber were shipped in a month from Bordeaux and Bayonne. This amount could have been increased but for the serious and prolonged shortage of railway material in that area. A fleet of 75 ships was used in this service, of which 2 were lost by enemy action.

26. *Railways.*—Sooner or later at some point or other, all forestry produce, except such as could be issued locally, had to pass on to the standard broad gauge system.

27. *Construction.*—As a rule the large forests which were under exploitation were not well provided with railway facilities. There are many reasons for this. The forests grow in parts of the country which are sparsely inhabited, and present serious difficulties to railway construction. It was therefore necessary to construct from time to time sidings to receive and deal with timber traffic. Thirty-six such sidings were constructed, ranging in size from a few yards to a siding with 2½ miles of track.

28. *Traffic.*—The small wayside stations which serve forests are as a rule ill-provided with traffic facilities. There is no natural traffic. The small exploitations permitted in State Forests do not in ordinary circumstances require a constant or large supply of rolling stock. It was therefore necessary for the railway traffic authorities to organise special measures to get adequate supplies of rolling stock at the forest despatching stations, the most successful of which was the institution of a regular service between the forests of the Central area and the depôts in the north. Special provision had to be made for the conveyance of the longer sizes of telegraph poles, rakes of tank trucks being used for this purpose.

29. *Metre Gauge.*—From earliest days, constant use was made of the secondary metre gauge lines which served the forests of Basse d'Eu, Crecy and Tournehem.

30. *Distribution.* (1) *Depôts.* (2) *Local Issues.* (3) *Direct Supply.*—The policy of distribution was to send all supplies to the depôts of the services, except as regards local issues from local resources which attained considerable volume in the Armies Areas where direct relations were maintained with the armies. In cases of emergency, timber products were sent direct from forest dumps by rail to the services at the front. Fuelwood was sent to regulating stations in bulk trains for distribution, thence with other supplies to army railheads. To allow of whole homogeneous trains of forest produce being sent direct to the front, large dumps were accumulated, and it thus became possible to maintain a regular supply when and where needed. At one period when the truck supply in the Central area was markedly irregular and uncertain, arrangements were made with the traffic authorities, by which, to save time, despatches of forest produce, especially of standard gauge sleepers, were regulated and reconsigned to destinations arranged with the construction service.

(4) *Regulation.*—At one time or another, every possible combination of distribution by rail was employed to meet the ever varying conditions both on railways and in the forests. Had not the end come when it did, it would have been necessary to simplify the system of distribution, and to extend the principle of the direct service to its fullest limit.

31. *Special Work. Pickets.*—The great advance of the enemy in March-May of 1918 called for extraordinary and most successful efforts on the part of forestry to maintain the supply of pickets needed for defensive purposes. Ninety thousand tons were supplied between February and May 1918. *Sleepers.*—The construction of secondary strategic lines of communication between the south with the bases of Rouen, Havre and Dieppe, and the battle area north of the Somme, involved the production of large numbers of standard gauge sleepers. In twenty months 4,171,000 standard sleepers were delivered. The supply of slabs to enable roads to be built rapidly was 5,780,000 pieces.

Honfleur.

32. *Development.*—The menace to our Lines of Communication *viâ* Amiens which was finally removed in August, 1918, threw upon the railways a heavy burden. The bulk of the timber came from forests situated south of the railway line from Amiens to Abbeville. The bulk of the army was north of that line, which was taxed to its fullest capacity, and could only deal with a limited amount of forestry traffic. It was obviously necessary to diminish the burden on the railways, especially as regards movement through the bottle neck. Steps were taken in April 1918 to utilise the Port of Honfleur for the despatch of forest produce to the North by sea instead

of by rail. The produce of the forests of Bord and Brotonne on the Seine was taken by sea-going barges to Calais. The forests of the central area despatched their produce by rail, as facilities offered, to Honfleur, whence it was sent to the north.

Other Developments.—It became evident that, to deal with the important traffic with the Central area, a timber yard was needed where the traffic could be dealt with under suitable conditions. A site was found, and it was proposed to erect thereon a drying plant where by artificial means timber from the forests would be rapidly dried and rendered fit for immediate use as seasoned timber. Military developments rendered these measures unnecessary.

APPENDIX A.

REVISED SAWING INSTRUCTIONS.

D/F.1047.P.

D.D. " E."
D.D.F., L. of C.
A.D.F., Armies Group.

(i). Amended sawing instructions are issued herewith : all previous instructions are cancelled, and should be filed for future reference if required.

(ii). It is essential that all Officers engaged in Forestry operations should be thoroughly conversant with the latest sawing instructions issued from Headquarters, and should strive to utilise every log or pole in the most advantageous manner possible for the needs of the Army. Group Commanders should take particular pains to ensure that all officers under them apply the sawing instructions intelligently and economically.

(iii). It is of first importance that Group Commanders should refer to headquarters any points in sawing instructions which are not fully understood.

(iv). It is of primary importance that the amount shown in the monthly allocation should be despatched, in order that the obligations of the Directorate as a whole may be fulfilled. Suggestions from Group Commanders as to alterations in the amounts of any particular categories which will assist production will be most useful information for determining allocations in subsequent months.

(v). Unless for special reasons temporary employment is required for men and saws, it is generally inadvisable to undertake manufacture of slats for trenchboards, or similar light work, in Forest Groups outside Army Areas. Facilities for resawing exist at the depôts of the Director of Works.

A.P.O. S.79.
1st Sept. 1917.

LOVAT, *Brig. Gen.*
Director of Forestry.

1. *Logging.* 1. 9. 17.—Felled trees should not be cross cut into logs before it is absolutely necessary for the progress of the work.

The normal cross cutting should not be more than a week ahead of conversion in the mill.

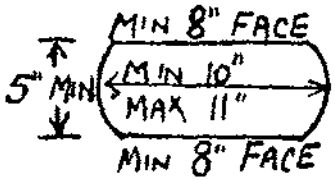
Military requirements will always vary and consequently lengths other than those specified at the moment may be subsequently required.

All cross cutting into logs should be done under close supervision, and with a clear understanding of the specifications attached.

2. *Standard Gauge Sleepers.* 10. 11. 17. *Class* 1.—Species: All softwoods and Oak—Beech up to 20% (maximum). Dimensions: Length, 9 ft.; Width of bottom, 9 in. to 10½ in.; Width of top face, 8 in. minimum; Depth, 5 in. minimum.

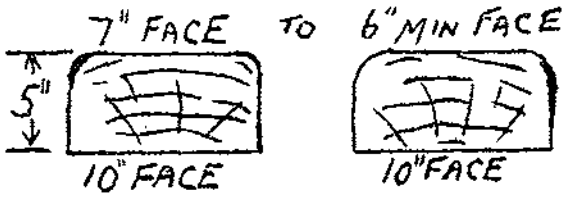
Permissible wane not more than 1 in. on either edge, but the minimum upper face of 8 in. must remain.

Also in Class 1.—A flatted sleeper having a minimum face of 8 in. on both faces will be accepted. Width of sleeper from bark to bark not less than 10 in. Edges of these flatted sleepers need not be sawn unless over 11 in.



Class 2.—Species: All softwoods and Oak or Beech. Dimensions: Length, 9 ft.; Width of bottom, 9 in. to 10½ in.; Width of top face, 6 in. minimum; Depth, 5 in.—permissible variation ⅛ in.

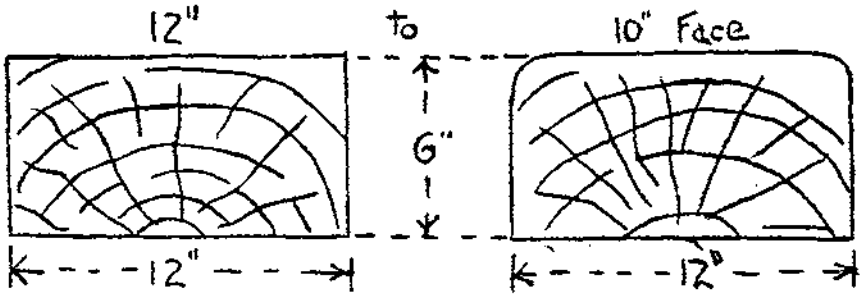
Permissible wane not more than 2 in. on either edge but the minimum upper face of 6 in. must remain.



To be piled in two separate piles according to Class. The different species of Timber (Softwood, Oak and Beech) also to be piled separately and despatched in separate trucks.

3. *Standard Gauge Crossing Sleepers.* (Crossing Sleepers). 1. 9. 17.—Species: All softwoods and Oak. Dimensions: 6 in. × 12 in.—14 ft. long. To be cut ⅛ in. over size.

Permissible variation: wane 1 in. on upper edges, but an effort should be made to supply Crossing Sleepers without any wane whatever. Lower face to be full width and die square.



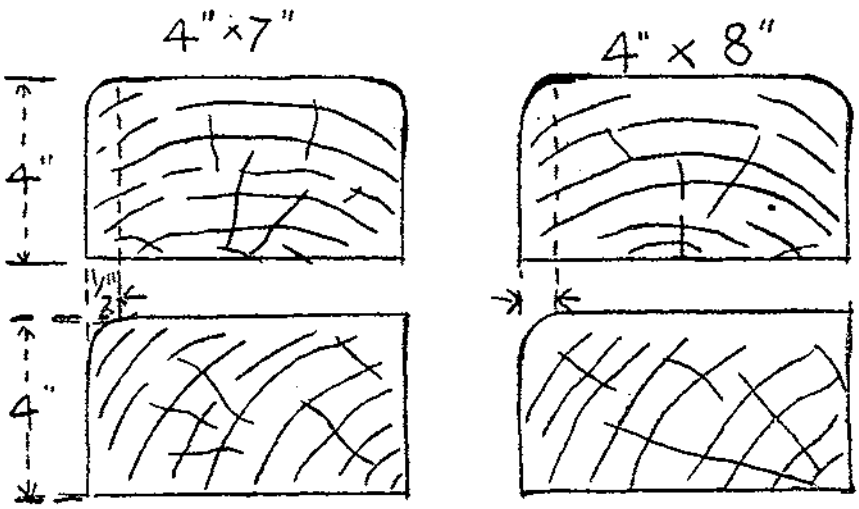
4. *Sixty Centimetre Gauge Sleepers.* (60 cm. Sleepers) 6. 11. 17.—Species: All softwoods, Oak and Beech. Length: Not less than 4 ft. 6 in. (minimum).

Permissible variation: Bottom Width, 6 in.—7½ in. in 7 in. Sleepers, 7½ in.—8½ in. in 8 in. Sleepers; Top Width: Sleepers must have a minimum upper face of six inches; Wane: The maximum wane on either edge to be in the 4 in. × 7 in. Sleepers—½ in., 4 in × 8 in. Sleepers—1 in., still giving the minimum 6 in. upper face.

5. *Metre Gauge Sleepers.*—Species: Pine or other softwoods, Oak and Beech. Dimensions: Length of Sleepers, 6 ft. 6 in.; Thickness, 4½ in. (minimum); Width of Upper Face, 5 in. (minimum); Width of bottom side of sleepers 7½ in. to 8½ in.

Can be made by splitting poles with the saw in the mill. The poles to be surfaced on two sides and then split.

6. *Road Slabs.*—Species: Hardwoods, including such Oak as is not suitable for conversion to other material. Dimensions: Thickness must be 2½ in. (Sawn ⅛ in. over size); length, 10 ft. 20% may be 9 ft.



9 in. and up hardwood logs, and Oak as above, to be sawn into Road Slabs and in the largest width obtainable from logs available, and may have waney edges.

Slabs over 20 in. in width, should be sawn in half longitudinally to make two slabs.

If a log will produce one or more Standard Gauge Sleepers with one or more 2½ in. slabs, it should be cut 9 ft. length and produce Standard Gauge Sleepers and Road Slabs all 9 ft. long.

Oak logs large enough shall be converted into Standard Gauge Sleepers. (See page 261.)

7. *4 in. Road Planks.* 1. 9. 17.—Species: Hardwoods, including such oak as is not suitable for conversion to other material. Dimensions: thickness, 4 in.; length, 9 ft.

9 in. and up hardwood logs (and oak as above) to be sawn into road planks and in the largest width obtainable from logs available, *but planking must be edged square.*

Planks over 20 in. in width should be sawn in half longitudinally to make two planks.

Oak logs large enough should be converted into Standard Gauge Sleepers.

8. *Sawn Defence Timber.* 4. 10. 17.—Species: Softwoods. Dimensions: Length 3 ft. and up, and longest average length possible.

All sawn defence timber must be edged square and sawn into the following categories:—

Group.	*Thickness.*	*Width.*	
B.	3 in.	3 in. & up.	Widest average possible.
C.	2 in.	2 in. & up.	
D.	1½ in.	3 in. & up.	
E.	1 in.	3 in. & up.	
J.	All boards under 1 in. in thickness and width.		

Each group to be piled separately and despatched in separate trucks.

Boards 1½ in., 1 in. and under 1 in. in thickness not to be specially produced, only as falling from the saw.

9. *Hardwood Boarding.*—Species: Hardwoods. Dimensions: Length, 3 ft. and up; Width, 5 in. and wider; Thickness, 1 in. and 1½ in. only. MUST BE EDGED SQUARE.

This should only be produced as necessary from the side cuts made in the sawing of Sleepers, 2½ in. Mining Timber and Road Slabs.

Only exceptional cases or special instructions will warrant logs being wholly converted into this product.

10. *Offcuts.* 11. 5. 18.—At the present time Corps and Army Workshops are not working, and the Base Workshops under the Director of Works are fully employed in sawing mining frames, etc., and no stabling is in the course of construction. Consequently, there is little or no demand for offcuts.

Every effort should be made to slab light, and keep offcuts to a minimum, both as regards quantities and dimensions. It will be seen from Revised Sawing Instructions dated 4/10/17 that Sawn Defence Timber is accepted in lengths of 3 ft. and up.

If this is done the majority of offcuts will be Class 4, suitable only for fuel.

The classification of offcuts will remain as before. Classes 1. and 2. will not be produced unless specially asked for.

Classification of Offcuts.

Class (1). 2½ in. and up thick at the thin end, 9 ft. and up long, to be despatched *with road slabs or split poles.*

,, (2). 1½ in. to 2¼ in. thick at the thin end, 6 ft. and up long, to be despatched *for stabling.*

,, (3). 1 in. to 1¼ in. thick at the thin end, 3 ft. and up long, suitable for resawing, but this class to be resawn at the mill as far as possible, and any surplus should be piled ready for despatch when required.

,, (4). Slabs and offcuts any length, suitable only for fuel to be piled together for that purpose.

11. *Poles and Pickets.* 20. 3. 18.:—

Letter.	Description.	Length.	Diameter at tip.	Primary use.	Remarks.
	Poles Round.				
O.	Stout	13 ft.	Over 6 in. up to 9 in.	Uprights of heavy bldgs.	Soft or Hardwood.
P.	Medium	13 ft. 6 in.	Over 3 in. up to 6 in.	Uprights and rafters of bldgs. etc.	Hardwood.
Q.	Medium	10 ft.	Over 4 in. up to 6 in.	Roads.	Soft or Hardwood. Must be *straight.*
R.	Medium	10 ft.	Do.	Uprights of Bldgs, and Dugouts.	Soft or Hardwood.
S.	Medium	6 ft. 6 in.	Over 4½ in. up to 6½ in.	Uprights of Dugouts.	Do.
U.	Thin	12 ft.	2½ in./4 in.	Screens.	Hardwood.
W.	Thin	6 ft. and to 8 ft.	2½ in./4 in.	Revetments.	Hardwood.

Letter.	Description.	Length.	Diameter at tip.	Primary use.	Remarks.
	Poles Half Round.				
X.	Stout ...	10 ft.	From Poles over 5½ in. and up to 7 in.	Roads.	Soft or Hard-wood. Must be *straight*. To be split with the saw in mill.
	Pickets.	Under 6 ft. various.		Not to be made unless specially ordered.	

Each category to be piled separately and to be despatched in separate trucks.

12. *Telegraph Poles.* "A" size—25. 5. 18.—Pine or Larch. Sound, straight and free from large branch knots.

Specification.

Length.	Maximum and Minimum diameter at tip under bark.	Maximum and Minimum diameter 5 ft. from butt under bark.
Feet.	*Inches.*	*Inches.*
24	4 in. to 6 in.	6½ to 8½.
26	Do.	6½ to 9
30	Do.	7 to 9½
34	Do.	7½ to 10
40	Do.	8 to 10
50	Do.	9 to 11
60	Do.	10 to 12

"B" size.—Sound, fairly straight and free from large branch knots.

Specification.

Length.	Maximum and Minimum diameter at tip under bark.	Maximum and Minimum diameter at 3 ft. from butt under bark.
Feet.	*Inches.*	*Inches.*
15	1½ in. to 2½ in.	2 in. to 3½ in.
17	2 to 3	3 to 4½
22	1½ to 2½	2½ to 4
24	2 to 3	3½ to 5

13. *Round Timber and Brushwood Supplies* (*Brush*). 1. 6. 18.—In addition to the supplies described in the Revised Sawing Instructions, the following should be produced when trees or brushwood are felled :—

Pickets. The principal source of supply is from *taillis*, but small quantities can also be obtained from straight boughs of trees.

Manufacture.—Sticks should be straight, stiff, and pointed one end, the other end being sawn square, so that they may be easily driven into the ground.

The sizes generally used and of which stocks should be made are :—

Class.	French Size.	English Size.	Av. dia.
Z.S.	1 metre	3 ft. 3 in.	2 in.—3 in.
Z.H.	1½ ,,	4 ft. 11 in.	2½ in.—3½ in.
Z.L.	1¾ ,,	5 ft. 9 in.	3 in.—4 in.
Z.R.	2 ,,	6 ft. 6 in.	3 in.—4 in.

Use.—Z.S.—for anchor pickets of apron wiring.
Z.H.—for knee wiring—placed in front of apron wiring.
Z.L.—for main pickets of apron wires.
Z.R.—for revetting.

The pickets chiefly used are 1 metre and $1\frac{3}{4}$ metre, and are used in the proportion of two 1 metre to one $1\frac{3}{4}$ metre.

The $1\frac{1}{2}$ and 2 metre pickets are used in about equal proportions.

Class Z.X.—In *taillis* it is generally found that the wood suitable for Z.S. and Z.H. pickets is in excess of the proportion required. A stock of pieces suitable for Z.S. and Z.H. cut to length but not pointed may be made, but the stock should not exceed the number of Z.S. and Z.H. Pickets made, and must be stacked separately.

14. *Hurdles.—Source of supply* from selected material in *taillis*.

Use.—Hurdles are used for revetting.

Large sizes are usually preferred for breastworks.

Manufacture.—All hurdles should be made with six pickets, the diameter of the pickets being $1\frac{1}{4}$ in. to $1\frac{1}{2}$ in. Larger pickets should not be used, otherwise the hurdle becomes very heavy. Lighter pickets, however, are too weak.

The pickets should extend at least one foot below the bottom of the hurdle, and five or six inches above the top.

Pickets should first be driven into the ground at least one foot, being equally spaced, the brushwood being allowed to extend 2 inches outside the end pickets.

The pickets having been driven one foot into the ground, the bottom of the brushwood commences on the ground level.

Hurdles should be made of light brushwood entwined in and out of the pickets, brushwood to be tightly packed, being pressed down by foot at the bottom, and by hand at the top. The ends of all brushwood should be trimmed.

The hurdle should be wired top and bottom, the wires being wound round the picket two or three times, double wire being used. The wires should be twisted up tight by placing a piece of wood between them, and twisting them together.

Wires should also be run between the centre of the hurdle, and the top and bottom of the brushwood; this helps to hold the hurdle together.

The whole secret of hurdle-making is in keeping the wires which hold the pickets together tight, as otherwise, the two end pickets break loose from the brushwood, and the hurdle falls to pieces.

Hurdles are handled many times before reaching their destination, and a badly wired hurdle becomes useless long before it comes to the end of its journey.

Hurdle-makers should either work singly or in pairs. If in pairs, one man prepares the brushwood, the other man making the hurdle.

The sizes generally used and of which stocks should be made are:—

Class.	English Size.	French Size.	Proportion.
Z.H.S.	1 ft. 9 in. × 6 ft. 0 in.	55 cm. × 2m.	15%
Z.H.M.	3 ft. 0 in. × 6 ft. 0 in.	90 cm. × 2m.	75%
Z.H.L.	4 ft. 0 in. × 6 ft. 0 in.	1m. 20 cm. × 2m.	10%

C.Es occasionally require special sizes, but large stocks of these will not be made unless instructions to do so are given.

15. *Fascines.—Source of Supply.*—From selected *taillis*. If pickets have first been manufactured from the *taillis*, it is best, if the wood is suitable, to make all hurdles possible from the brushwood, and then, where trees are being felled, to wait until this part of the exploitation is finished before working the remainder of the *taillis* into fascines. Fascines made from brushwood only, without any light poles, are of very little use, whereas fascines made from the tops of trees with the remaining brushwood are suitable for road-making.

If trees are not being felled, the brushwood should be bundled up for revetting material or for dunnage.

Use—Principally for roads.

Manufacture.—Brushwood with a good proportion of light poles are placed in trestles so as to compress into a bundle 10 ft. 0 in. long by about 9 in. diameter. The bundle is then choked and wired (double) in seven places, at equal distances, the two end wires being 6 to 8 inches from the ends of the fascine.

These wires must be choked tightly so that no pressure can loosen them, and any ends pushed into the middle of the fascine.

The size of fascines should be:—

Class.	*Length.*	*Av. dia.*
Z.F.	10 ft. 0 in.	9 in. to 10 in.

16. *Brushwood Bundles.—Source of Supply.*—from material in *taillis*, and heads of trees, which is unsatisfactory for the manufacture of fascines but which is sufficiently straight for bundles.

Use—Roads, dunnage, foundations on bad ground.

Manufacture—Similar to fascines, but less care is taken in the selection of material, and bundles are only wired single in four places.

Class.	*Length.*	*Av. dia.*
Z.B.	8 ft. 0 in. to 10 ft. 0 in.	9 in. to 10 in.

The stock of this supply which should be held depends largely on the locality in which the wood is situated.

The supply will only be produced when it has been ascertained that there is likely to be a demand for same.

Frequently the brushwood is issued in G.S. wagon loads, same being tightly packed into wagons.

17. *Continuous Revetting Bundles.—Source of Supply*—From *taillis*.

Use—For revetting trenches, etc.

Manufacture.—Long selected sticks suitable for weaving into basket-work, too small for fascines, are made into bundles.

Five 4 ft. 0 in. pickets being put in each bundle, the bundles being wired tightly in four places for transport. Three bundles should be sufficient to make 20 ft. of continuous revetting 2 ft. 0 in. high.

Size of Bundles.

Class.	*Length.*	*Av. dia.*
Z.R.B.	10 ft. 0 in.	9 in.

18. *Poles.*—Specifications of poles are given on page 264, (20.3.18) Revised Sawing Instructions. " U " Poles should be cut from 12 ft. 0 in. to 15 ft. 0 in. long, as frequently 12 ft. poles are not sufficiently high for camouflage work.

19. *Bayonet Sticks and Blob Sticks.—Source of Supply*—From *taillis.* Straight clean sticks 5 ft. 2 in. in length about 1 in. dia. at tip, and 1½ in. at butt.

H.Q., Armies Group, Directorate of Forestry.
1st June, 1918.

(Previous articles under the heading of " The Work of the Royal Engineers during the European War, 1914—19 " appeared in the *R.E. Journals* of September, 1919 (Introduction p. 105; Anti-Aircraft Searchlights, France, p. 106; Postal Section—Army Postal Services, p. 114), October (Bridging, Chapter I., p. 162), November (Bridging, Chapter II., p. 200), December (Bridging, Chapter III., p. 261), January 1920 (Bridging, Chapter III., *(concluded)*, p. 13), February (Bridging, Chapter IV., p. 61; Organization of Engineer Intelligence and Information, p. 79), March (Bridging, Chapter V., p. 149), April (Bridging, Appendix—Formation of R.E. Bridging School). Copies of these Journals may be obtained through the usual channels.)

THE EGYPTIAN EXPEDITIONARY FORCE.

R.E. Services in the Operations from 1st September 1918 to 15 Nov. 1918. Report of the C.R.E., Desert Mounted Corps. Dated 12th Dec. 1918.

The R.E. services previous to the actual commencement of active operations on the night 18—19 Sept., 1918, included certain preliminary measures undertaken in the Jordan Valley.

Special efforts were made to complete bridges in hand on the Jericho—Wadi Auja road and to consolidate the metalling already laid. The road north of the Auja across Maskerah to Khirbat Fusail was put in order, the work being done at night, and improvements were effected on those portions south of Wadi Auja where work had hitherto not been possible. As a result the whole of the main road Jericho—Wadi Auja—Khirbat Fusail was rendered fit for traffic when troops moved forward on the 21st Sept.

At the same time a Battle Headquarters was built at Abu Tellul, and splinter-proofs for Signal Office and Artillery Headquarters were provided, while a road practicable for motors was constructed from the Auja Crossing and continued as a pack track on to Musallabeh.

Five large masonry hospital huts were erected for the Australian Casualty Clearing Station, and, with the object of deceiving the enemy as to the direction of the offensive, a number of dummy horses were made and set up in the lines of the cavalry transferred by night to the western flank.

A scale of explosives was made out in order that each Division should be capable of undertaking all the railway and bridge demolition it was anticipated might be found necessary, with the exception of the railway and road bridge at Jisr Mejamie, for the destruction of which a special party was organised.

The explosives for this party were carried in tins and carriers designed in such a manner that the charges could be placed in position and detonated without unpacking, and iron dogs, rope ladders, and other equipment were prepared to enable the demolition to be carried out in the least possible time, in the event of enemy pressure.

The Corps demolition party, divided into two sections under Captain W. Falcon R.E. and Lieut. L. L. Blake R.E. respectively,

was organised by, and attached to the 4th Cavalry Division, and was given special and practical training in speedy demolition.

Experiments were made in the destruction of permanent way to avoid, as had previously happened, the possibility of trains being able to pass over lengths of line which had been cut. The Turkish rail offers too little resistance to a slab of guncotton if placed in the web at the centre of the rail, and regiments were instructed in the placing of charges at the fishplates, which was found to be more effective.

Parties from Brigades were also instructed in the erection and use of Chursa deep well gear, and the handling of troughs and pumps, the suggestion having been adopted that regiments should carry their own, instead of having to rely on Field Troops, which might have difficulty in keeping pace with a very rapid advance.

In anticipation of possible water difficulties, Field Squadrons were issued with and instructed in the running of Isler-Lyster pumps and engines, and a number of "spares" were collected for the rapid repair of enemy installations should such be met with.

From the available information concerning the country to be crossed on the western flank, difficulty was anticipated at the Nahr El Falik and at the Iskanderuneh, and Field Squadrons were ordered to carry material for negotiating swamps, while 'D' Field Troop A.E., in lieu of their normal pontoon equipment was fitted out with a complete trestle bridge especially designed for rapid erection.

Other preliminary arrangements included the preparation of bivouac areas and watering arrangements in the orange groves around Sarona, Summeil, and Seimeh villages; the reconnaissance of existing bridges crossing the Auja river; and the construction of two additional pontoon bridges for the special use of the Desert Mounted Corps at Jerisheh.

Watering arrangements for horses and men while awaiting the developement of the Infantry attack were also got ready north of the Auja, and, for the actual advance, Divisional flags were made up and issued to demarcate the roads to be followed through our own and the enemy's systems of wired defences.

In order that Field Squadrons should be able to travel as light as possible, a Mobile Park with small R.E. *personnel* on lorries was organised under Captain C. L. Gray, R.E. to follow up the Cavalry as soon as circumstances would permit. Actually the Field Park arrived at El Lejjun, the Headquarters of the Desert Mounted Corps at the end of the first phase of the operations, the same afternoon as Corps Headquarters itself.

For months past squadrons had been very seriously under strength and sufficient reinforcements most difficult to obtain to keep pace with the steady number of evacuations caused by the climate of the Jordan Valley.

Finally however, on the 19th Sept., every Squadron and Troop was enabled to take the field practically with its full complement of officers, N.C.O's, sappers and horses.

As events turned out no obstacles were met with, and no special engineer work was called for during the first phase of the operations.

Small repairs were effected at El Afuleh Railway Station and five days after the offensive had commenced two engines had been patched up by the 2nd Field Squadron A.E., and 'D' Troop engine drivers were able to run trains between El Afuleh and Beisan, materially assisting the evacuation of Turkish Prisoners of War, for whom the early arrival of the Mobile Field Park had made it possible to erect barbed wire enclosures at El Lejjun. Meanwhile the advance of Chaytor's Force from the Jordan Valley had commenced, and the 1st Field Squadron A.E. was called upon to repair a serious gap where the road crosses an almost precipitous cliff six miles from Nimrin. A hole to a depth of fifteen feet and seventy-five feet in extent had been blown in by the retreating enemy. A temporary retaining wall was very rapidly erected, the hole filled in and the road made passable, the only troops in any way delayed being the actual working party.

From Essalt, where water points had been established, the Force moved to Amman, and a detachment of 'B' Troop was despatched with orders to blow up the railway north of Leban Station, from which direction an enemy force of 6,000 was advancing with 3 trains of ammunition and supplies. Breaks of 150 feet and 1,450 feet were effected.

At Amman the area was reconnoitred for mines, and about one ton of explosives, mostly set charges including the electrically connected mine from the water tower, were collected. A very large number of stick grenades and bombs of all kinds were likewise disposed of either by detonating or burying. Further engineer services undertaken by the 1st Field Squadron A.E. included the repair of the steam pumping plant at Amman Railway Station, the repair of a motor truck captured at Samra, and of a lorry and motor workshop. Work worthy of special mention was done by Lieut. H. A. Lockington, N.Z.E., who succeeded in making serviceable a badly damaged German engine found in the running shed at Amman.

The Squadron laboured under considerable difficulties in attempting to make use of the captured trains, on account of the shortage of fuel and water, but make-shift arrangements were made and useful expeditions to Mafrak and elsewhere enabled much war material to be salved.

On the western flank previous to the further advance towards Damascus, aeroplane reconnaissance reported the demolition of the central arch of the Benat Yakub Bridge over the Jordan.

'D' Field Troop A.E., who, on account of heavy sand, had been obliged to dump their trestle bridge material, succeeded in collecting suitable timber at Afuleh and were promptly sent forward on lorries. Work however was not permitted till the eastern slopes of the Jordan had been cleared of the enemy, when a high trestle bridge was constructed to span the demolished arch and completed within 5 hours. The lorries were subjected to enemy bombing on arrival at the site.

The further advance to Damascus entailed repairs to broken culverts and roads generally by the 2nd Field Squadron A.E Similar services being rendered by the 4th Field Squadron R.E., accompanying the 4th Cavalry Division along the Eastern route.

On entering Damascus the 2nd Field Squadron A.E. was occupied for a considerable time in repairing and strengthening culverts and bridges, and in assisting during the first few days to get the permanent way and rolling stock into a fit state to resume traffic, work which was also energetically taken up by the 5th Field Squadron R.E. in the Rayak direction.

The further advance from Damascus to Hama calls for no particular mention, but at the latter place aerial reconnaissance reported extensive damage to the road bridge over the Orontes at Er Rastan village. Inferior material only was available at Homs, but the 5th Field Squadron R.E. succeeded in bridging the gap and enabling transport and lorries to cross within 24 hours.

No special engineer difficulties were met with during the final stage of the operations as far as the outskirts of Aleppo, where blown-up bridges necessitated the construction of deviations to admit wheeled traffic into the town. Wherever possible railway reconnaissances had meanwhile been made by officers of the 4th and 5th Field Squadrons R.E. Station buildings were found to have been systematically destroyed, water tanks rendered useless, and in most places points and crossings, and bridges had been blown up. Arrangements for repair were undertaken by railway officials sent up from G.H.Q. as far as Hama. From this point to Aleppo a trolley reconnaissance made by the 5th Field Squadron R.E. had shewn that the repairs necessary were not beyond the powers of the Corps Engineer Services. Former *personnel* of the Railway Staff were collected at Aleppo, and, under the direction of Major J. B. Alexander, M.C., R.E., work was immediately commenced.

At Aleppo itself two very complete demolitions of bridges had been most skilfully made between the Baghdad and Damsacus Stations. Before exploding large oil tanks had been run on to the

bridges in such a manner that their collapse completely blocked the exits from the town in the Alexandretta direction.

The débris was rapidly removed, the bridges rebuilt, and, on the 15th Nov., two engines, the repair of which had in the meantime been effected, were able to proceed with a construction train to the temporary station prepared at Hama level crossing. A regular train service was then established and run by the Corps between Hama and Aleppo until taken over by representatives of the D.R.S.

The rapid advance and length of communications made it difficult to arrive at any finality regarding the line of supplies to be adopted and the consequent necessity of repair and upkeep of particular roads. Arrangements were at once made regarding the Homs—Tripoli road, but it was decided that this should be in charge of the 21st Corps. An early rainstorm proved that the metalling of this road was quite insufficient to support heavy lorry traffic, and it was agreed that the Desert Mounted Corps should assist with the repair of dangerous bridges and other work from Homs.

Between Homs and Hama Level Crossing two large railway bridges had been completely destroyed beyond the possibility of immediate repair, and it became essential to keep open the road for heavy traffic between these places. Metalling was exceedingly scarce along the route and was collected with difficulty. Little more than patching was possible and in the absence of steam-rollers consolidating the road metal laid was a serious problem. Horse rollers drawn by lorries were utilised with moderate success.

North of Hama, between the town and the new Station, metal was more plentiful, and as this portion was likely to be required for some months, more extensive work was undertaken.

Between Hama and Aleppo a good fair-weather track existed for most of the way, but in the neighbourhood of Maarit En Naaman, Khan Sebil, and Seraikin the road passed over naked rock, and in other places very rough stretches were met with. Local labour, to the number of 2,000 was immediately organised from eight villages, and a fair light motor track was completed after a month's work. At Khan Tuman, 10 miles south of Aleppo, a raised causeway a kilometre long was found necessary to cross a low and swampy belt of country.

Four masonry arch bridges, all within 15 miles of Aleppo, on the Aleppo—Alexandretta road had been blown up by the enemy and were being rebuilt, and steps were being taken to clear side drains and improve the surface over the Bailan pass. Three steam-rollers and one motor-roller were found in the Aleppo area, all in a damaged condition. Two had been already repaired and were at work, and spare parts were found in Aleppo and were to be fitted to the remaining two rollers as soon as Turkish evacuation permitted work to commence.

Field Squadrons were too short-handed to assist in the direction of work on lines of communication, which had therefore been confined to the staff of the C.R.E. The provision of tools was the first difficulty, and proper supervision of unsatisfactory contract labour, owing to the great distance covered and the necessity of undertaking all work at the same time, in anticipation of early winter rains, was almost impossible.

The advent of an Army Troops Company, R.E. and the assistance of 2/155th Sikh Pioneers would it was hoped materially improve matters and though continuous and heavy convoys of motor lorries rendered road-making an impossibility, it was hoped that all essential lines of traffic might be kept open until the completion of the railway relieved the pressure.

MACEDONIA.

By BRIG.-GEN. G. WALKER, D.S.O.

Ancient Roads.—The Seres road existed in ancient times and followed its present route from Salonika *via* Likovan (Xylopolis) and Lahana to Seres and thence *via* Drama (Drabescus) to Kavalla (Neapolis).

Another route across the Struma (Strymon) ran *via* Langavuk in the Langaza valley *via* Suho (Ossa)—Ahinos to join the Seres-Drama route near Kikna (Sasxa).

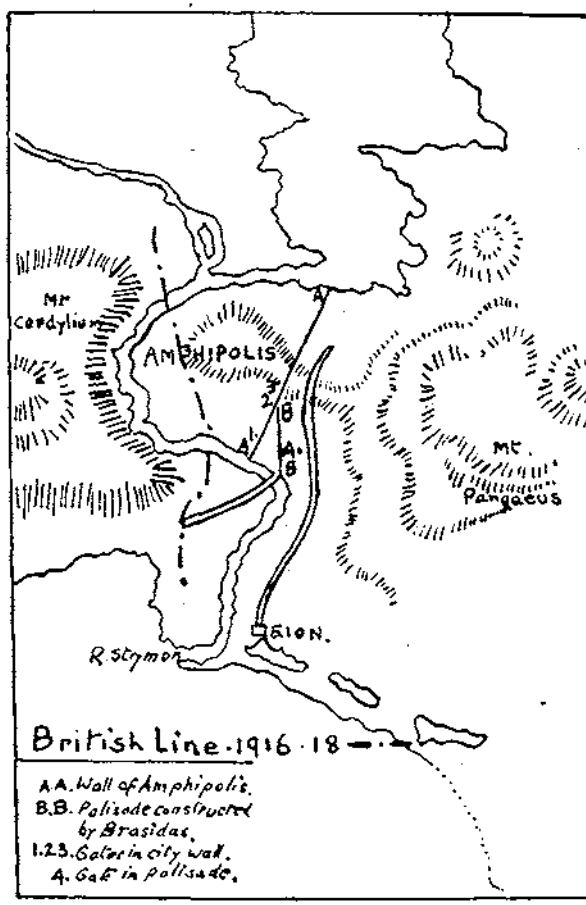
The main route from Salonika to Constantinople ran south of Lakes Langaza (Vasilas) and Besik (Bolbe) *via* Langavuk, Bezarkia (Appollonia), Stavros, Vrasta (Arethusa), Neochori (Amphipolis) Kavalla (Neapolis) and so east along the coast.

There seems to have been only one route northwards, viz: a road from Salonika *via* Naresh (Gallicum), Avret Hissar to Karasouli (Idomene) on the Vardar (Axius).

Another, west to east, communication existed, viz: from Karasouli (Idomene) to Doiran (Doberus) and thence down the Butkova valley to Demi-Hissar, Seres and Drama.

Amphipolis.—On the advance of the British Army from the "Birdcage" line of defences round Salonika (Naresh on the Galliko to the Gulf of Orphano) in 1916, the 27th Division, which had previously occupied the neighbourhood of Stavros with one Brigade, swung round with this Brigade as its pivot and took up a position on the Struma river, from its mouth to about Negrita, facing east. The southern portion of this line comprised the ground surrounding the Neochori Gorge through which the river Struma rushes to the sea at Cajagzi, after leaving the flat open valley in which Lake Ahinos lies. The position of the line about Neochori presented many difficulties. It was first essential that the British should command and hold Neochori bridge, in view of a possible advance. This was difficult to do from the western bank, where the hills were high and precipitous towards the river. On the other hand to cover the bridge by holding the high ground on the east of the gorge, meant having a rapid and unfordable river close behind the trenches and entailed several new bridges to ensure reliable communication. The existing bridge at Neochori was under observation and fire by the enemy, the gorge afforded bridge sites which would be difficult to hit. The eventual decision was suggested by Captain Hall, R.E.

who knew the area well. This officer had great difficulty in overcoming the anxieties of the staff as regards the rapid stream and the apparent precariousness of the communications, but finally persuaded them to cross the river, to test his opinion. Once across, on the high ground east of Neochori, there remained no doubt and the Neochori Salient was decided upon. The works were dug as shown on the attached map. During the work a great number of antiquities



were discovered in the way of stones and coins, etc., as Neochori is the modern name of the ancient Amphipolis, which was the Athenian outpost on the Strymon (Struma), guarding the bridge which was on the main land route to the East.

Amphipolis was founded by Pericles about 437 B.C. The Athenians had held the mouth of the Strymon for some time but, in order to provide a better base of operations against the Edonians, on the Upper Strymon, the city was built by Hagnon on the rocky elevation that guards the river gorge from the east. Apparently defences

were only regarded as necessary for protection from the east, as was the case in 1916 A.D., when the British occupied the ground with the same strategic object, *i.e.* to hold the road and bridge over the Struma which gave access along the coast to Mecedonia from Thrace. A reference to ancient maps shows that the sites of the British trenches coincide very closely with those of the Athenian works, after an interval of 2350 years. A striking example of the immutability of military principles.

It is interesting to trace the subsequent military history of Amphipolis. In course of the operations between the Athenians and the Spartans in Macedonia, Brasidas the Spartan commander had established himself on the eastern shores of the bay of the Strymon, (Gulf of Orphano) in the autumn of B.C. 424 and thence advanced against Amphipolis from the west. The defence of the place was in the hands of two Athenians, Eucles on land and Thucydides by sea. The former was in the town itself and the latter lay with a squadron of seven ships at Thasos. The island of Thasos was apparently considered to be in danger but there was no anxiety about the town of Amphipolis. The Spartans seem, however, to have seduced some of the inhabitants of the town from their allegiance and, at daybreak one winter morning, Brasidas and his Spartans seized the bridge over the Strymon and occupied the place. Thucydides hearing of the fall of the town hastened to Eion at the mouth of the Strymon and, occupying it, thus deprived Brasidas of the command of the mouth of the river.

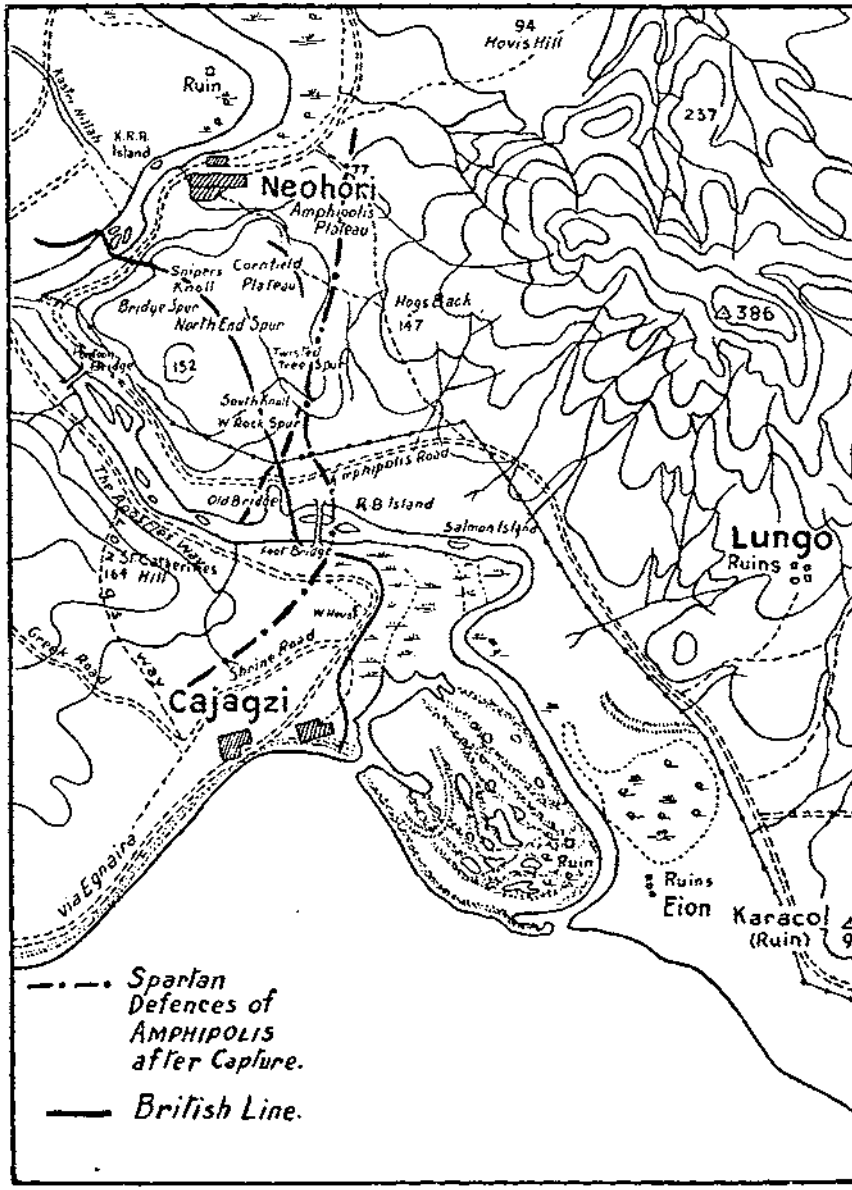
In B.C. 422 Cleon, an Athenian, led a force against Amphipolis. He operated from Eion and reconnoitred the city from the hills to the East of the river and North of Eion. Brasidas by a well-timed counter blow heavily defeated this reconnaissance in force and drove the Athenians back in disorder to their ships in Eion, Cleon their commander being among the slain; Brasidas also lost his life, dying of wounds received in the action. The Athenians by various means continued to strive to regain possession of Amphipolis, until it ultimately fell in B.C. 357 into the hands of Philip of Macedonia, who held the ground, like all the rest of us, to cover the approach into his dominions from Thrace along the sea coast.

Amphipolis is also notable as the scene of the murder of Eurydice at the hands of Olympians and of the imprisonment and murder of Roxana (Widow of Alexander the Great) and her son by order of Cassander, the founder of the present town of Salonika. It seems to have been always more or less in the limelight, for Perseus, the son of the last Philip of Macedonia, fled to Amphipolis after his defeat at Pydna in B.C. 168 by the Roman L. Aemilius Paulus—Perseus subsequently fled to Samothrace when he was ultimately taken and sent by the Romans to grace Paulus' Triumph in Rome in B.C. 167.

Salonika.—The present town of Salonika is the modern representative of the ancient Therma which stood at the head of the Thermaic gulf to which it gave its name. Therma was aggrandised by Cassander after the death of Philip of Macedonia—Cassander collected the inhabitants of the district round and put them into his new town of Thessalonika which he had named after his wife, who was a half-sister of Alexander the Great.

Thessalonika was celebrated for its amphitheatre and circus—Pliny states that it was in his time a free city and it received the distinction of a colony from the Emperor Valerian. The ancient citadel or Greek acropolis is still extant and contains what is believed to be the remains of a temple of Hercules.

Many Roman Relics also survive (1918) among them being the Arch of Marcus Aurelius and the famous Acqueduct that brings water from Hortiac Mountain to the city and from which many thousands of British troops were supplied during the occupation 1915—1918.


94
Hovis Hill
Ruin
237
K.R.R. Island
Neohóri
Amphipolis Plateau
Sniper's Knoll
Cornfield Plateau
Hogs Back
147
386
Bridge Spur
North End Spur
Twisted Tree Spur
152
South Knoll
W Rock Spur
Amphipolis Road
Old Bridge
R.B Island
Salmon Island
Lungo
Ruins
Foot Bridge
164 Hill
W House
Shrine Road
Cajagzi
Ruin
Ruins
Eion
Karaco!
(Ruin)
99
Spartan Defences of AMPHIPOLIS after Capture.
British Line.

ORGANIZATION AND EMPLOYMENT OF ENGINEERS IN WAR.

A Lecture delivered at the S.M.E. on 18th March, 1920, by MAJOR-GENERAL H. F. THUILLIER, C.B., C.M.G., COMMANDANT S.M.E.

THE subject of my lecture is the "Organization and Employment of Engineers in War." I found when I got down to it that it was too big to be dealt with adequately in one lecture. If I were to try and cover the whole of the ground in the time available I should have to deal with it in so cursory and sketchy a manner as to be of little value. I propose therefore to deal only very briefly with the subject of Organization. We do not at present know what the future organization of the engineers of the field army will be, as it has not yet I believe, been finally decided by the Army Council. I shall therefore confine myself to stating certain of what I believe to be the broad principles governing the problem generally, which may, I hope, be of assistance to officers in forming their own opinions.

2. As regards the employment of engineers in war there does not unfortunately yet exist any general "doctrine" authoritative or otherwise on this subject. It is to be hoped that the new edition of *Engineer Training* will contain something of that nature. Something that will be accepted by the engineers themselves, by the other arms with which they work, and by the Commanders and Staffs who regulate their employment, as guiding principles, conformity with which will ensure the most effective and economical use of this valuable, but often little understood, Auxiliary Arm.

3. I by no means suggest that all that I say this afternoon should be accepted as such a "doctrine." On many of the points I shall discuss there is room for differences of opinion. Many of the members of the audience have had wide practical experience of the subjects with which I am dealing and may well have views differing from mine, I propose to make my remarks sufficiently brief to permit of a short discussion after them and I hope that any officers who have views on the subject or have questions to ask will give voice to them. Ventilation and discussion of thoughtful ideas are the best means of arriving at a sound doctrine.*

*As the remarks in this paragraph which were addressed to a local audience apply to a large number of the readers of the *Royal Engineers Journal* it is hoped that any who have views on the subjects touched on in the lecture will give their brother officers the benefit of their opinions by sending them to the *Journal*.

ORGANIZATION OF DIVISIONAL ENGINEERS.

4. As regards organization I shall be able to deal only with the engineer troops of a division. These are the basis from which the remainder of the engineer organization of an Army may be said to start. During the War the engineer work in a division, though all controlled by one man, the C.R.E., was executed by troops of three different branches of the Army, commanded and administered by a number of separate commanders. First there were the engineer companies commanded and administered by the C.R.E., secondly the pioneer battalion commanded and administered by its own C.O. and not under the C.R.E., lastly, attached to the engineer companies were working parties of infantry each taken from a unit separately commanded and administered. The defects of this arrangement are well known. There is inevitably divided responsibility with its consequent evils, and wasted effort and inefficiency owing to the real difficulties of co-operation between the engineers and casual working parties without previous experience allotted day by day to individual tasks.

DILUTION OF SKILLED LABOUR.

5. The inefficiency of the casual working party became so apparent that in the last two years of the war it became the practice to attach a party of about 100 infantry for prolonged periods to each field company in the line. The improved skill and interest displayed by parties so attached greatly improved the efficiency of the work, but the depletion of the infantry battalions and the disturbance caused in their platoon organization were serious defects, more especially in view of the fact that these attachments always took place in the period preparatory to a battle when their consequences were worst felt.

6. In view of these difficulties it is I think practically universally agreed that efficiency would be greatly furthered by having (i) all engineer and pioneer troops under one command, *i.e.*, that of the C.R.E. (ii) by having skilled labour and the semi-skilled in the same company on the principle of the artizan and his mate being trained together and working together.

7. What is meant by semi-skilled? These men may be said to represent both the class of labour of which the pioneer battalions were mostly composed and also the "attached infantry." It will be desirable naturally to have among them as many as the conditions of the labour market allow of men with some knowledge of a R.E. trade, but there will be no objection to enlisting men without a trade who will become "semi-skilled" by the special training they will get after enlistment.

8. The proportion of skilled to semi-skilled will naturally

differ according to the class of unit. For field companies the general consensus of opinion is that skilled men should be from 25 to 30% of the whole. In Army Troops companies, E. & M. Workshops and specialist companies, the proportion of skilled men would naturally be higher.

Proportion of Engineers.

9. The next thing to consider is the total strength of the engineer troops to be provided in a division. Most engineers are agreed that the proportion existing at the end of the War, *i.e.* 3 field companies and 3 pioneer companies to a division of 9 infantry battalions was the minimum required for the conditions of position warfare. I have however heard officers of other arms express the opinion that a smaller proportion will suffice for moving warfare, though few engineers think so. Moreover the above proportion takes no account of the "attached infantry" which were always required in position warfare.

10. The actual proportion is a matter for the consideration of the General Staff and the decision of the Army Council and we do not know what will be decided. The opinions of many officers who have been asked vary from 1,600 to 2,000 of all ranks to a division of 12 battalions. I think it probable that the Army Council decision when we do hear it will be found to be nearer the lower of these figures than the higher.

Importance of the Section.

11. How should this body be organized? The foundation of the organization of any arm is the *smallest unit* commanded by an officer *i.e.* the platoon or section or troop. Although for success in war many things are necessary such as sound strategy, good generalship, well organized staff work, efficient services of supply and transport, yet when it comes to battle the ultimate issue lies in the manner in which the platoons, sections, troops do their job. This is as true of engineers as of any other arm. It is therefore correct to say that the foundation of the organization of the divisional engineers is the *Section*. The section must be of a strength and composition which is capable of carrying out a normal engineer task under a single officer. In passing I may mention that a proposal has been made to change the title of the engineer section to platoon. In the infantry, with whom engineers work more closely than with any other arm the term section has a different signification to what it has in the engineers. It means $\frac{1}{16}$ of a company, *i.e.* a Corporal's command of 10 or 12 men. To avoid possible confusion it is better to call the engineer command which corresponds to a platoon, *i.e.* the subaltern's command, by the same name. I shall however

continue to speak of it tonight as a section as being at present more familiar.

12. The present section of a field company is 36 men, practically all tradesmen, and, as all who have commanded sections know, owing to various causes a section commander thought himself lucky if he had actually present for work over 20 men. Now when the section is composed, as is proposed, of 25% tradesmen and 75% pioneers, it is evident that it will not be capable, if it is no larger than before, of doing the ordinary job of work, owing to the insufficiency of tradesmen.

13. The majority of engineers consider that the minimum strength of a section in such circumstances should be 50, a few even advocate 70 or 75.

14. Having come to a sound decision regarding the strength of the section it will be possible to build up the organization and composition of the company and from that consider the complete organization, of the engineers of a division. Given sections of proper composition and strength an organization which in other respects is not ideal would be workable. But an ideal organization of the higher grouping, if based on weak and ineffective sections, will inevitably be a failure.

GROUPING OF COMPANIES.

15. Another crucial point is the number of companies into which the engineers of a division should be organized. If the section is not under 50, the company, of 4 sections will be 250 to 280 strong. This would give about 6 companies. Experience has shewn that 4 units is the maximum that a single commander should be required to control, and all our Army organization is based on this principle. A division into four companies would make each company too large and unwieldly. Is the alternative to group 6 companies in two battalions? When I come later to consider the methods of tactical employment of engineers it will I think be seen that an organization in two battalions will be cumbersome and awkward. Engineers are almost always used as single companies, never as battalions or groups of companies. The necessity for unity of tactical control, centred in the C.R.E., is paramount. The battalion commanders would I believe be found to be fifth wheels to the coach.

16. A suggestion has been put forward which has much to recommend it, to have the six companies grouped in three double companies, each company commanded by a Captain and the double company by a Major. This makes the double company the tactical and administrative unit, and in view of the fact that the companies will be "diluted" this would probably work well. It would give considerable elasticity in tactical working and would provide well for continuity of *liaison* with infantry brigades.

Headquarter Company.

17. Whatever the number of companies and however they may be grouped there are strong arguments in favour of having, in addition to the field companies, a small headquarters company. It would be composed of a much higher proportion of skilled men, and some of these would be of trades which it is desirable to have for 'back' work but which are not required for work at the actual front, such as electricians, turners, moulders, draughtsmen, &c. The function of the headquarter company, which might be quite small, would be to do all the numerous small skilled jobs, manufacture of special stores, &c., which were done in the war by bleeding the field companies of their skilled men and setting up a scratch organization. It would also provide the organization and the *personnel* for dealing with engineer stores, which is very necessary.

We do not know at present what the Army Council decision on the organization of divisional engineers will be, so the preceding ideas are merely thrown out for consideration and discussion.

Functions of C.R.E.

18. The only other point in connection with organization on which I need touch is the position and functions of the C.R.E. The C.R.E. of a division has a dual rôle. In the first place he commands all the engineer units of the division and is entirely responsible for the direction and control of their work. Secondly, he is the expert adviser to the divisional commander on all engineering matters. He advises him regarding all engineer works projected or in progress, whether carried out by the engineer units or by other arms. He advises when necessary commanders of other arms regarding any engineering work that they contemplate or have been made responsible for, and he also provides them with all necessary engineer stores, but he does not control or supervise or take any responsibility for the works done by the other arms. The responsibility for their execution lies with those commanders and not with the C.R.E. More will be said on this subject, and on the duties of the C.R.E., when dealing with the employment of engineers in the field, so it is not necessary to do more now than refer to the dual nature of his functions. To assist him in these functions, which are onerous, he requires a proper Staff. This should be larger than it was in the late war, it was insufficient then and with the larger command under him in the future it will be more so. He requires a Staff Officer to assist him in the preparation of his schemes for organizing work and for issuing his orders to his units. He requires also an officer to look after the important question of provision of engineer stores. If there is a headquarter company its commander could probably fulfil this function. The

administrative and disciplinary work in connection with his increased command will necessitate his having either a second in command to take all administrative details off his hands or failing that a second Staff Officer for the purpose.

EMPLOYMENT IN THE FIELD.

19. Engineering work in the field has to be carried out by all arms. How can the employment of the engineer units be best co-ordinated with that of the other arms in such work? Let us take the case of infantry who are more often concerned, though the principles are equally applicable to Cavalry, Artillery, Tank Corps, Machine Gun Corps or any other arm.

20. It is to be hoped that the old idea of employing engineers by distributing the individual sappers among an infantry working party to supervise their work is dead and buried. The only people who can supervise the work of the infantry working parties are the infantry officers and N.C.O's. The sapper, without the influence conferred only by military rank, can effect nothing useful in the way of supervision, and is wasted. His job is to work with his own hands.

21. Another method not unknown in the earlier stages of the War is to detail for a job of ordinary simple work requiring no technical skill such as the digging of a fire or communication trench, a section of engineers and a party of infantry. This however is also wasteful. Ask an officer who advocates this plan how he really disposes of his men. Does he distribute his little party of sappers among the infantry, *i.e.* every 5th or 6th man in a line of diggers a sapper? He will probably say, no. Does he dispose of his sappers all together at one end of the line of trench and his infantry at the other? He may say, yes. What good does that do? Why not employ instead of the 20 sappers an equal number of infantry and use the sappers for work elsewhere which the infantry cannot do? He will perhaps say that the presence of the sappers exerts some moral effect on the infantry and that without the sappers to "hold their hands" the infantry cannot set about even a simple job. Well, I don't believe that. I don't believe in the moral force generated in the infantry on the right of a line 200 or 300 yards long, on a dark night, by the presence (unknown to many of them) of a few sappers on the left. Whatever moral force they want can only be generated by their own officers. With proper training of those officers it can be and is done. It is not true to say that infantry cannot be made to do entrenching work without sappers holding their hand. It is grossly under-estimating the capacity of infantry to say so. We must get out of the habit of assuming that no one can do anything except ourselves. It is a habit which is too common and does not, I can assure you, endear us to the rest of the Army. It is also based upon error and delusion. I know from ample personal experience

that, if the responsibility is laid on them, and proper instructions are given to them, infantry can carry out all the works that have up to now been expected of them without any engineer assistance whatever. If the after-war training in this direction is improved as much as we hope it will be they will be able to do works of much greater difficulty than those expected of them in the past. If time admitted I could give examples of the excellent work done by infantry units under my command at various times in the War.

22. The essential things are :—*to give your engineers and your infantry, separately, each their specific jobs of work and to avoid divided responsibility.* Secondly, ensure that the engineers are only employed on such work as the infantry cannot do, *i.e.* those requiring technical skill or in exceptional cases those requiring an elaborate and difficult organization.

Allocation of Responsibility.

23. In regard to the question of responsibility I should like to see it laid down as an axiom that all works in the field come under one or other of two caregories :—

(*a*).—Those for which the R.E. are responsible.

(*b*).—Those for which the infantry and other arms are responsible.

Mark that I say for which they are responsible, not merely which they execute.

24. The works for which the R.E. are responsible may be carried out by engineer units alone, or in certain special circumstances by engineer units with infantry attached for the unskilled portions of the work. They may under certain conditions be carried out by civil labour working under R.E. supervision or even by civil contract. But the essential point is that the engineer officer in charge is responsible and that the person to whom he is responsible is the C.R.E. or the senior R.E. officer with the formation.

25. Works for which the infantry are responsible will be carried out by the infantry normally without any engineers. In exceptional circumstances it may be desirable to give them a few sappers—not to supervise their work—but to do actual technical work themselves of such a nature as the infantry cannot do. Such sappers, whether with or without an engineer N.C.O. will be under the orders of the infantry officer in charge. The essential point is that in all cases of works allotted to infantry for execution the responsibility for efficient and expeditious execution lies with the infantry commander.

Duties of the C.R.E.

26. The C.R.E., as I have already stated, is the responsible adviser on all engineering matters to the divisional commander and similarly in smaller formations the senior R.E. officer present is in the same position.

Whether the situation is one of position warfare or of moving warfare the duties of the senior engineer of any formation will be of the following nature :—

(i).—He must make himself acquainted with the intentions of the commander. He may sometimes find that this information does not flow freely or unasked from the General Staff, but it is imperative the he should seek it out and get it. This means that he must be on such terms with the Staff that they never overlook the importance of keeping him informed or that he can without offence ask outright for it at any time.

(ii).—He must obtain all possible information regarding the engineer work that is likely to be necessary for the execution of the commander's intentions, and of the labour, materials, transport, &c., which will be required to carry them out. This information he obtains from various sources, from the intelligence staff, from engineer reconnaissances by his own officers, from his own personal observations, by personal consultation with the commanders of the lower formations and units and with the staffs concerned.

(iii).—His best course then is to prepare a programme—whether the situation is one that permits of a programme looking a week ahead or only a day ahead it is always best to prepare it—shewing the works necessary in order of priority and the units or formations to be made responsible for their execution In doing this he must consult the senior general staff officer and in fact prepare it in collaboration with him.

(iv).—Lastly he must, with the general staff officer, obtain the orders of the commander of the formation on his proposals.

27. It is in this last stage that the works should be divided as I proposed previously into two categories—one of those to be entrusted to the engineers and the other of those for which the responsibility will rest with the commanders of infantry formations or units.

28. Now, as to the mode of issuing the orders for those works. In both cases the necessary orders should appear as an operation order issued by the General Staff and the order should specify who is responsible for the execution, *e.g.* the C.R.E. or such and such an infantry brigade as the case may be. It must be remembered that the C.R.E. is not a staff officer and has no authority to issue orders for works to anyone except to the engineer units under his command.

29. It should be an understood thing, preferably laid down in the standing orders of the formation, that when infantry (or other) formations or units are ordered to execute works they have to do it without any engineer troops. Needless to say only such works as they can do without such assistance should be allotted to them, similarly it is important that no work which the infantry (or other

arms) can do by themselves is allotted to the R.E., for whom one may be certain there will be more than sufficient jobs of the type which the infantry cannot do.

30. The responsibility for carrying out the various works must be made a real one. It is useless to order works and then not to know if they are done or not. The commander responsible—whether the C.R.E. or an infantry commander—should be required to report to the General Staff of the formation when the job is completed (if it is a one or two day one) or when it is a long one, such as a long C.T. or a strong point, &c., to send in periodical reports of progress. It should be remembered that the work is an 'operation' and as in the case of every other operation a report is required of its completion or progress.

31. As soon as the decision is received as to what jobs the C.R.E. is responsible for he will issue his executive orders for their execution to his own units. He will also make the necessary arrangements for the supply of materials to the infantry formations concerned for those works for which they are responsible. He must also be prepared to give the infantry commanders any advice they may require in regard to the works they have to do—particularly as to materials, &c. He must keep in the closest touch with the changing phases of the tactical situation and be ready to produce at short notice a fresh programme of requirements to meet it and a scheme for executing this programme. For such purposes a well arranged system of *liaison* with the formations in contact with the enemy is of the highest value. Of how to secure such *liaison* I will speak later.

32. You will easily understand from what I have said, I mean those who do not know it from personal experience as many of you do, that the position of a C.R.E. of a division is no easy one. I know that many officers believe that he would find his difficulties much less if he were given higher rank and status, *i.e.* equal to that of an infantry brigade commander. No doubt it would help him, but remember that what is going to make the C.R.E. successful in his job is not an extra pip, or crossed swords or batons, on his shoulder, but that indefinable quality—one which is often present where the pips are few and sometimes absent where they are many—which we call "personality." If you can inspire confidence in your judgment and your competence in getting things done, if the commanders of the infantry and other arms know you are all out to help them on all occasions, never obstructive, not constantly producing some better plan of your own but prompt in carrying out theirs, if you are well known to everyone and welcome when you appear, if you are a *persona grata* with your commander and his staff, *then* it won't matter whether you are a Brigadier-General or a Major—you will make good.

INFANTRY WORKING PARTIES WITH ENGINEERS.

33. I have mentioned before that in certain circumstances infantry working parties may be attached to engineer units for the unskilled portion of the work. In the future, if the engineer units contain their own dilution of semi-skilled men such occasions will seldom arise. But they may arise and when they do the question of responsibility must be clearly defined and understood by all. In such cases the engineer officer in charge is responsible for the design and execution of the work. He will give specific tasks to the officers commanding the infantry working parties and these officers are responsible for the diligence of their men and for the efficient execution of the tasks given.

PREPARATIONS FOR WORK.

34. When any work has to be carried out, whether by engineers or by infantry, it is necessary, in order to ensure its ready commencement and rapid execution, that certain preliminary arrangements are thought out and made. Otherwise confusion and delay are inevitable. These are :—

(i).—There must be a carefully prepared scheme to ensure that each unit (company, &c.) receives in good time clear and definite instructions, with sketches if necessary, as to the nature and scope of the work required.

(ii).—Rendezvous points must be carefully selected, (with due regard to the position of the tool and material dump) and notified to all concerned and provision made for "guides" who must be men with a thorough knowledge of the routes to be followed.

(iii).—There must be a well thought out organization for the ready issue of tools and materials, and definite responsibility laid on the officer in charge for the return of all tools.

(iv).—Before leaving the rendezvous clear instructions should be given to all ranks of the nature of the work to be done and the method of alignment of the party on the work. The tasks required should be explained to all ranks.

35. Task work is nearly always the best method of carrying out work. Not individual tasks, but a definite task assigned to each platoon or other party. The sooner they finish it the sooner they may go. This means that the officer in charge must estimate the amount of work it would be able to complete during the working period.

36. This is often very difficult, but it will nearly always be the best way of securing a good output. If you find that though they have been working steadily and well they cannot complete it in the time

estimated it can be reduced. But it should never be increased even if you have under-estimated the amount they could do.

Tactical Employment of Engineer Units.

37. Broadly speaking this question resolves itself into one of whether it is best to attach individual field companies to infantry brigades and leave it to the infantry commander to use them as he pleases, or to keep them all working under the direct control of the C.R.E. Some men are in favour of the one method and some of the other and I think that their opinions are often based on the particular angle of view which their own, perhaps rather limited, experience has afforded them. Actually, no doubt, there are situations in which the one would be the best method and others where the other would be. My own opinion—and I have had opportunities of viewing the question from the angle of view of a C.R.E. and also of a brigade and divisional commander—that in the great majority of cases the large number and variety of engineer services required makes it most desirable that the C.R.E. should retain direct control of the engineer operations to the greatest possible extent in order that the work may be properly organized and the whole of the available resources in engineer *personnel* and materials made use of in the fullest degree.

The Attack.

38. Let us consider the control of engineers in the attack. In an encounter attack—which pre-supposes little or no time for preparation—it is of importance that the advanced infantry formations in contact with the enemy should be accompanied by sufficient engineers to ensure as far as possible that progress is not arrested, and that important tactical points gained during the successive phases of the attack are consolidated and fortified. In view of this it may well be advisable to attach a field company, or portion of one to the brigades making the attack. But it is also of importance that once an engineer unit is engaged on any specific work whose rapid completion is desired it should not be required to hand it over to another engineer unit. Therefore the engineer assistance required by the advanced brigades can generally best be provided by engineers being pushed forward as the situation demands from reserves in the hands of the C.R.E. that is to say by leap-frogging companies up from the rear. Close touch by the C.R.E. with the tactical situation is a prime necessity and he must use all possible means, including an organized *liaison* service, of maintaining it.

39. In the deliberate attack, there are three phases:—the preparatory phase, the assault itself and the phase following up the assault. In the preparatory phase, which, when the objective is a highly organized and strongly fortified position, may be a matter

of several weeks, the works required are so numerous and so important that it is imperative that the engineer resources should be controlled with the utmost care so that none should be devoted to objects of minor importance. This can only be ensured by the C.R.E., in close consultation with the General Staff, exercising direct control.

40. In the actual assault it is never right to send engineers with the assaulting infantry on unspecified missions. They suffer unnecessary casualties and are unable to work when required, and their action is uncontrolled and of little value. It may often be desirable to send engineer parties to follow up the infantry with a specific mission such as consolidation of tactical points or opening up of forward communications, but their objectives should always be a specific work for which they have prepared beforehand. Even then it is undesirable that they should follow the leading waves of infantry too closely. It should be realized that they cannot do effective work on the actual advanced line occupied by the infantry in an attack. They get mixed up with the infantry, take part in the fighting, do not do the required work and suffer losses. Real consolidation can only be done when the advanced infantry line is 800 yards or so in advance of the position to be consolidated. The paramount necessity of rapidly opening up forward communications during an attack makes it of importance that the C.R.E. should retain within his immediate control as much of the engineer *personnel* as possible for this purpose, and also in order that the necessary disposition of the engineer units may be made to ensure the prompt execution of the works required in the third phase—that following the actual attack.

41. In the phase following a successful attack the conditions are in many respects similar to those of an encounter attack and the engineer units should be handled as described under that head. The infantry and artillery are pushing on to secure fresh objectives and circumstances calling for engineer assistance may develop rapidly. An organized *liaison* service is the best means of securing that this assistance may be promptly forthcoming and the C.R.E., who is in close touch through the divisional Staff with the general situation, must decide which demands must have priority at the expense of less vital ones. All engineer officers with the advanced formations must render to their immediately superior engineer commander frequent and clear reports on the engineer situation and obtain and report all possible information that would be of value.

THE DEFENCE.

42. An organized defensive system is composed :—

(i).—Of the advanced works in close contact with the enemy, which is known as the outpost zone.

(ii).—Of the main battle position where it is intended to resist a decisive attack.

(iii).—In some cases, of one or perhaps more rear systems of defence.

The position of the outpost zone will generally be dictated by the tactical situation and will as a rule be on or near the lines on which the leading troops found themselves when stationary conditions supervened. The location of the main battle position will always be decided by the Commander of the formation.

The development of the works of the outpost zone will normally be the duty of the advanced infantry formations occupying it, but engineers may be required for such works as require technical skill.

The development of the main battle position will ordinarily be the duty of the d.visional engineers with such additional working parties of other arms as may be required.

When there is in addition a rear defensive position its works will usually be undertaken by the engineers of the higher formations with the assistance of labour units or civilians.

43. There are certain principles which govern the employment of engineers in the defence. They are :—

(i).—The decision as to the order of importance of the defensive works required rests with the commander of the division or other formation holding the line. The governing factors will be the time, materials and labour available.

(ii).—The responsibility for the construction and maintenance of the defensive works in any sector of the front or outpost system rests with the commander of the troops in occupation of it and responsible for its defence.

(iii).—All troops are responsible for the execution as far as possible of their own defensive works, including obstacles, the employment of engineers being limited as far as possible to those which require technical skill or are of such magnitude and urgency as to call for special organization.

(iv).—Divided control and responsibility for work must be avoided.

(v).—Continuity in the carrying out of works is essential.

Allotment of Engineer Units.

44. From a consideration of these principles it will be found that in occupying a defensive system engineer units should be allotted to definite sectors of the defence which should where possible correspond with the sectors allotted to the higher infantry formations, *e.g.*—brigades.

45. It will often be convenient to allot to a field company in such circumstances a dual rôle, namely (*a*) the execution of works in the

front system, working in affiliation with the infantry brigade responsible for its defence and (*b*) the execution of works in the main system of defence under the direct control of the C.R.E.

46. This arrangement allows for a portion of the Company working on "forward" works and a portion of "back" works and permits of regular reliefs being carried out within the company, with the result that whereas the infantry formation or units occupying the area frequently change the engineer unit can be retained in the same sector for longer periods and so assist in securing the continuity of work which is essential.

POSITION WARFARE.

47. In position warfare the duties of engineers will be by no means confined to those connected with the defence of the position. They will also have numerous and varied duties under the following additional heads :—

(i).—Duties in preparation for attack.

(ii) —Duties in connection with the security, comfort and efficiency of the troops behind the line.

(iii).—Duties in connection with raids.

(iv).—Duties in connection with the development of communications of all kinds behind the line.

48. The inception, execution and control of the numerous works required under these heads, and the supply of the necessary materials, will necessitate the most careful organization and preparation on the part of the engineer commanders of the divisions and higher formations. It is of greater importance than ever to utilize to the best advantage all available *personnel* and material and to secure continuity in the policy and progress of the works. It is therefore essential that the engineer units should be under the direct control of the C.R.E. and that the latter should maintain a programme of the necessary works to be carried out by engineers and other arms and obtain the orders of the divisional commander on it on the lines described previously.

49. The progress of work may depend as much on the supply of stores as on the available resources of labour and the former may easily become the ruling factor. The railing up of stores from the base and their distribution through the Army and Corps parks to the divisional dump and thence to the sector dumps will become a matter of requiring great foresight and careful organization on the part of Chief Engineers and divisional engineer commanders.

THE RETREAT.

50. It may be thought that a forced retreat in the presence of a pursuing enemy would be an occasion when engineer units can best

be employed in attachment to the formations in actual contact with the enemy. The rapid development of new situations that occur in such operations entail very varying and urgent demands on the engineers. The requirements may, as you know, be the demolition of bridges, the destruction of railways, water supplies, telegraphs, stores, &c., the erection of obstacles, blocking of roads, &c., the preparation of successive defensive positions, the construction of special communications and bridges to permit of withdrawal of troops, guns and transport.

51. However desirable the attachment of engineer units to infantry formations may at first sight appear this method will, even under these circumstances, generally be wasteful. A large amount of the work has in any case to be carried out under direct divisional control and even in the case of work required by the formations in contact with the enemy the C.R.E. alone is in sufficient touch with the general staff to estimate and provide for the engineer requirements of the situation as a whole by allotting units to carry it out as required.

52. The work however requires the most careful co-ordination and control under circumstances of peculiar difficulty. The movements of the engineer units will necessarily depend on the localities where the main engineer work is required and will therefore seldom correspond with the movements of the infantry formations in contact with the enemy. It is necessary for the C.R.E. to arrange for a close and effective *liaison* with these formations and thus to provide promptly for their requirements, which moreover can generally be foreseen and the necessary preparations made.

53. There are certain points which call for the special attention of the commanders of engineer units in a retreat :—

(i).—They must take special steps to keep in touch with the situation, and must act with initiative and readily assume responsibility.

(ii).—They must keep their superior engineer commanders well informed as to the situation and the progress of works and must report all information of tactical importance.

(iii).—They must be ready to respond to any call for engineer assistance, or other assistance, made on them by any other arm, on their becoming satisfied that the call is warranted and having due regard to the importance of any other orders under which they may be acting.

54. The entire success of the engineer operations during a retreat depends on the maintenance of efficient communication between the C.R.E. and the engineer units. The former must be kept informed always of the exact locality of the report centres of the engineer units. It is advisable to organize an independent and efficient engineer communication (motor despatch) service for the above

purposes, though whenever possible use must be made of the divisional signal service to avoid unnecessary despatch work.

ENGINEER LIAISON.

55. Numerous references have been made to the necessity for a well-organized *liaison* service between the engineers and the arms towards whose assistance the engineer effort is directed. The best method of effecting this is to attach an engineer officer, whenever circumstances seem likely to require it, to the headquarters of the formation needing engineer assistance. Generally the formations will be infantry brigades but there are times when such an attachment to the headquarters of artillery formations, particularly the heavy artillery, will be of great value.

56. The main functions of this officer will be to form a close and personal link between the engineers and the formation to which he is attached. He should be the agency for furnishing the C.R.E. with early and accurate technical information regarding the engineer assistance required. He is in a position to estimate the nature and extent of the work, the tools, equipment, material, skilled and unskilled labour required, and the best method of executing the work, and for this purpose he will make the necessary engineer reconnaissances. He should be able to effect all the local preparatory measures to ensure the rapid execution of work by the Engineer parties when they arrive.

57. To the commander of the formation he will be the technical means of communication with the engineers and will also be able to furnish technical information and advice regarding works for whose execution the formation itself is responsible. It will often happen that such works, though not requiring the technical skill of engineers for their execution, are of a nature to make it desirable to have technical advice in regard to the design, method of execution, supply of materials and organization of labour. He should not however undertake any of the executive or administrative duties proper to the staffs of the formations or units composing it, such as issue of orders or supervision of work.

58. An important part of his duties, besides those already specified, is to foresee and suggest to the staff of the formation the occasions when engineer assistance will be of value and the nature of the work which the course of operations are likely to give rise to. The responsibility both for foreseeing such occasions and for asking for the assistance rests of course with the commander of the formation, but the he p of an officer with technical knowledge will be of great value to him. For assistance in the above duties, particularly in the reconnaissance work, it will often be advisable to provide him with one or two specially selected N.C.O's or sappers.

59. Lastly it is of importance that the officer himself should be

specially selected. He must have experience of what engineers can do and what infantry can do, he must also have a good military knowledge and judgment, be resourceful and gifted with iniative. His duties will often be of a delicate character requiring tact and discretion. In short, as in the case of the C.R.E., he requires to be an officer of personality. This after all is the quality which is almost more necessary to engineer officers of all ranks and grades than any other.

SUMMARY.

60. To sum up, we may say broadly that for the effective employment of engineers in war it is necessary to ensure the following :—

(i).—A close and accurate knowledge of all developments of the tactical situation.

(ii).—A thorough comprehension of the needs of the various fighting arms.

(iii).—A definite estimation of the work to be done.

(iv).—Well prepared arrangements for producing the materials and *personnel* for doing it.

These practically boil down to "*liaison*" and "organization." Having developed these an engineer commander should be able in the first place to furnish the General Staff with sound and competent advice on the engineering requirements of the operation in hand and in the second place to utilize to the best advantage all the available engineer resources to meet the varying tactical conditions.

The lecture was followed by a discussion.

CORRESPONDENCE.

DEVELOPMENT OF THE WORKS DEPARTMENT IN MESOPOTAMIA.

To the Editor, R.E. JOURNAL.

DEAR SIR,

In the December number of the *R.E. Journal* there is a slight error with regard to the Shaiba Bund in the article on the "Development of the Works Directorate in Mesopotamia."

It is stated that the height of the bund was 6½ feet, designed to be 5½ feet above flood level. This would mean that there would be only one foot of water against the bund. The 5½ feet should read 3½ feet; the average depth of water to be contended against was 3 feet. With this depth of water the wave action is serious and difficult to deal with.

This error might have given rise to a criticism of the methods used, which appeared in *Railway Gazette* on the 26th December, entitled "War work of the R.E's" which reads as follows:—

"Some further particulars of the bridge and other excellent work done by Royal Engineers in the European War are given in the December number of their Journal. During the three months between the last advance and the armistice about 320 stock spans were erected, or nearly double the number put up during the preceding four years. Some further particulars are noted by Major F. P. Anderson, R.E., on the Houplines railway bridge. Owing to the proximity of the station, no deviation could be laid down. As the abutments were built for a double line the damaged girders for the single line were shifted, leaving space for a new super-structure in case the old one failed entirely; this did not happen, and the repairs were duly carried out. In the same issue, a full account is also given of the 40 miles of roads and many miles of flood protection works executed at Basra. The great difficulty in the way of laying down rails in the first instance, and of protecting the bunds to keep out the floods, appears to have been the absence of material for ballast and metalling, and for resisting the action of waves on the outer slopes of the bunds. Trap rock was brought from Bombay, and limestone from an island many miles off, for the roads, and a coarse sand, also brought from a great distance, was found sufficient for the latter purpose. Many buildings of brick were occupied, showing that brick burning was indigenous to the locality but the manufacture of bricks was not attempted owing to the lack of fuel. In Eastern lands garbage of all kinds is burnt in rough kilns, and coal dust is exclusively used in Bull's kilns. There must have been plenty of both kinds of fuel available with which this difficulty might have been overcome from the very beginning of operations."

The writer of this article does not appreciate the conditions of lower Mesopotamia being a country without trees, other than date palms, and without grass and very sparcely populated; there is no litter or garbage suitable for brick burning from the local inhabitants, and practically all litter available from military camps was utilized as fuel for incinerators.

Bricks were burnt locally with reeds and oil fuel, but their supply was insufficient to cope with the demands for buildings and were not available for roads and revetments. Coal dust was not available in sufficient quantities to warrent its use, and it was not considered expedient to import it from India owing to the scarcity of sea tonnage. The coarse sand of which the correspondent speaks was not brought from a great distance, but was excavated from the Shaiba Ridge where the bund abuts on high ground.

Yours etc.,

D. K. EDGAR, *Colonel, R.E.,*
Director of Works.

G.H.Q. Baghdad. 4th March, 1920.

THE WORD "GADGET."

A correspondent sends the following:—"You know, in the Marines, when we can't think of the generic name for anything, we call it a 'gadget' or a 'gilguy.'" [R. G. Kauffman "Our [U.S.] Navy at Work" p. 194, quoted by C. A. Smith in "New Words Self-Defined."]

REVIEWS.

APPLIED AERODYNAMICS.

By L. BAIRSTOW, C.B.E., F.R.S. (Longmans Green Co., E.C.4.). Price 32/-.

This work will be found of great value, by designers of aircraft, as it contains much useful information; is clearly written, and well illustrated. Mr. Bairstow is the expert adviser on this subject to the Air Ministry, and has had exceptional opportunities of studying aeronautics, both theoretically and practically. One rather unusual feature in the book is the information given about "lighter than air" craft, as most works of this kind seldom mention this subject.

In *Chapter I.*, after some introductory remarks on earlier experiments, the author gives a general account of a typical biplane, monoplane, and flying boat, explaining briefly the principal points in connection with their construction. Various types of engines are then considered, and the chapter ends, with a good description of the different classes of airships and kite-balloons. The statement that for safety it is desirable to take 40 m.p.h. as the maximum alighting velocity for aeroplanes, is interesting.

In *Chapter II.* the general principles of flight for both aeroplanes, and "lighter than air" craft are discussed. In the aeroplane section the following points among many others are considered viz. the wings and their resistance, body and other resistances, the propulsive mechanism, etc, while climbing flight, diving and gliding are fully gone into. It is satisfactory to see that the author gives the correct explanation of "Soaring Flight," viz.: that it can only be performed in rising currents, in gusty winds, or when the wind has different velocities at different heights. Various other questions are considered, such as flight at high altitudes, variation of engine power with height, etc. In discussing the "centre of pressure" it should be noticed that the author defines this as the "point where the line of the resultant pressure cuts the chord of the section of the aeroplane" This point is taken as a matter of convenience and is not the true centre of pressure as defined by Langley. Numerous other matters are considered and there is an interesting paragraph on the effort necessary to move the elevators, the force on the pilot's hand (under the varying conditions given) being shown very clearly in Table 18. The forces acting on flying boat floats are next dealt with, and the chapter concludes with an explanation of the calculations necessary for "lighter than air" craft. There is also a useful section on the equilibrium of kite-balloons.

In *Chapter III.* there is a very good general description of the various instruments used in aerodynamical experimental work. The apparatus required for measuring the velocity, pressure, etc., of the air are described, as also the accelerometer, aerodynamic turn indicator, etc. The use of the cinema camera for recording movements of aircraft is explained and a description of the "Wind Tunnel" and the method of using it follows. The chapter concludes with a brief account of the "Water Tank" used for making experiments on the resistance of the floats, and hulls of flying boats, but no details of the apparatus known as the "Whirling Table" are given, though it is mentioned in connection with the subject of air screw testing.

Chapter IV. is a very important one, as it contains a large amount of information regarding the problems which usually arise in the aerodynamic design of aircraft. Part I. "Straight Flying" discusses the geometry of wings, their aerodynamical co-efficients of different kinds, the effect of changes in wing form, etc. A comparison between monoplanes, biplanes and triplanes follows, and the results of varying the "gap," "stagger," etc. are considered. The pressure distribution on the wings of a biplane is explained, and a comparison between the forces as estimated from the pressure distribution diagrams, and those measured directly on a balance, is made. A discussion on the resistances of various bodies such as struts, cables, radiators, engine cooling apparatus, etc. follows. The method of finding the resistance of a complete aeroplane model is then described and analysed, and it is shown that, as stated in the Advisory Committee Report dated December, 1917, the more closely the model wing tested represents that used on the full scale machine the more reliable will the results be. The description of the experiments on airships is particularly interesting, especially Table 42, which gives in detail, the resistances of the different parts of a non-rigid

airship. Part I. concludes with a description of the pressure distribution round an airship envelope, and shows the positive pressures round the front, and the development of the negative pressures in rear. Part II. "Non-rectilinear Flight." In this a standard system of axes for flight calculations is described and the symbols used for the forces, moments, etc., are considered. The method of calculating the forces on the model of a flying boat hull is explained, as also the scheme for calculating those on an aeroplane body, with fin and rudder; the effect of the presence of the tail plane being specially considered. This Part II. concludes with the consideration of "change of direction of axes without change of origin" and describes the formulae with the equations of motion and stability.

Chapter V.—In this "aerial manœuvres" and the equations of motion are considered. "Looping" "Spinning" and "Rolling" are briefly described and the method of calculating the forces, etc., acting on a machine in such cases is given.

Chapter VI. deals with "Airscrews." The theories of "Froude" and "Drzewiecki" are first explained and it is pointed out that a combination of the two gives the best results. Experiments on the velocity and direction of the air flow, near an airscrew, carried out at the National Physical Laboratory are then considered, and the results for both stationary and moving airscrews described. A mathematical theory of the airscrew, from which expressions for the thrust, torque, etc., are deduced follows, and the author points out, as a result, that rotational inflow may be neglected, that an average value of (.35) may be used for the translational inflow, and that the final calculated results for thrust and torque are in good agreement with practice. An example of the calculations for a particular airscrew is given, the efficiency being shown to be ·825. The effect of the aeroplane itself on the performance of an airscrew is next discussed, and the chapter ends with formulae for airscrews suggested by considerations of dynamical similarity.

In *Chapter VII.* experiments on Fluid Motion are described, and the mathematical theories of aero and hydro dynamics discussed. As regards fluid motion shown experimentally, a description of the apparatus used is first given, and the results obtained by photographing the flow round a disc are shown. Steady and unsteady motion of a fluid are then described, as also the path of particles in an eddying fluid. The two standard methods of presenting fluid motion which correspond with the difference between stream lines and paths of particles, are then explained and it is pointed out that there are three distinct stages (1) steady: when forces due to viscosity are very great compared with inertia forces (2) steady; when both forces are appreciable (3) unsteady, and possibly steady: when inertia forces are large compared with those due to viscosity. The elementary mathematical theory of Fluid Motion is next considered. The "Sink and Source" system is well described and there is a particularly interesting account of Fuhrmann's arrangement of the sources and sinks, to ensure a fair shaped form. All the forms generated in this way are of course forms of "no resistance," but it might be found useful to use sinks, rather less than sources (surplus water running to infinity) and thus obtain forms which by suitably

shaping the rear portions would be "forms of resistance," and possibly of practical utility. Cyclic and discontinuous motion are then considered and the chapter concludes with a discussion on motion in viscous fluids. It is clear that this subject requires a great deal more examination.

Chapter VIII.—In this dynamical similarity and scale effect is considered. A general explanation of the theory is first given, and its application to fluid motion explained. The law of corresponding speeds is described, and the reasons why this law cannot always be applied are given. Numerous examples follow and the conclusion arrived at is, that so far research shows that a reasonable application of model results to full sized work is justifiable.

Chapter IX.—The prediction and analysis of aeroplane performance. This chapter commences with a discussion on the effect of height on aeroplane flight. A rapid method of predicting the speed, climb, etc., is first described, and later on a more accurate method is explained. A good feature of the chapter is the calculated examples, which are always useful to students.

Chapter X. on "Stability" is divided into two parts, the first dealing with the general mathematical theory of the subject, the second with the details of the disturbed motion of an aeroplane. Part I. commences with a description of some experiments on two aeroplanes in flight, one stable, the other unstable, and the definition of a stable machine follows. The use of models for solving questions of this kind is explained, and it is pointed out that while the action of the airscrew brings new and appreciable forces into play, the general principles of stable and unstable motion are not changed. A full description of the mathematical theory of stability follows, and a number of miscellaneous questions in connection with the subject are examined. In Part II. the details of the disturbed motion of an aeroplane are discussed, and suitable formulae for calculating such details are given. The effects of gusts, etc., are considered, and a discussion on the controlled and uncontrolled flight of a stable aeroplane in a natural wind, concludes the chapter.

Appendix.—In this a new method of solving equations of the 4th and 8th degree is described. This will be found useful for the stability equations, which are often of these classes.

J. D. FULLERTON, *Colonel, R.E.* (*ret.*)

PAGES D'HISTOIRE, 1914—1918.

(Librarie Militaire Berger-Levrault, 5—7 Rue des Beaux Arts, Paris).

(*Continued from R.E. Journal for March*, 1920).

The 162nd number of this series is entitled *La Lutte Financière entre les Belligérants*; the author of the volume is M. G. Cerfberr de Medelsheim, Director at the Direction Générale des Finances d'Alsace-Lorraine. M. de Medelsheim points out that the Great War was not only a military conflict, but also a contest in the fields of economics and finance. So far as certain military aspects of war were concerned,

the Central Powers and their allies, the Bulgars and Turks, possessed an advantage over the Allies and Associated Powers: however, the weakness in their armour was finance, Germany alone had any credit worth speaking about. The National Debt of the Belligerants at the date of the outbreak of the War is set out: at that time the German debt was less than one-fifth of the French debt and equal to about one-third of the debt of the British Isles. The borrowings of the several Powers are touched upon and information is given relating to the amounts raised in the principal belligerant countries by means of each of the loans floated and the rate of interest which the several Governments had to pay for their respective loans. An interesting feature of this volume consists in the eight diagrams which show the fluctuations in the rates of exchange during the progress of the war: they afford some index of the confidence, or want of confidence, at various dates as to the supposed chances of ultimate victory falling to this or that group. Taking the Swiss franc as a standard, the depreciation of the French franc reached its low water mark in the July of 1918 (32% below par); the £ sterling was at its minimum during May and July 1918 (26% below par); the American dollar reached its minimum at the same time as the £ sterling (also 26% below par); the German mark fell to a value 50% below par in the August and November of 1917, but experienced a sharp recovery in January 1918 (28% below par), eventually reaching its low water mark in November 1918 (56% below par); the Austro-Hungarian krone followed the German mark and stood at 64% below par in August and November 1917, recovering to 46% below par in March 1918, it finally dropped to its minimum in November 1918 (68% below par).

The 163rd number contains the official communiqués issued by the Central Government to the Provincial Authorities during the period July—September, 1918; it is the XXXVIII volume of the series dealing with such matters.

The 164th number is a Diary of the War covering the period 1st July to 31st December 1918; it is the 9th volume of the series dealing with such matters.

W. A. J. O'MEARA.

NOTICES OF MAGAZINES.

LA REVUE D'ARTILLERIE.

The *R.E. Journal* has much pleasure in announcing the re-appearance, after an interval of nearly six years, of the *Revue d'Artillerie*. This event is one of more than ordinary interest in view of the noted excellence of the French Artillery during the Great War and of its high promise of further epoch-making successes. The *Revue* proposes to deal with a large range of subjects, from the scientific methods of preparation and execution of fire to metallurgy in so far as it concerns the construction of the arm. It is edited by Berger-Levrault, and may be obtained, at the annual cost of 35 fr., from *La Revue d'Artillerie* 252 Rue de Vangirard Paris XV°.

THE MILITÄR-WOCHENBLATT.

No. 78.—" Esse Delenda " compares the fate of Carthage with that which Germany may expect if she does not devote all her energies to the restoration of her national spirit and defensive powers.

The new Army law and the struggle for German Unity.—Expresses the hope that the new Army will stand as a homogeneous force unaffected by questions of state partitions and above all by politics. Before the war the individuality allowed to the various state contingents was permissible on account of the large effectives, now however such divisions would be disastrous to the diminutive army of the new Germany.

No. 79.—The surrender of German War criminals to the Allies is the subject of the leading article. Captain Scheibe makes a frantic, but very badly expressed protest against the handing over for trial of any Germans accused of war crimes. Most of it consists of wild abuse of the allies, who, he says, having robbed Germany of all her material possessions, now wish to take away her soul. After reading Captain Scheibe, one cannot help thinking that Germany would be better without the kind of soul that he wishes to defend.

The Military Situation in South Russia.—Thanks to excellent Bolshevik leading and to the fact that the ice on the Dnieper was thick enough to allow a crossing, Denikin's forces round Kieff were defeated. The Bolsheviks are delighted at the re-capture of the rich Donetz Mineral Area, and attribute this event largely to the raids of the Red Cavalry, in which the White Cavalry was several times defeated. Belgian capitalists who had come to Donetz, to exploit the minerals, have had to clear out again. The comments of the *Militär Wochenblatt* on the situation in Russia must be exceedingly difficult to compose. On the one hand their author is always pleased to see any of the Entente or their *protégés* getting a knock, while on the other he evidently fears the Bolshevists and cannot applaud their success.

The equipment of the Polish troops on the Beresina.—A quotation from the *Times* describes this as pitiful and the *Militär-Wochenblatt* contrasts this with the abundance which Poland maintains in areas where a plebiscite is to take place.

Roll of Honour.—Reserve Infantry Regiment No. 27—105 officers and 2,557 other ranks killed excluding 13 officers and many other ranks killed serving with other units.

No. 80.—*Turning points of post-Bismarckian policy* describes the course of Germany's policy in the last 30 years, how she sought power now in the east and now overseas with varying, but on the whole satisfactory progress. Von Bülow however tried to push both programmes at once, and then came trouble after trouble, until, in 1914, Germany found herself attacked on all sides. Even in 1916, when she had practically attained her eastern aims, it was still possible, by surrendering her western ones, to save much from the wreck. The wise guiding hand of Bismarck was, however, lacking and so far from giving up any of her overseas and western ambitions she expanded them and so lost all. A last frantic attempt, made while in the act of collapse, to change her policy once more and embrace with America, the League

of Nations, came much too late and could not even delay the bitter finale.

The Military Situation in Russia.—Anxiety is expressed regarding the fate of the flourishing German Settlements near Ekaterinoslav and on the sea of Azow, now closely threatened by, if not actually in the hands of the Bolshevists. Poland is said to be desirous of peace with Soviet Russia, but to be prevented from coming to terms by the *Entente*.

An Army Order states that the Ministry of War lays great stress on the maintenance of close personal touch with the commanders of the Army, and accordingly directs them when in Berlin on leave or duty to report to the War Office. Similarly whenever the Minister of Defence stops on a journey for more than 24 hours in a place, any senior officers, who may be present, will report to him.

A fund for the benefit of soldiers returning from the Baltic is being raised and subscriptions are invited.

No. 81.—*Education of War Orphans.*—It is estimated that 153,000 German Officers were killed or wounded during the war. Under existing conditions the education of their children presents an almost insoluble problem. The *M.W.B.* advocates the conversion of the now prohibited cadet schools into training colleges. The idea has already received powerful support from many directions. Funds are asked for.

German and French Cavalry on the Marne in 1914.—This is a comparatively impartial review of the French book entitled "Rôle de la cavallerie française à l'aile gauche de la première bataille de la Marne." The reviewer says that French and German writers both complain that their opponents would not stand and fight in the open, but withdrew to the protection of their artillery and machine guns. He attributes this not to lack of Cavalry spirit (*Reiter-geist*) but to the nature of the ground and the conditions of the fighting. Everyone admits the right of cavalry to use their mobility to get out of tight places, and the occasional weakness of individual squadrons is no proof of general worthlessness. In 1916 in Roumania, German cavalry showed that it had not lost the art of the mounted attack. If the author is a cavalry man, his pride in the enterprise, which placed the French 5th Cavalry Division in the forest of Villers-Cotterets behind two German armies, from the 8th to 10th September 1914, is understandable, but he is mistaken in his estimate of the influence its action had on the operations. Its attack on the 17th German Division, which fell chiefly on a brigade of the 24th Artillery, was quite unsuccessful and though its presence was naturally not entirely without effect, the Army Commander refused to allow himself to be disturbed thereby. In fact the only measure that appears to have been taken against it was the detachment of two batteries for the protection of the Aerodrome. The decision to break off the successful attack of the right flank of the 1st German Army was due to the, to us rather mysterious, instructions brought by Lieutenant-Colonel Hentsch, from G.H.Q. and not to the French Cavalry. The reviewer then describes the action of the German Cavalry, and maintains that they fulfilled their rôle to the last, holding the British in check in spite of the superior numbers of the latter. Finally in 1918 the brilliant

performances of the German dismounted cavalry divisions, show that they need fear no comparison with their French comrades in arms.

Cost of the National Army.—Taking pre-war rates of exchange, the pay of various ranks of English, French and German Officers is compared as follows, in Marks.

English.

2nd Lieutenants ...	6,400—7,500	*Unmarried.*	7,880—8,960	*Married.*
Lieutenants ...	7,500—8,580	,,	8,960—10,060	,,
Captains	10,340—11,240	,,	12,440—13,340	,,
Majors	13,680—15,680	,,	15,360—17,360	,,
Lt.-Cols.	23,680	,,	24,840	,,
Generals	up to 81,055	,,	84,650	,,

French.

2nd Lts. & Lieuts.	7,212—9,930	*Unmarried.*	7,212—9,930	*Married.*
Captains ...	11,172—12,792	,,	11,172—12,792	,,
Majors	15,140—16,040	,,	15,860—16,760	,,
Generals	43,405	,,	43,405	,,

German.

2nd Lts. & Lts. ...	5022—5922	*Unmarried.*	5490—6390	*Married.* plus, in each case 600 Marks for each child.
Captains ...	7652—9304	,,	8120—9760	
Majors and Lieut. Cols. ...	10,756	,,	11,212	
Colonels	12,816	,,	13,272	
Generals	15,084—31,980	,,	15,540—31,980	

These rates are stated to be quite inadequate.

The Military Situation in South Russia.—The present population along the shores of the Black Sea is said to be embittered against Denikin on account of forced requisitions to supply the corn England has extorted in payment for a comparatively modest quantity of Munitions. The drive and impetus of the Bolshevik armies is praised.

No. 82.—The old Prussian cadet corps, founded more than 200 years ago, is now to be abolished in accordance with the conditions of the Treaty. Of the 739 Cadets who were commissioned immediately on the outbreak of war no less than 373 fell, and from Von Roon to Lettow-Vorbeck and Richthofen there is hardly a famous name which will not be found in its books.

In *The Military and Political situation of the World* the idea of an alliance with the German speaking portion of Austria is opposed, partly because Germany cannot afford to support the broken down Austrian Empire and partly on account of the alleged treachery of the ex-Emperor Karl. That France, contrary to the advice of Bismarck still clings to the idea of revenge, is deplored, but the embarrassment, which America causes her by holding back, is remarked with satisfaction. The question of conscription of the French colonial man power in North Africa, on an organised basis, as opposed to free recruiting, is discussed. France wants all possible relief from the burden of national defence, but it is pointed out that, whereas she has at home no less than 36,000 local authorities to administer conscription, in Africa with seven or eight

times as large an area, and far worse communications, she has but 150 Military stations with which to carry conscription into effect. Remarks on the attitude of France and England towards the Bolshevists follow, with their usual mixture of satisfaction at the defeat of the *protégés* of the *Entente* and anxiety at the success of the Reds. In discussing the question of the trial of the War Criminals it is declared that those whose names are included in the list will, far from being pilloried, be honoured as having carried out their true duty to the Fatherland, an attitude of mind that scarcely pre-shadows fair trial at German hands. The true cause of Germany's present position is given as follows:—"After unparalleled victories she threw down her arms, with blind and senseless trust in the brotherhood of nations; now her enemies lay the heaviest sacrifices on her, etc., etc." The return of German prisoners is looked forward to with the consciousness that in the immense majority of cases their surrender was inevitable, but in those cases where it was not, the culprits must be prosecuted with the utmost severity.

The financial position of Officers on the active list, who wish to marry.—Hitherto such Officers have been obliged to deposit a sum, varying inversely according to their rank, as guarantee of their ability to support a wife. The *M.W.B.* hopes that this rule will be maintained in the future Army regulations, in order that the position of Officers may be kept up in proper style.

Review of the Press.—Extracts from Lord Fisher's "Records" such as "Moderation in war is madness," "The essence of war is power," etc., are quoted with much gusto, as is also his letter to *The Times* of 22nd December 1919.

No. 83.—General Von Kuhl's book "The German General Staff before and during the war" is very favourably reviewed. The author, who had 22 years' service on the Staff, and, during the war, filled some of the highest appointments, was in pre-war days Chief of the French Section of the German General Staff. A large part of the book deals with the preparations for the war. The author claims that the greater part of the estimates of the enemy's strength was correct. The French Army was not under-estimated in quality or numbers and due consideration was given to her African troops. He maintains that the opinion of the German Staff, that French discipline would not have resisted the disintegrating effects of a long retreat, would, but for the battle of the Marne, have proved to be correct. As regards Russia it was recognised that her Army had made much progress since the Russo-Japanese war and her course of action was correctly estimated. The only error was concerning the Siberian, Turkestan, and Caucasian troops who made themselves felt earlier than was expected. The General Staff had no delusions about England's entering the war and described her Army as "a small but worthy foe," though possibly lacking in skill in manœuvring, as was only to be expected. It was, however, hoped that fears of native risings would prevent her bringing many colonial troops to Europe, and this hope was falsified by events. Though it was expected that England could gradually raise a National Army, what she actually accomplished astonished not only the German Staff,

but England herself. The value of Austro-Hungarian assistance was not over-rated and the probability of Italy joining in against England was considered very small. The second part deals, more briefly, with the General Staff during the war. Here too it was as a rule correct in its appreciation of the situation and it was just bad luck that the points concerning which it was wrong, turned out to be vital.

Roll of Honour.—Field Artillery Regiment No. 22.—48 officers and 285 other ranks killed.

No. 84.—*The situation from the point of view of the Entente in June*, 1918.—This, the Editor says, is published to show how near Germany was to her triumph and how all blame of the German Higher Command is unjustified. It consists of an extract from General Pershing's report.

Regimental Unions.—Notifications regarding these are published gratis. In this number, eleven of them appear.

Roll of Honour.—Infantry Regiment No. 72 (Thuringian) 109 officers and more than 3,150 other ranks killed.

No. 85.—*Memories of January 27th.*—Captain Scheibe bewails this anniversary of the Kaiser's birthday and sadly compares it with previous ones, then bursts into a torrent of abuse of France and particularly England, and finally finds a grain of comfort in the fact that Holland declines to surrender the Kaiser.

The Entente Forces and Germany's Army.—The writer comments on the exaggerated accounts current in France and England concerning Germany's present-day armed strength; and declares that this is so small that a further reduction will expose her to Bolshevism which will assuredly not stop at the Rhine or the English Channel.

No. 86.—*The German deployment and plan of operations in* 1914.—In this article Major Foerster discusses the preparations of the Germans and of the *Entente*. Immediately after the war of 1870 Von Moltke was convinced that Germany's greatest danger would lie in a war against both France and Russia; at the same time the possession of interior lines would indeed give her the opportunity to attack both enemies, but it would rarely be the case that she would be strong enough for this. He accordingly decided, after seeing how quickly France recovered her strength, on the offensive in the west and the defensive in the east. He hoped that within three weeks he would have so beaten the French, that they could be left to the diplomats to deal with. After the agreement with Austria, he gave up this idea and contemplated a defensive policy on a narrow front in the west, while in conjunction with Austria, he defeated Russia. Waldersee, his successor, followed the same policy, but early in the nineties von Schlieffen drew up another plan of campaign. He did not think that a successful defence could be carried out on German soil, against the ever stronger French Army, long enough to allow for the defeat of Russia, especially as this latter was also much stronger and more quickly mobilisable than ever before. He determined therefore on the offensive against France. The Belfort—Verdun line was too strong and allowed insufficient room for the immense armies that would have to be used. He therefore decided on the attack through Luxemburg and Belgium and eventually worked out a far-reaching plan whereby Paris would be invested with 13 corps, while

the French Army would be driven back on Switzerland and the Jura mountains. Meanwhile Russia was to be held with a strategical defensive though a tactical offensive, and, if it came to the worst, the country east of the Vistula given up to her overwhelmingly superior numbers. Schlieffen's successor, the younger Von Moltke, held to the same idea in the main, but could not bring himself to agree to the possibility of a French on-rush in Alsace-Lorraine, which his hardier predecessor contemplated with equanimity. In consequence too great strength was piled on the German left flank, and when it came to the point the right wing was too weak. The difficulty of transferring troops from the left to the right was too great. The envelopment which should have followed by reason of the advance through Belgium and between Toul and Epinal failed on both flanks. Schlieffen's plan was soundly and logically thought out; it failed only in its execution. Hence the battle of the Marne.

The Military Situation in Russia gives the names of some of the most prominent Red Commanders, of whom almost all held high position in the old pre-revolution Russian Army. Among them are such names as Evert and Klembowsky. The Red Armies have reached a strength hitherto unequalled. They are said to be over 2,000,000 strong and well provided with heavy artillery, tanks and every other sort of equipment.

The *M.W.B.* gives many particulars concerning the various organisations working towards settling ex-Officers and men on the land.

Roll of Honour.—Reserve Infantry Regiment No. 111, 94 officers and 2,561 other ranks killed and missing.

L. CHENEVIX-TRENCH, *Maj., R.E.*

REVUE MILITAIRE GÉNÉRALE.

November, 1919.

THE LESSONS OF CHARLEROI AND BRIEY.

In this article "A. A." who describes himself as a general "Vieux jeu," criticizes the strategy of the French General Staff at the opening of the War. Officers of his age, instructed in the principles of Napoleon, recognized that Germany could launch and maintain an attack on the French North and North-East Frontier, and, in reply to the defensive system prepared there, had organized an elaborate system of railways towards the Belgian frontier, with the camp of Malmedy as an advanced guard; also that, to avoid being caught between two fires by the intervention of Russia, it was to her interest to hurl herself against the French Army and dispose of it at the very beginning. Twenty years ago it was considered that the concentration of troops should be made sufficiently far from the frontier to ensure, under the protection of strategic advanced guards, the time and space necessary for manœuvre, the object of which would be to bring, with all forces united, a vigorous offensive against the point selected at the desired moment. A con-

centration based on this principle seemed to be the logical result of the organization and distribution of the troops in time of peace, and more than ever dictated at the present time owing to the introduction of the new factor of mobilization, and the necessity for organizing and training the reservists after joining their units. The new school, challenging the older doctrines, laid down that it was not necessary to watch the game of the adversary, but by attacking him, to impose operations on him instead of submitting to his, a seductive doctrine, but one requiring a sufficiently considerable superiority to preserve intact the flanks of the initial offensives and to assure the lines of communication. The position of Verdun, and the Couronné of Nancy were prepared, in accordance with the older view, as strategic pivots to support the covering troops, and hold out until the retarded offensive could be launched by the striking force which was to be organized well to the rear. But the ideas of the young school were rapidly introduced into all the great general staffs. The result was a strategic deployment all along the frontier and too close to the enemy, violating all the maxims of Napoleon. Security was not assured, there was no liberty of action, no economy of force, and no striking force at hand for the decisive shock after the general engagement. Extended *a priori* in the wrong direction the line could only slowly, and too late, extend to the left, and then only with inferior strength and by leaving a dangerous gap between the 4th and 5th Armies. Consequently the enemy was able to attack a weak point with his best troops, the essential end of all strategy and tactics. This faulty disposition was afterwards abandoned, and during the retreat after the battle of Charleroi strategic advanced guards were formed, then by a judicious return to the Napoleonic doctrine (a general attack along the whole front combined with a flank attack) success was attained on the Marne which had been gravely compromised by pre-war conceptions. Still, by exaggerating the principles of the *defensive-offensive* and by a misunderstanding of the term "liberty of action" the recoil was only effected, and the offensive recaptured, when the troops were 50 kilometres to the South of Paris. The German General Staff, taught by von Moltke to rely on their superiority in material resources, made a similar mistake, attacking concentrically with forces approximately equal in strength everywhere. If they had added more weight to the head of the hammer acting through Belgium, and reduced that of the handle, it is possible that in spite of the heroic resistance of the Belgians the allied left wing might have been crushed and Paris isolated. The attack through Belgium also violated one of the principles of Napoleon which is always to keep an eye on the line of communication. The attack in fact threw us back on our reserves and all our resources, instead of separating us from them. Two lessons are to be learnt, the first is that the general conduct of a war cannot be based only on the pursuit of a preconceived ideal or of an abstract principle, but also, and principally, on the adaptation of this ideal to positive axioms and to the special case, the second is that trench warfare is only a provisional phase to be thrown aside as soon as a war of manœuvre can be adopted.

GERMAN OPINIONS ON THE WAR.—(*Continued from the October number*).

This article (translated by M. Forget from the German by Lt. Genl. Von Freytag Loringhoven) contains nothing of much interest, but as an illustration of the German point of view the remarks on aeroplanes are reproduced. He mentions that during some of the raids by German machines places which were not fortified and were of no military importance had suffered, and although bombardment of such places was in itself reprehensible, still the limits allowed to such matters were elastic. Each new contrivance develops its own ethics, the submarine for instance. In this conflict of nations, embracing economic strife as a consequence, war inclines more and more against the enemy nation as a whole, and the principles hitherto accepted, that war is levied against its armed power alone, must now be relegated to the background.

THE EVOLUTION OF THE INTELLIGENCE SERVICE DURING THE WAR.

In 1914 a war of movement was anticipated, in which events would move so quickly that rapid decision on often inadequate data would be required of military commanders, the intelligence system was organized on this conception. The Intelligence Branch, the 2nd bureau of the General Staff, did not exist in formations below the Corps d'armées; the Divisions had interpreters only. Maps did not exist on a larger scale than 1/80,000. After the establishment of the opposing forces in trenches the first air photographs were obtained, but were far from clear. Their value in showing the exact trace of the trenches was recognized at once; the existing maps no longer sufficed and maps on scales as large even as 1/5000 for special purposes were soon demanded, in the preparation of which photography from the air was most important. The next development was the detail with which operation orders had to be issued, exacting the most precise knowledge of the locality of the attack, and during 1917 Intelligence Branches were constituted in the Divisions, supplemented by Topographical Sections. Gradually specialists in Intelligence work were attached even to Battalions and Artillery units, whose duty it was to see that no modifications of the ground in front escaped observation and record. At the same time the Corps and Army Intelligence Branches were augmented, topographical sections were posted to Corps, with separate units for the Artillery, and similarly each Army Head Quarters branch was added to, with a supplementary unit for the Air Service. By degrees the photographs were so improved that even a machine gun recently placed in a shell hole could be identified, and accurate maps of the enemy's latest dispositions could be constantly issued to all concerned. Listening posts were also organized, and were of great assistance until their object was discovered and the use of telephones in the forward areas was discontinued. Radio-goniometry was improved until it was possible to locate the position of any wireless telegraph station, and sound, flash, and smoke ranging enabled the enemy gun emplacements to be located. An average day's arrangements for the interchange of intelligence throughout the forces is sketched, and the qualifications of a good Intelligence Officer are discussed, with some speculations as to the work still in front of the Intelligence

Branch in keeping touch with, and applying to military purposes, the ever extending discoveries of science.

JOTTINGS.

Germany.—Remarks on the encouragement given to Germany owing to the failure of the American Senate to ratify the treaty of peace, Germany's failure to deliver the coal she agreed to supply, her dealings with the Bolsheviks and anti-Bolsheviks, her non-compliance with the clauses demanding reduction of her armed forces, her interference in Schleswig, Dantzig, and Upper Silesia, her failure to reconstruct the districts of France which she ruined, the sinking of the fleet at Scapa Flow. A long list is published of various engagements which she has failed to meet.

A. R. REYNOLDS.

REVUE MILITAIRE SUISSE.

No. 2.—February, 1920.

THE STRATEGIC POSITION OF SWITZERLAND.

The article on the above subject begun in the number of the *Revue* for January, 1920, is continued in the number under notice. Under the heading, The Campaign of 1916, Colonel Feyler discusses the question whether the strategic position of Switzerland was different in 1916 as compared with its position in the summers of 1914 and 1915. Looked at from the German standpoint, two questions arise: Would it have been more advantageous to the Germans had they, instead of launching their attack against Verdun, utilised the troops so employed for an attack *viâ* Switzerland against a more southern point of the French frontier? Given that the attack on Verdun had been determined upon, would they have gained anything by deciding to use the reserves collected to feed this attack as an army for the invasion of France, *viâ* Switzerland, in the event of the attack against Verdun not meeting with success? It would seem that at one time the French Generalissimo credited the Great General Staff with some such design and plans were worked out at the French Headquarters to counter it. It is stated that the Germans had satisfied themselves that the adoption of neither of these courses would have given them any advantage. Turning to the plans of the Western Allies, the question is asked: Would the Allies have done better to make a thrust *viâ* Switzerland rather than from the Somme? Colonel Feyler considers that on ethical grounds such a scheme was ruled completely out of Court. His final conclusion is that the events of 1916 in the Western Theatre go far to discount the theory that Swiss territory possesses any special strategic value in an European War. The Campaigns of 1917 and 1918 are next discussed. Two new elements affected the situation: the break up of the Russian Front and the position of the Italian Army. The Germans were now in a position to withdraw a part of the troops which had been fighting on the Eastern Front to reinforce their Armies in the Western Theatre; and they now had therefore a freer hand. Colonel Feyler points out that the Germans had

more to gain by utilising their additional troops for effecting a separation of the British and French Armies, and possibly for the purpose of occupying the north coast of France, than for the purposes of an attempt to create a diversion by an advance through Switzerland. The final section treats of the morrow of the Great War; the strategic position of Switzerland in relation to the possible eventualities of the future, four in number, are discussed. The general conclusion that Colonel Feyler comes to on the subject is that the neutrality of Switzerland is of most benefit to that State on its frontiers which is acting on the defensive on the sectors contiguous thereto. This conclusion he tells us involves another: the gallant Colonel is of opinion that the extent to which it is of interest to Europe that some territory, or merely some obstacle, may, under particular circumstances, afford protection to an army is not a matter dependent on that territory or obstacle *per se*, but on the cause for which the army in question is fighting.

Notes and News.

Switzerland.—It is announced that on the 17th and 18th January last, a General Meeting of the Vaudois officers was held at Villars-sur-Ollon. Colonel Vuilleumier, the Chief of Staff of the 1st Division, presided at the meeting and there was a full programme of subjects for discussion. Colonel Sonderegger, Chief of the Swiss General Staff, addressed the meeting, choosing for his subject the modern principles governing the conduct of an action. He pointed out that troops which are not provided with the most up-to-date weapons and equipment cannot be expected successfully to fulfil their rôle in war.

Apparently some mistakes were made in the translation into French of the Report made by General Wille to the Federal Assembly; this incident has given rise to regrettable discord between the German and the French sections of the Swiss Officers. The absence of frankness in their dealings between one another is said to be the cause of the discord existing between these two groups in the Swiss Army.

Colonel Sarasin's article in the January number of the *Revue* has resulted in a public discussion in the daily press, on the question of the organisation of the Swiss Army. Two camps have naturally been formed: in one of them all those who desire a large army have taken shelter, and in the other have gathered together those who would be satisfied if effective instruction were to be given to limited cadres organised on suitable lines.

France.—A special correspondent contributes notes on points of interest relating to the French Army. He states that M. Andre Lefevre, the new War Minister, who is a mining engineer, has effected a reorganisation of the French War Office and the *conseil supérieur de la Guerre*. Marshal Pétain is now the Commander-in-Chief designate of the French Army in the eventuality of a future war, and General Buat has been nominated to occupy the position of Major-General of the General Staff under similar circumstances.

Attention is called to an interesting volume relating to the reorganisation of the French Army published under the title of *La "Nation armée" nouvelle*; the authors of the articles appearing therein are young

officers of the regular army and have adopted the signature *Viri* as a joint *nom de plume*. They are, it is stated, very outspoken in relation to the matters on which they write.

Belgium.—A special correspondent states that M. Masson has resigned the portfolio of the War Ministry on account of ill-health. His successor M. P. E. Janson has taken up his new duties and has, it is stated, created a very favourable impression. He is taking a keen interest in the establishments set up to assist those broken in the war. An enquiry is in progress in relation to the responsibility of those who surrendered Antwerp to the Germans. There seems to be a tendency to place some of the blame for the incident on the shoulders of the then Minister of War, who is alleged to have intermeddled in matters outside his province. It is stated that the demobilisation of the temporary officers has been suspended; it would appear that many of them are claiming permanent commissions in the regular army.

Portugal.—A special correspondent points out that a difficult problem has arisen in connection with the demobilisation of the Portuguese Militia. Many of those who joined up for the war are not particularly anxious to resume their pre-war occupations; on the other hand, the State is not in a position to retain permanently the services of all the officers and men called up. It is not a matter of want of gratitude, but that of a want of funds to meet the charges which would fall on the State Treasury were the wishes of all and sundry met that is responsible for the difficulties which have arisen. The Minister of War has drawn up regulations with a view to mitigating hardship; concessions are to be made to those who accompanied expeditionary forces sent out of the homeland, and particularly to those who distinguished themselves on active service.

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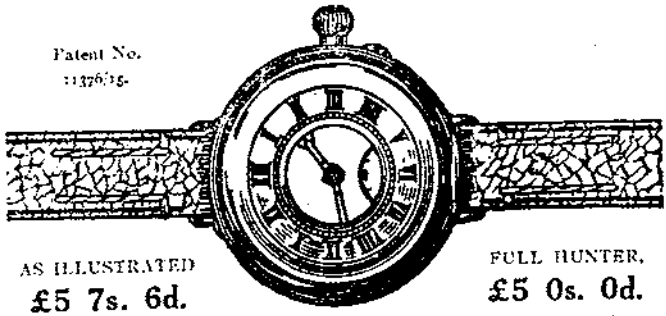

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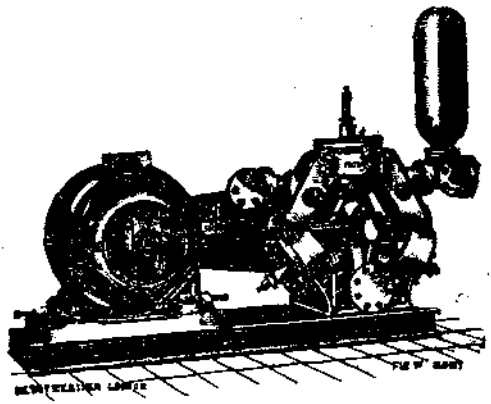

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