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THE ROYAL ENGINEERS JOURNAL.

Vol. XXXII. No. 6. DECEMBER, 1920.

CONTENTS.

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Similarly $$d \cdot GH = \frac{CG \cdot CH}{CD \cdot CB} \times \frac{K}{GH}.$$

$\therefore$ Principle of virtual work gives

$$\frac{P}{EF} \cdot \frac{AE \cdot AF}{AD \cdot AB} + \frac{Q}{GH} \cdot \frac{CG \cdot CH}{CD \cdot CB} = 0.$$

Q is opposite in sign to P and if E, F, G, H, are the centres of the rods, $P + Q = 0$.

PROBLEM 17 (Solution).

Find the equation of the directrix of the parabola $x = at^2 + 2bt$, $y = At^2 + 2Bt$ where a b A B are constants.

The equations to the tangents at t_1 and t_2 are

$y - At_1^2 - 2Bt_1 = \frac{At_1 + B}{at_1 + b}(x - at_1^2 - 2bt_1)$ and a similar expression in t_2

which reduce to

$$y(at_1 + b) - x(At_1 + B) + t_1^2(Ab - aB) = 0 \quad \ldots\ldots\ldots\ldots (1).$$

and $$y(at_2 + b) - x(At_2 + B) + t_2^2(Ab - aB) = 0 \quad \ldots\ldots\ldots\ldots (2).$$

Now the directrix is the locus of intersection of perpendicular tangents.

The condition that 1 and 2 are perpendicular is

$$t_1 t_2 (A^2 + a^2) + (t_1 + t_2)(AB + ab) + B^2 + b^2 = 0 \quad \ldots\ldots\ldots\ldots (3).$$

The eliminant of 1, 2, 3 is the directrix.

Now for any given values of x. y, $t_1 t_2$ are the roots of

$$t^2(Ab - aB) - t(Ax - ay) + by - xB = 0,$$

from which $t_1 + t_2$ and $t_1 t_2$ can be found.

Hence the equation of the directrix is

$$(A^2 + a^2)(by - xB) + (AB + ab)(Ax - ay) + (B^2 + b^2)(Ab - aB) = 0.$$

PROBLEM 19.

Show that the nine point circles of the triangles formed from any 4 points by taking them 3 at a time meet in a point.

PROBLEM 20.

If the straight line $lx + my + n = 0$, meet the conic

$$ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$$

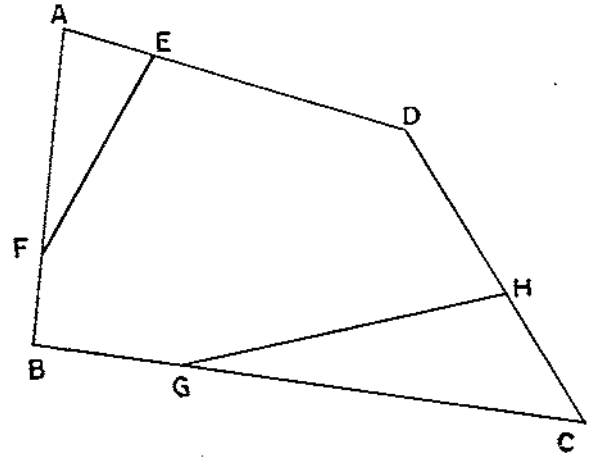
in the points P and Q, find the equation of the pair of lines HP, HQ, the co-ords of H being $x^1 y^1$.

J. M. WADE, *Lt.-Col.*

PROBLEMS.

PROBLEM 16 (Solution).

Four rods are freely jointed at ABCD, and lie on a smooth horizontal plane. EFGH are the centres of the rods, and the points EF and GH are joined by bars smoothly jointed at EFGH. If the system is in equilibrium and if the tension in EF be P, find the stress in GH.



To make the solution more general I have supposed EFGH to be any points.

Suppose EF and GH to be shortened by small quantities of the 1st order d. EF and d. GH.

Then by the principle of virtual work

$$P \,.\, d \,.\, EF + Q \,.\, d \,.\, GH = 0 \qquad Q = \text{stress in GH.}$$

AB, AD, BC, DC become very slightly bent, but their alteration in length is by a well known principle of geometry a small quantity of the 3rd order.

Hence the lengths of AB, AD, etc., may be considered as constant.

$$\cos A = \frac{AE^2 + AF^2 - EF^2}{2 \,.\, AE \,.\, AF} = \frac{AD^2 + AB^2 - BD^2}{2AD \,.\, AB}$$

$$\therefore \qquad \sin A \,.\, d \,.\, A = \frac{EF \,.\, d \,.\, EF}{AE \,.\, AF} = \frac{BD \,.\, d \,.\, BD}{AD \,.\, AB} = \frac{K}{AD \,.\, AB}$$

where $K = BD \,.\, d \,.\, BD$.

$$\therefore \qquad d \,.\, EF = \frac{AE \,.\, AF}{AD \,.\, AB} \times \frac{K}{EF} \,.$$

have been strengthened. The appreciation of the general situation on the part of the German G.H.Q. was as faulty as that in relation to the local situation on the right wing by von Kluck. The German High Command persuaded itself that its most dangerous foe had been beaten, and that the annihilation of the Entente Armies on the Western Front was but a matter of time; one, moreover, requiring but relatively weak forces. Hence the decision to reinforce the German Eastern Front by withdrawing forces from the Western Front: the Tannenberg Victory, it follows, cost the German nation very dear. The visit of Colonel Hentsch, the *liaison* officer sent from the German G.H.Q., to von Kluck's headquarters is dealt with at some length. It is suggested that Hentsch formed a wrong impression from what he had learned whilst at von Bulow's headquarters. Attention is directed to the remarkable circumstance that, on visiting the headquarters of the German I. Army, Hentsch only saw General von Kuhl, von Kluck's Chief of Staff, in spite of the fact that the commander of the I. Army was close at hand at the time; von Kluck does not even seem to have been informed of Hentsch's visit until after the latter's departure. The interview between von Kuhl and Hentsch acquires importance from the fact that accounts of what passed at this interview, as now given by the two officers, differ in material points. The question is whether Hentsch issued orders, on behalf of the German G.H.Q., for the retreat of the I. Army, or whether he merely confirmed, on behalf of G.H.Q., the measures already adopted at I. Army headquarters. It is on record that, after Hentsch's departure, von Kluck learned from his Chief of Staff of the visit of the G.H.Q. *liaison* officer, and thereupon issued an order to the troops under his command. In the circumstances, the terms of this order are, from a historical point of view, exceedingly important. In this order it is stated that the position in which the II. Army was then placed necessitated a retreat. Von Kluck next proceeds, "*by order of the High Command* the I. Army will retire in the general direction of Soissons in order to cover the right of German line, etc., etc., etc." Hence, it seems unlikely that the decision to retire originated with him. Whatever blame attaches to von Bulow, the conclusions appear to be, that the responsibility for the steps taken during the fateful days of September, 1914, must be shared by the German G.H.Q., which was further guilty of a most serious error in judgment in establishing itself so far back from the battle front as Luxemburg, where it was completely out of touch with the events in progress and therefore could not intervene in time, had it the capacity to do so, either to remedy the faulty handling of the troops by the Army Commanders, or to take advantage of the developments in progress for the purpose of recasting the strategic plan to meet the changing conditions.

REORGANIZATION OF THE INFANTRY.

The article on the above subject by Major Schmidt begun in the *Revue* for May, 1920, is continued in the number under notice. The question of the organization of the battalion is dealt with; the battalion organization is considered entirely from the point of view of battle requirements.

W. A. J. O'MEARA.

for Christian and Moslem alike; 3rd, the existing financial laws should be applied impartially, the imposition of taxes must be regulated, and their systematic collection arranged for; 4th, the police force of the towns requires complete reorganization; and 5th, the administration of the Customs, Public Works and Agriculture must be rescued from their present state of neglect. Under Turkish misrule the development of Syria made no great strides, while in Roman times the country was the granary of the Empire. Still the trade was considerable until interrupted by the war, and it is incumbent on France to hasten the ratification of peace with Turkey. Then to develop the country economically the following must be put in hand at once: (1) a system of roads and railways to complete those existing and make Syria the channel for the commerce of Central Asia through Persia to the Mediterranean; (2) agriculture and re-afforestation; (3) modern institutions for the encouragement of trade must be introduced, such as commercial schools, chambers of commerce, etc., and coastal navigation must be developed; (4) an official recognized monetary system must be established. The Ottoman Bank could help in this pending the finding of a definite solution of the difficulty. Above all the good offices must be secured of competent administators who understand the East and especially the Turkish Empire.

A. R. Reynolds.

REVUE MILITAIRE SUISSE.

No. 8. *August*, 1920.

From Charleroi to the Marne.

The article by Colonel Poudret on the above subject begun in the July number of the *Revue* is concluded in the number under notice. The enquiry as to who it was that should primarily be held responsible for the orders for retreat from the Marne given to the German Armies in September, 1914, is pursued. It is pointed out that the situation of the German *right wing* was certainly most unfavourable at the time; but elsewhere on the German battle front the situation was no better. Von Kluck may reasonably be held responsible for the condition of affairs that existed on the extreme right of the German line, but for the general situation the blame lies on other shoulders. Von Kluck's appreciation of the local situation, it is pointed out, appears to have been faulty in many particulars, and he seems to have acted too impetuously and to too great an extent on his own responsibility. The German army system in which every effort was made to develop initiative in the higher leaders was thus bearing fruit of a kind little expected of it. Admitting that von Kluck's handling of his command was not as skilful as it might have been, nevertheless, Colonel Poudret thinks, the situation was aggravated by the measures adopted by the German G.H.Q. It was essential to success that the German right wing should possess a superiority in numbers, in order that it might remain the deciding factor on the Western Front. In the original article, it is shown that von Kluck had just cause for complaint against his G.H.Q.; for the German right wing was weakened just at the time that it should

THE SYRIAN QUESTION.

An article by Major Sarron written to place concisely before the French public the military and political questions involved by the conquest of Syria. It relates the main military operations, the political state of the country before, during and after the war, and sketches the administrative work to be carried out under the French mandate. The article, though written from the French point of view, is interesting and instructive, bearing as it does on British interests in the country. After describing the state of the country at the time when General Gourand was dispatched to Syria, Major Sarron writes :—It is therefore an urgent matter to remedy this critical situation, or Bolshevism, already rampant in the Caucasus, may obtain a hold in Syria. From experience gained during 15 years' residence in the East the following programme is suggested : 1st, to occupy the whole country over which the French mandate is to be exercised ; 2nd, to proceed immediately with the administrative organization ; and 3rd, to restore and develop the economic position. The zone to occupy is that recognized by the 1916 agreement from Mosul to the Mediterranean, and from the Taurus to Hauran inclusive, together with the districts of Aleppo and Damascus. To allow the Sherif to administer Eastern Syria is to tolerate anarchy and open the whole country to Bolshevism, including the coastal region occupied by the French troops, and even the neighbouring British possessions of Egypt and India. For divers reasons the inhabitants, Christian and Moslem, wish France to occupy the whole country, and the English colonial agents should have the same desire if they have any conception of their real interests. The occupation would not demand more troops than are now in the country, for the inhabitants are friendly to France. The administrative reorganization presents no difficulty. It would suffice to perfect the Ottoman administration, the laws and regulations of which were derived from French sources, and are adapted to the needs of the country. The retreating Turks removed the greater part of their own functionaries, and the gendarmerie is particularly disorganized but enough Syrian officials, both Christian and Moslem, still remain to carry on the various services, if competent supervision is arranged for. A native administration is necessary, and is desired by the people ; the control of it should be entrusted to French officials who know the country. The boundaries of some of the administrative sub-divisions, somewhat arbitrarily traced by the Turks, require modification. Over the sub-divisions a general council should be instituted, presided over by the Governor-General or High Commissioner, whichever is appointed by the French government. This council could be composed of one or more delegates from each province, and of a ministerial representative. The ministries necessary would be Home Affairs, Justice, Finance, Public Works, Trades, Police, etc., and ministers should be Frenchmen of acknowledged repute. A mixed council of this nature would result in the greatest benefit not only to Syria but to France, and would meet the aspirations of the Syrians. The following services in order of urgency require attention : 1st, the gendarmerie should be remodelled on the lines introduced by France before the war ; 2nd, the Justiciary demands certain modifications to establish absolute equality

REVUE MILITAIRE GÉNÉRALE.

May, 1920.

Variations in the German Plan of Campaign between 1871 *and* 1914.—A study by Lt.Col. de Thomasson of a book called "Der Generalstab," by General von Kuhl, for 22 years attached to the General Staff in Berlin, and Chief Staff Officer to Kluck's Army in 1914, and of a criticism of it by Count Max Montgelas, published in the *Berliner Tageblatt*. Kuhl affirms that after the war of 1870, and before the Congress of Berlin, Moltke was studying a war against France and Russia combined. Moltke first advised an offensive against France and a defensive against Russia, but on the reorganization of the French Army and commencement of the system of fortifications of General Séré de Rivière, he saw that a rapid decision on the west front was *no longer* possible. In 1879, as soon as the Austro-German alliance was concluded, he induced the Emperor to adopt an offensive against Russia, and a defensive against France. Waldersee, who worked with Moltke from 1882 and succeeded him in 1888, agreed with this policy with certain reservations. Schlieffen, Chief of the General Staff from 1891, at first followed his predecessors' steps, but as armies increased in size and required larger areas in which to manœuvre, it became evident that Moltke's plan must be revised. Schlieffen also partook of Waldersee's doubts in regard to Poland, and resolved to return to Moltke's first plan, but in fear of the French fortified front in Lorraine saw no other solution than the invasion of France through Belgium. As years went on Schlieffen entirely renounced any idea of a frontal attack, and strengthened more and more the German right, and, after the Russo-Japanese War had removed the menace to his rear, detailed for the western front almost the whole of his first-line troops, and even reduced to a minimum the containing force left in Alsace-Lorraine. In 1906 Schlieffen was replaced by "le petit Moltke," a mere figure-head, and the General Staff, considering that to abandon almost the whole of Alsace-Lorraine to the French would have a bad effect, doubled the small field army in that area, and in view of Russia's recovery after the Russo-Japanese war sent 4 more *corps d'armées* to the eastern front, leaving only 27 instead of 35 for the great outflanking movement through Belgium and the north of France. Kuhl considers that it would have been better to mass on the right wing all the troops possible, and his remarks are sound. It is odd, however, that no German writer has brought out the fundamental inferiority of Schlieffen's plan, and of his plan as modified by the little Moltke to that of the great Moltke. The latter made the right his pivot, and the left his enveloping flank, to drive the French armies back on Belgium, whereas the former could only drive them back into France where they might hold out indefinitely if beaten in the first battle. Montgelas, wise after the event, has a great deal of advice to offer, but allows that he has mainly followed Schlieffen's plan, and that the dispositions he proposes might not have proved a striking success. At any rate his ideas are of interest, but hardly bear critical examination. The great lesson which emerges from the study of all these German plans is the immense value of our fortified front in Lorraine.

Still less do the results of his observations tally with von Bulow's times for the 3rd English (left flank) corps Towards 4 or 5 o'clock he saw English skirmishers feeling their way cautiously towards the section of the Marne held by his right-hand neighbour To his surprise they were only received with a little rifle fire, obviously from a patrol left behind, and even that soon ceased. As he afterwards learned, everybody on his right had already been ordered back on to the heights of the northern bank. The English crossed the Marne by the lock in single file and deployed from the lock house in the direction of the heights north-east of La Ferté. The English, therefore, were not across the Marne with the main body of the 3rd Corps at 10 a.m. on the 9th, but not till between 4 and 5 p.m. In order to prevent his platoon being captured, he withdrew now to the plateau to the north and saw, the time being about 6 p.m., the leading English firing line about a kilometer to the south-west. Subsequently he reached his battalion and marched with it *viâ* Coulombs to Gandelu which he reached on the 10th. Here his own and the 4th Jägers had a very unequal fight with a parallel-marching English column in the course of which both the Jäger battalions were practically wiped out. He remarks how much more to the point it would have been to have expended these fine battalions in the higher task of defending the Marne crossings, rather than to have them destroyed as they were, almost uselessly, while in retreat. He sums up as follows :—

(i).—The two left English corps did not reach the points indicated in the maps accompanying von Bulow's account, at 10 a.m. on the 9th, but not till six to nine hours later. How far the right corps had reached by that time he did not see for himself, but, as von Bulow says it was echelonned in rear of the others, it must have been still later.

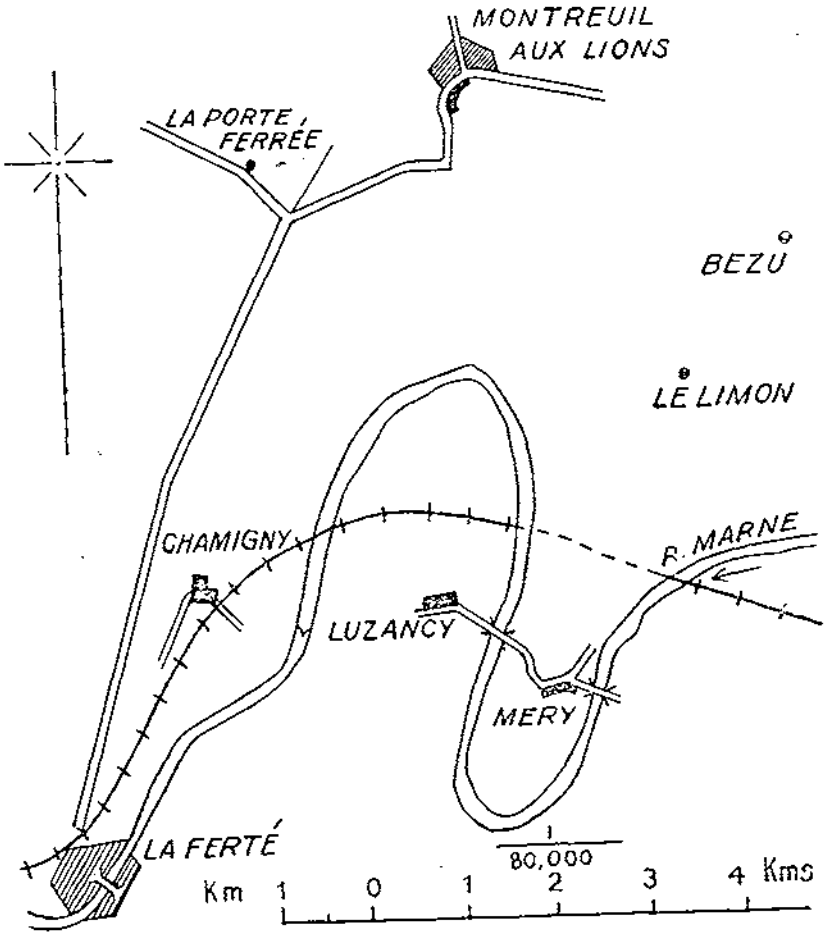
(ii).—In his opinion such war-tried crack battalions as the Jäger were admirably suited for such a task as the defence of the Marne, and could have put up a much longer stand there, particularly considering the lack of offensive spirit and sluggishness of the enemy. He and other front-line fighters will never be able to understand why after six weeks of the greatest exertions in fighting and marching they were not asked on this occasion to give their utmost until all their successes had already been sacrificed.

NOTE :—As regards (i.) above, the author appears to have drawn wider conclusions than his comparatively restricted opportunites for observation justify. We know from other accounts that von Kraewel's brigade was heavily engaged by 9 a.m. on the 9th at Montreuil-aux-Lions, having been under artillery fire for over an hour before that. It is noticeable that the author makes no mention of this fighting, but sound travels very curiously in that country, and he very likely never heard a shot.

The first meeting of the Army Advisory Council did not, it appears, pass off very smoothly and the extreme left Press did not fail to utilise the chance for an attack on the army chiefs. The *M.W.B.* recapitulates the objects of this Council, the chief of which is to establish confidence, and to convince the army that its interests are best represented by superiors. The Council is a concession to the now almost universal principle ot class representation, and it is hoped that this new institution will develop in a way that will work no harm to the internal strength of the troops.

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

had seen nothing more than a few artillery observers at several kilometres distance. However, the night was absolutely undisturbed and the morning of the 9th was equally quiet, except for heavier artillery fire towards La Ferté, and so far as he could see not even a cavalry or infantry patrol approached the opposite bank. He therefore went for a tour round beyond his patrols, as far as the tunnel south of Courcelles, meeting on the way a patrol of the 2nd Dragoons, who told him an English battery was near Bucancy (? Luzancy). On returning to his platoon his attention was directed to an English battery immediately



above the tunnel, which was trying to conceal itself with straw. It was then past mid-day. The next thing he saw was a column of six English batteries followed by at least 12 companies in column of route marching north on the road from Mery to Bezu, near Limon, already north of the Marne; as the artillery could scarcely be leading he concluded that at least one regiment of infantry must already have passed unnoticed by him. According to von Bulow's book this must have been the left column of the middle English corps. He concludes that the main body of this corps cannot have been as far north as the Marne, as von Bulow states, by 10 a.m. on the 9th, but not till early in the afternoon.

condemn any move in this direction on the part of the Germans, is not at all unwilling to receive word of such from the side of the Entente.

Salaries of Brain-workers.—Out of 233 non-established professors, only 13 have a total income of more than 10,000 marks and out of 487 established ones, 232 fall below this level (between £40 and £50 per annum at present exchange).

Tannenberg Festival.—Some 30,000 people assembled in Berlin to commemorate the anniversary of Tannenberg. *M.W.B.* much pleased with the enthusiasm aroused.

No. 11.—*Observations from the 2nd (? 1st) Army Front during the Battle of the Marne*, 1914.—A subaltern of the reserve who served in the 9th Jäger Battalion in 1914 gives his experiences. He begins by stating that the numerous articles that have recently appeared dealing with the problem of the Marne leave little room for doubt that it was over-estimation of the danger caused by the penetration of the English into the gap between the First and Second Armies that brought about the decision to retreat. He hopes that some one on the staff of the Cavalry Corps whose duty it was to fill this gap, and under whom the other troops allotted for this purpose (Kraewel Brigade, 5th Division, etc.) were placed, will publish an account from their point of view. From his position in the front line with his battalion he declares that the drive of the English, at any rate on the 9th September, was not powerful enough to arouse any fears of a break-through, and in support of this contention he recounts as follows :—On the 5th September the 4th Jäger battalions of the Cavalry Corps reached Coulommiers and on the 6th had their first day of rest since 4th August, while their cyclist companies pushed on to near Maupertius and maintained touch with the English. On the 7th came the order to retreat, and early on the morning of the 8th they reached the high ground near Jouarre, where they bivouacked. Thus far they had been unmolested, but now there were a few skirmishes between rear and vanguards south of Jouarre. About noon they marched down the valley towards La Ferté and filed over the Marne and up the hills on the opposite side. The long columns of vehicles trailing over the single bridge could, he thinks, have been very roughly handled had the English been pressing hard on their rear, but, as it was, only a few shrapnel bursting high and harmless over the town gave any sign of their approach. The author was now ordered to take his platoon and hold the big railway bridge over the Marne near Chamigny " to the last man." This phrase was under the circumstances, quite incomprehensible to him, since the hestiating manner in which they were being followed led him to believe that the rearward move was merely a manœuvre to lead the enemy into a trap. So little seriously was the situation taken that on arrival at the bridge he allowed his men to bathe, half at a time, their first bath for 6 weeks, while overhead the artillery exchanged a few shots. The afternoon went quietly on ; towards evening the gun-fire in the direction of La Ferté increased somewhat and presently a heavy detonation signalled the demolition of the bridge there. Late in the evening the company commander on his right (4th Jäger) asked him to support him with connecting patrols along the bank because several English divisions were opposite and would probably try to force a crossing during the night. The author

the 20th Division facing Allemant early in the morning of the 9th September. At noon he observed the German infantry had reached the French position at Allemant and the enemy's artillery was obviously withdrawing. German infantry could be seen in column of route on the south bank of the Petit Morin, everywhere the French were retreating in haste, and the victory of the left wing of the 2nd Army and the right of the 3rd seemed complete. He had been fighting since the 5th September and felt the then well-known satisfaction of hard won success. Then came the order, "At 4 o'clock the retreat will begin." They thought at first it was a joke and laughed at the orderly officer; sent the Adjutant to Divisional H.Q. to point out how well everything was going and to see if the order was correct. He came back with a glum face, having received the answer "Its just as well things are going well here, otherwise the right wing of the army could never get out of it. There things are very bad." Later he learnt that the Division had already remonstrated, without success, at Corps H.Q. He knew that the 10th Reserve Corps had had hard fighting, but has since been confidently assured by troops of this corps that they were well able to hang on. Had they been allowed to do so, and even if they had been pushed back to some extent, the advance of the left wing would have placed the 5th French Army and the English in a very critical position. However, he saw the long German columns halt and pile arms; after a time they set off again, but this time in the opposite direction, their lines of skirmishers forming a rear guard. No enemy followed them. French artillery fired for hours on to ground long evacuated by the Germans. One battery of 10th Artillery Regiment left its guns in position, the detachments joining the infantry and thinking it impossible to limber up in broad daylight. In the evening, when all the infantry had gone, the Adjutant took back the teams and brought away the guns absolutely unmolested by the enemy. The Saxons left behind them over 30 captured French guns. It was a victory if ever there was one. Dieterich declares that even if the 2nd Army had been beaten there was no need for the retreat of all the German armies, and that as a matter of fact the victory of the left was complete enough to outweigh any reverse on the right. The men could not understand why they had to retire and all thought it only for a time. It was not till the 11th that the French came cautiously into touch with them on the Marne near Epernay; on the evening of the same day the author followed the 12th Corps, in pouring rain, through the forest of Rheims. No one imagined what tragic consequences the Miracle of the Marne was to have.

Recruiting for the Russian Army.—In view of the many statements that the Bolshevists are receiving help in one way or another from Germany, the following note by the *M.W.B.*, which has always derided such statements, is interesting: "Attempts are said to be being made by the Russians to enlist members of the German Army under apparently favourable conditions. Particulars are lacking, but it is hardly necessary to point out to any servant of the German State that in the interests both of it and of themselves the most emphatic warning must be given against such recruiting."

Reconciliation.—It is noticeable that the *M.W.B.*, though quick to

Dangers of Unions in the Army.—The *M.W.B.*, which has hitherto been the great supporter and unofficial registrar of regimental unions and various similar associations, now publishes a warning as to the "Dangers of Unions in the Army." After pointing out where these lie, it adds that in the new army every soldier must feel that he can rely on the Government and the Reichstag to look after his true interests. The formation of protective leagues, guilds, and economic organizations in connection with the army must be forbidden. Article 177 of the Treaty definitely prohibits any such associations in connection with military matters, and para. 32 of the Reichswehr law has been drawn up to carry this article into effect. Members of the Reichswehr still retain, however, the right to associate for non-political objects.

Shortage of Houses.—The use of vacated barracks is discussed, but as 40% of Germany's pre-war barracks lie in territory now no longer at her disposal and as the remaining 60% has to accommodate the much-married long-service Reichswehr man and has to fulfil many other uses that have arisen since the war, it is feared that very little relief can be expected from this source.

No. 9.—*Racial Impulse.*—Dr. Erich Ritter asks how it came about that Germany, the superior of her enemies physically, spiritually, and morally, came to be beaten. He finds the answer in a book recently published by an officer, who attributes all Germany's misfortunes to lack of "Racial Impulse." It appears that this is a quality which every race except the Teutonic possesses. The French-Swiss, Danish-Sleswiger and French-Alsatian sided vigorously with the Entente, but the Dutch, who are of Low-German origin, and the German-Swiss showed no inclination to emerge from their artificial frontiers. As for Germans in other lands, except for a few leading personalities, they fitted their politics to their frontiers. Among German working classes race feeling is entirely lacking, and they gladly side with their own classes in enemy countries against those of their own race who happen to be of the possessing or governing classes. There can be no hope for Germans till they cultivate a healthy selfishness and learn to regard every fellow countryman as a friend and every alien as a potential enemy.

Scandinavia and the General Situation.—This article points out the awkward position in which Scandinavia is placed. On the one hand the Entente demands assistance towards the blockade of Russia, and on the other imperialistic Soviet-Russia, headed off from the Black Sea outlet for her exports by the Entente, threatens to overwhelm her, *viâ* Finland, all the more willingly by reason of the hatred by which the blockade policy arouses. The article, which is from a Swedish source, is welcomed by the *M.W.B.* as showing, firstly, how correctly this journal has always estimated the Bolshevist danger, and, secondly, what a snare and delusion the League of Nations is to those who adhere to it.

No. 10.—*Sedan.*—The 50th anniversary of Sedan calls forth from Lt.-Gen. von Altrock the wish that the rebuilding of German power may one day give rise to a new Sedan which will make Germany free and strong.

The Miracle of the Marne, 1914.—Lt.-Col. Dieterich, who commanded an artillery brigade in the 2nd Army, contributes an account of his personal experiences. His guns took up a position behind the right of

NOTICES OF MAGAZINES.

MILITÄR WOCHENBLATT.

No. 8.—"*Politics and War—the past and the future.*"—Lt.-Gen. von Altrock quotes Clausewitz's saying, "War is merely pursuit of policy by other means," and says that whereas Germany always understood these "other means" to imply the destruction of the enemy's armed forces, England went and goes much further; she aims at the destruction of Germany. It was through England that the hunger blockade was instituted and the war turned into a process of attrition of men and material. German policy was half-hearted and her strategy spasmodic. Her enemies, however, followed the example of ancient Rome and, finding themselves in danger, placed themselves unreservedly under the command of dictators; Clemenceau in France, Lloyd George in England, and Wilson in America. Results show they did right, but it is questionable whether in the Germany of the future, the land of full political individuality, where everyone from the Chancellor to the ploughboy thinks he knows far better than the man on the spot, will ever produce or put up with such a dictatorship. The day of reckoning is far distant; there can be no real hope of any essential amendment of the treaty and now and always the hunger blockade can be used as a whip to bring Germany into line. Nevertheless an industrious people cannot always be held down. Let Germany but organize and inspire those inexhaustible resources that lie in Eastern Europe, and within the next 50 years she will be able to stand free from England's bonds. Let her make away with Internationalism and Universal Brotherhood and adopt the true socialism which makes Germans hold together and gladly give all for the State. Then will the millions of Germans be able to pass from universal misery to the day of reckoning which will enable them to say once more "Lieb Vaterland, magst ruhig sein!"

Orders for the Reduction of the Army.—As already notified the Reichswehr will, after 31st December, 1920, consist of seven divisions, corresponding to seven districts, and three cavalry divisions. The divisions will be constituted on lines very similar to those evolved in the war, but without heavy artillery. Each infantry and artillery regiment will have a depôt battalion or battery included in the division. Up to 31st December, 1920, an additional 50,000 men have been authorized. These, who at present are distributed partly among divisions and partly in three extra brigades, are being disbanded and on 31st December, 1920, a considerable re-arrangement will come into force in order to get troops into their correct districts; Berlin in particular will lose a large number of men.

The Break-down of Russian Railways.—It is estimated that whereas in April, 1919, the Bolshevists had 17 serviceable locomotives per 100 versts, in April, 1920, they had only 9. This is largely accounted for by the collapse of Denikin, after which many versts of railway but few engines came under their control.

THE GOLD MEDAL FOR THE CAPTURE OF FORT DETROIT AWARDED TO CAPT. M. C. DIXON, R.E.

The Riband of the Medal is red centre ($1\frac{5}{8}$") with blue edges ($\frac{1}{4}$"), similar to that issued with the Waterloo Medal.

GOLD MEDAL

APPENDIX B.

ENGINEER OFFICERS AWARDED GOLD CROSSES OR MEDALS, 1806–1814.

Name, and Rank in Campaign.	*Battles and Sieges earning the Awards.*
ROYAL ENGINEERS.	
*Lt.-Colonel Sir Richard Fletcher, Bt. (6 awards)	Talavera, Busaco, Ciudad Rodrigo, Badajoz, Vittoria, San Sebastian.
Lt.-Colonel John Fox Burgoyne (5 awards)	Badajoz, Salamanca, Vittoria, San Sebastian, Nive.
Lt.-Colonel Henry Goldfinch (4 awards)	Vittoria, Nive, Orthes, Toulouse.
Lt.-Colonel Howard Elphinstone (3 awards)	Rolcia, Nivelle, Nive.
Brig.-General Sir Chas. Shipley, Kt. (2 awards, *Large* Gold Medal and Clasp)	Martinique, Guadeloupe.
Major Chas. Felix Smith (2 awards)	Vittoria, San Sebastian.
Lt.-Colonel Steph. Remnant Chapman (1 award)	Busaco.
Lt.-Colonel Jno. Thos. Jones (1 award	Badajoz.
Major Chas. Grene Ellicombe (1 award)	San Sebastian.
Major Jno. Squire (1 award)	Badajoz.
Capt. Geo. Landmann (1 award)	Vimiera.
Capt. Matt. Chas. Dixon (1 award)	Detroit.
Capt. Geo. H. Henderson (1 award)	San Sebastian.
MADRAS ENGINEERS.	
Lt.-Colonel Colin Mackenzie (1 award)	Java.
INFANTRY, ATTACHED TO R.E.	
Major Alex. Thompson, Assistant Engineer	San Sebastian.

* Lt.-Col. Sir R. Fletcher was killed at the Siege of San Sebastian.

giving the detail of the gold medals awarded for Detroit; and Appendix B giving a complete list of all engineer officers who received gold medals during the period 1806–1814. The first gold medal awarded to the army was that for Maida in 1806; and successive gold medals were authorized for the principal battles and sieges until 1814. On the enlargement of the Order of the Bath, into three classes, in January, 1815, the issue of gold medals ceased, as it was considered that the services of subordinate general officers, commanding officers, and senior staff officers could be rewarded adequately by the C.B. or K.C.B.

On 7th October, 1813 it was laid down that, owing to the increased number of medals, one medal only should be borne by each officer, and that successive battles and sieges should be commemorated by gold clasps. On an officer becoming entitled to a fourth mark of distinction, a gold cross was to be substituted, with the names of four battles or sieges inscribed on the four arms; subsequent distinctions being additional gold clasps. (The Duke of Wellington wore the gold cross with nine clasps).

No general or other officer was entitled to an award unless he had been personally and particularly engaged on the occasion, nor was he to be a candidate except upon the special selection and report of the commander of the forces upon the spot for conspicuous services.

Further, the Commander of the Forces was to restrict his choice to General Officers, Commanding Officers of brigades, Commanding Officers of artillery and engineers, Adjutant-General, Q.M. General; the Military Secretary, D.A.G., and D.Q.M.G. being field officers; the A.A.G. and A.Q.M.G. being field officers and being at the head of the staff with a detached corps or distinct division; Commanding Officers of battalions or corps equivalent and officers succeeding to the command during the engagement owing to casualties.

These regulations account for the distinction and the rarity of the Gold Medal.

APPENDIX A.

Officers Awarded the Gold Medal for Detroit.

The Issue was Authorized on 28th January, 1814.

*Major-General Isaac Brock, G.O.C. (Large Gold Medal).
Colonel Matt. Elliott, commanding Battalion of Canadian Militia.
Lt.-Colonel Robt. Nichol, Q.M.G. Militia in Upper Canada.
Lt.-Colonel Thos. Bligh St. George, Inspecting Field Officer.
*Lt.-Colonel Jno. M'Donnell, Military Secretary.
Major Jno. B. Glegg, A.A.G.
Major Peter Latouche Chambers, 41st Foot.
Capt. Matt. Chas. Dixon, R.E.
Capt. Joseph Tallon, 41st Foot.
Lieut. Felix Troughton, R.A.

* Major-General Brock was nominated on 10th October, 1812, K.B. for his services at Detroit, but fell in action on 13th October, 1812, at Queenston with Lt.-Colonel Jno. M'Donnell (Attorney-General of the Province) who acted as his Military Secretary.

over 900 men surrendered after a hot engagement. Captain Dixon's part in these operations is told in the following extracts:—

(*a*) CAPTAIN J. B. GLEGG, A.A.G., TO COLONEL THOS. TALBOT.

YORK, *12th March*, 1812.

" * * * Captain Dixon is gone to Amherstburg to superintend the works at that post and St. Joseph's. In a few weeks we shall commence our grand plan of fortifications for this post, and the marine department will not be idle * * * "

(*b*) H.E. LT.-GENERAL SIR GEO. PREVOST, GOVERNOR-GENERAL, TO MAJOR-GENERAL ISAAC BROCK.

QUEBEC, *July 31st*, 1812.

" * * * The report transmitted by Capt. Dixon of the Royal Engineers to Lt.-Colonel Bruyères (C.R.E.) of the state of defence in which he had placed Fort Amherstburg, together with the description of the troops allotted for its defence, give me a foreboding that the result of General Hull's attempt upon that fort will terminate honourably to our arms. * * * "

(*c*) DISTRICT GENERAL ORDERS, H.Q. FORT AMHERSTBURG.

August.14th, 1812.

" * * * Captains * * * and Captain Dixon, Royal Engineers, are appointed to the rank of Major so long as the local service on which they are employed continues. * * * "

(*d*) DESPATCH OF MAJOR-GENERAL I. BROCK

H.Q. DETROIT, *August 17th*, 1812.

Sir, * * * Batteries had likewise been commenced opposite Fort Detroit for one 18pr., two 12-inch and two 5½-inch mortars, all of which opened on the evening of the 15th (having previously summoned Brigadier-General Hull to surrender) and although opposed by a well-directed fire from seven 24-pr., such was their construction under the able directing of Captain Dixon of the Royal Engineers that no injury was sustained from its effect * * * "

ISAAC BROCK, *Major-General.*

H.E. LT.-GENERAL SIR GEO. PREVOST, BART.

The prize money for Detroit varied from 1 share for a private to 80 shares for a general; each share being £3 currency. Capt. Dixon's further services in the war were at Sandusky, when the British under General Procter made an unsuccessful attack on Fort Stephenson, 2nd August, 1813, on which occasion Dixon was wounded; and in the retreat to Moraviantown, when General Procter with a small force of about 1,000 all told, was defeated by an American force of over 4,000 men. (September-October, 1813). On this occasion Captain Dixon was taken prisoner. A short *résumé* of Dixon's services is as follows:—First commission, 2nd April, 1806; Canada, 1808–1815; West Indies, 1825–1827; Ceylon, 1835–1842; Canada, 1852 until his retirement in 1854, the intervals being home service or unemployment. He attained the rank of Major-General on 20th June, 1854, and died at Southampton on 30th Jan., 1860.

As a matter of interest two lists are appended: Appendix A

THE GOLD MEDAL FOR THE CAPTURE OF FORT DETROIT AWARDED TO CAPT. M. C. DIXON, R.E.

By Col. H. BIDDULPH, C.M.G., D.S.O.

THE R.E. Institute has been fortunate enough to acquire by purchase a relic of the greatest rarity and historical interest, viz.: the Commanding Officer's Gold Medal for the capture of Fort Detroit, awarded to Captain Matthew Charles Dixon, R.E. The war of 1812–1814 is one of interest, as an example of the successful defence of an extended frontier by inferior forces.

On 19th June, 1812, the U.S. declared war on Great Britain, having already put in train its plans for the invasion of Canada. The American force detailed for the attack above Lake Erie was commanded by Brigadier-General W. Hull, who had served in the War of Independence; crossing the Detroit River he established himself on the Canadian side at Sandwich.

Meanwhile Major-General Isaac Brock, President of Upper Canada, had taken active steps with his inadequate forces for the defence of the frontier. Various skirmishes took place, unfavourable to the Americans, and before long a small British force crossed to the American side of the river cutting the American lines of communication. Their attempts to re-open their communications failed, and in consequence the American troops were compelled to re-cross to their own side at Fort Detroit. By this time General Brock, having completed urgent civil duties, hastened to take the field in person. The troops at his disposal consisted of 500 men of H.M. 41st Foot, 400 militia and some 600 Indians, with a few guns. Capt. Dixon, R.E., was his engineer officer and superintended the construction of batteries near Sandwich to bombard Fort Detroit, on which they opened fire on 15th August. During that night and the next morning the British crossed the river and proceeded to the attack, the bombardment being continued meanwhile. When General Brock and his men were within a few hundred yards of the fort, Hull hoisted the white flag and surrendered with all his force, 2,500 in number. His command included the 4th Regiment U.S. Infantry, detachments of the 1st and 3rd Regiments, two troops of cavalry, one company of artillery engineers, four regiments of militia, with 39 cannon, all of which fell into the hands of the British with large quantities of arms, ammunition and stores, and also a brig of 200 tons. The British casualties on this day, 16th August, 1812, were *nil*. For his eminent services General Brock was nominated a Knight of the Bath on 10th October, 1812, but did not live to learn of this recognition, for he fell while leading his men at Queenston, on 13th October, 1812, when the American General, Wadsworth, with

fortifiée" instead of a fortress, the organization of the place was completely upset, to General X's personal knowledge. The permanent garrisons of the forts were abolished—with the result that the Germans walked into Fort Douaumont without opposition, and found only a barrack-warder there. When the plan of the fort was asked for with a view to its recapture it was discovered that the archives had been sent to the interior of France and the plan could not be found. At Fort Rozellier the ammunition for the flanking guns was found to be "drill" with wooden projectiles; the drawbridge could not be raised because the telephone wires of the central exchange ran over it, and the lifting gear was broken. At Fort Vaux the tanks of drinking water were found empty when it was attacked by the Germans, as Commandant Raynal, its defender, has already told us.*

When the Germans attacked Verdun in February, 1916, "the forts did not stop the advance of the enemy because their permanent garrisons had been withdrawn. The troops retiring walked past these works which were in a perfect state and empty; they did not enter them. The Germans, who followed closely, occupied them and stayed in them."

The author does not point out, except as regards Antwerp, that the fortresses detained a considerable number of German troops:—Givet, the 24th Reserve Division which only came up to the front during the battle of the Marne; Namur, the XI Corps and Guard Reserve Division till the 25th August; Maubeuge, first the IX and VII Corps, so that they were absent from the battle of Le Cateau, and afterwards the VII Reserve Corps, etc. Had La Fère, Rheims, and Laon been defended, the German forces at the Marne would have been reduced by the troops, probably some six corps, required for the first investment of those fortresses.

General X does not tell us either how the Fort Camp des Romains in the St. Mihiel salient was lost, though he mentions its capture. It appears from a recently published book,† that as the French Third Army advanced in pursuit northwards after the battle of the Marne, German troops from Metz slipped in behind it, into the salient, and by assault without preliminary bombardment, took the fort, which was held by some troops of a Reserve Division (not a permanent garrison). The loss is a reflection on its defenders, not on its defences.

It is hoped at a later date to draw attention to the main features of the defence of a fortress by the Germans, for an account of the loss of Tsing-tau has just been published by a German admiral who took part in the defence.

* *La Defense de Fort de Vaux.*

† *La Guerre de la délivrance*, Vol. I, by General Cherfils, p. 155 *et seq.*

Epinal, Toul, and Verdun, to the exclusion of the forts of the Hauts de Meuse, and of course those of the northern frontier. Some further experiments with 10-inch (270 mm.) shell against Fort Saint-Antoine seemed to throw doubt on the conclusions drawn from the Malmaison experiments, and in view of the enormous amount of ammunition that it was considered the enemy would have to bring up to effect important results, and the uncertainty of hitting, the Government seized the pretext to reduce the vote for fortification still further. They were supported by the General Staff, "*in whose mind*"—even under General Joffre, an engineer officer—"the questions of fortification appeared to occupy a place more and more secondary." The results achieved by the Japanese at Port Arthur had no influence; the few officers who pointed out the great effects achieved with 28cm. howitzers against shell-proofs designed to resist 21cm. could not obtain a hearing. From another source we know* that at Belfort only a third of the forts had been remodelled when hostilities opened in August, 1914, a third were under reconstruction, and a third still untouched. How far this state of things obtained at the other great fortresses is not known, but it appears that there was but little if any ferro-concrete at Verdun.

General X quotes a number of instances to show the attitude of the higher authorities in France towards fortification. In 1905 in a mobilization scare, hasty measures were taken to provide reserve ammunition for Verdun, as it was found that the credits allotted for it had been diverted to other purposes. In 1907 when the Governor of Maubeuge asked for some howitzers, he was informed by the Inspector-General that the place was "only expected to hold out for a few days from the beginning of mobilization until concentration of the armies was effected." In 1912 Verdun was refused guns carrying 15 kilometres "for the reason that observation at that range was too uncertain." The governors of the fortresses were selected from generals "judged not competent to command divisions in the field." Finally when the Président du Conseil and the Minister of War visited one of the great fortresses in the east of France, the Governor made a great attempt to bring the state of the defences to notice. As the Minister of War was going into lunch he found the way barred by the Governor who said, "M. le Ministre I must speak to you about this fortress. Urgent matters are being held up. They have been a long time under consideration, but I cannot get any decision from the ministry." "Let me pass," said the Minister. "I must go; my afternoon is all planned out." Actually the afternoon was spent in an "excursion touristique."

When the field army took over Verdun and it became a "région

* General Thevenet (Governor of Belfort), *La Place de Belfort*, pp. 3–4.

been up to Liège, supposing there had been no opposition, much before the 6th or 7th. Undoubtedly the defence of Liège gained ten or eleven days. And we may feel certain that General Leman's 30,000 men of the garrison and 3rd Division, could not have opposed General von Emmich's 130,000 men for that length of time in the open field; far less could the Belgian commander have withdrawn the division practically without loss, and inflicted 42,000 casualties on the enemy, had there been no fortifications.

As regards Namur, General X makes still greater claims. He admits it is true that after a bombardment of only two days the place was at the mercy of the attacker; but the Germans were not in a position to open the bombardment with heavy howitzers until the 21st August, although their advance troops appeared before the fortress on the 5th. The last fort capitulated only on the 27th. General X claims that there was a gain of time of 21 days. Here again a small correction must be made; for although the troops of von Bülow's army had not to make a march through a defile like the town of Aix-la-Chapelle, as the German First Army did, yet the heads of the main columns which passed by Namur on the 22nd August could hardly have reached that place, if unopposed, before the 7th or 8th August.

The Antwerp fortifications proved of even greater value than those of the Meuse. Until the end of September they sheltered the Belgian field army, and detained some 150,000 German troops. The author might have added that Antwerp kept employed the III Reserve and IX Reserve Corps, which according to plan* were detailed to march to the coast in August, 1914, "direction Calais." The two sorties made by the Belgians during the Le Cateau and Marne battles were not without important results in keeping at least two German Corps from the decisive front.

The actual siege of Antwerp lasted from the 28th September to the 10th October; the exceptional material required for the bombardment could not be accumulated before the end of September. Thus the total amount of time gained by the Belgian fortifications was two months. The rôle of the great zone of fortifications on the French eastern frontier is too well known to need description here. Built in the seventies from the projects of General Séré de Rivière of the Engineers, they had by 1876 the effect, as we now know, that von Moltke framed his plans to attack France through Belgium. In 1889 experiments carried out by the French at Fort Malmaison, with melinite, indicated that all the casemates and cover must be reconstructed with ferro-concrete. The Government refused to provide all the necessary credits, and such money as was made available was devoted to improving the four great fortresses of Belfort,

* See Von Hausen, *Marnefeldzug*, p. 244.

THE FUTURE OF PERMANENT FORTIFICATION.

By BRIG.-GENERAL J. E. EDMONDS, C.B., C.M.G.

THE first article in the *Revue Militaire Générale* for September is entitled "L'avenir de la fortification permanente"; the author merely signs himself Général X, but its prominent position in a magazine, whose *Comité de patronage* consists of twenty-one of the most famous French generals, headed by Maréchal Joffre, is sufficient voucher for his claim to be heard. Besides, the custom of writing under *noms de plume* is far more common in France than in Britain. General Palat wrote for years under the pseudonym of Pierre Lehautcourt, and recently General Cornulier-Lucinière published a book on the action of the French cavalry under that of J. Héthay.

In any case the article contains a store of useful ammunition for anyone who wishes to advocate the expenditure of national funds on fortification. For France and Belgium, however, the question is one of actuality. The characteristics of nations remain constant through many centuries, and Prussia, we may be sure, will not submit to remain the under dog now, any more than she did after 1806.

The author recalls that when the question of defences on the Meuse, involving considerable sums of money, was raised in Belgium, von Moltke the elder said:—"As regards Germany it is unnecessary that Belgium should make the sacrifice." King Leopold II., however, who knew a great deal about Prussian mentality, persisted in the project, at the risk of compromising his popularity with his subjects. General X considers that "the Belgian fortifications completely fulfilled their mission of serving the general interests of the Allies quite as much as the interests of Belgium."

The story of Liège is well known and the name of the gallant engineer officer who defended the place, General Leman, will for ever live in history. Attacked by *coup de main* on the 5th August, 1914, the last fort surrendered only on the 17th. The Germans, says the author, lost before Liège 42,000 men, and thirteen days. The latter claim is perhaps a little exaggerated. The heads of von Kluck's main columns are shown on his map* as abreast and north of Liège on the 17th; allowing time for the concentration of his army on the frontier and for two marches, they could hardly have

* See *The March on Paris*. Translation published by Edward Arnold, price 10s.

THE GERMANS AND CAMOUFLAGE.

"As regards concealment from aeroplanes (Fliegerdeckung) we had learnt as good as nothing (in peace time). Even in the war we followed haltingly and hesitatingly behind our adversaries. Actually, we only learnt 'camouflage'" (the French word is used in the original) "from the English,* after our losses had made us wise."

GENERALMAJOR G. VON GLEICH
in *Die alte Armee und ihre Verirrungen* (p. 19).

* This bears out the statement that the first German book on camouflage was a translation of the British text book captured in autumn of 1917.

TRANSPORTATION WITH THE B.E.F.

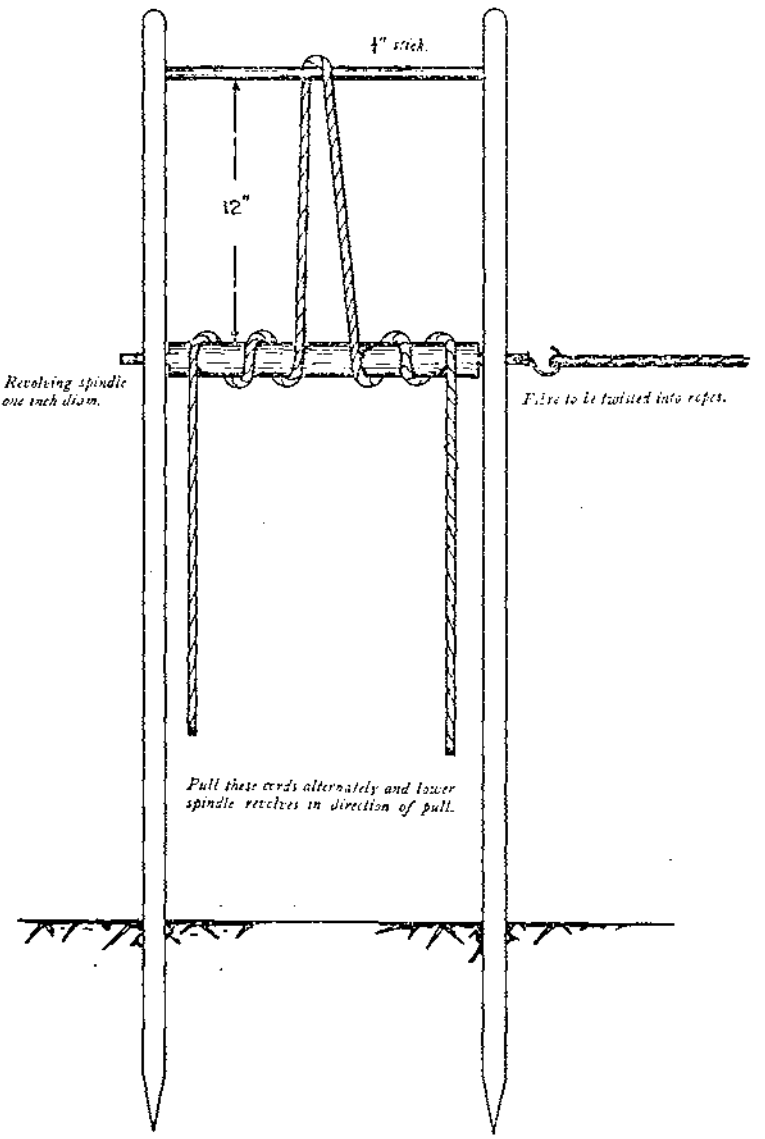
SINCE the publication of Colonel Sir S. D'A. Crookshank's article in the *R.E.J.* for November 1920, a portfolio of ten plates, illustrating the article, has been received from India. This has been deposited with a copy of the lecture in the R.E. Library, Horse Guards, where it may be seen on application to the Librarian.

The following is a list of the plates:—

Plate (I). Cross Channel Train Ferry, Calais Terminus. Elevation showing T.F. Steamer (1, 2 and 3) in berth.
" (II). Cross Channel Train Ferry. Midship Section of T.F. Steamers (1, 2 and 3).
" (III). Graph.—Total Imports and Exports, 1917–18.
" (IV). Graph.—Imports, including traffic carried by C.C. Barges, analysed between traffics.
" (V). Graph.—Loaded Trains run for British Army.
" (VI). Graph.—Loaded Train kiloms. of British Army Traffic compared with that hauled by R.O.D. Locomotives.
" (VII). Map of Railways in British Army Area.
" (VIII). Graph.—Light Railways. Tonnage Conveyed.
" (IX). Graph.—Light Railways. Analysis of Tonnage Carried.
" (X). Sketch Plan of Transportation and Distribution on a Battle Front.

A METHOD OF TWISTING ROPES.

Contributed by MAJOR L. E. HOPKINS, O.B.E., D.S.O., R.E.

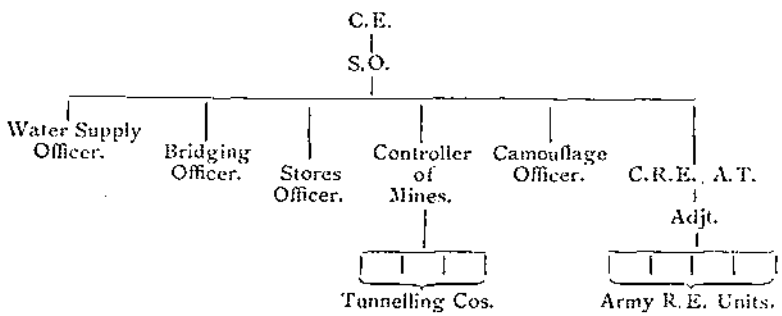


The above sketch represents a simple Indian arrangement for twisting ropes which is not only useful but also an interesting mechanical contrivance. It is used by Indian jute cultivators.

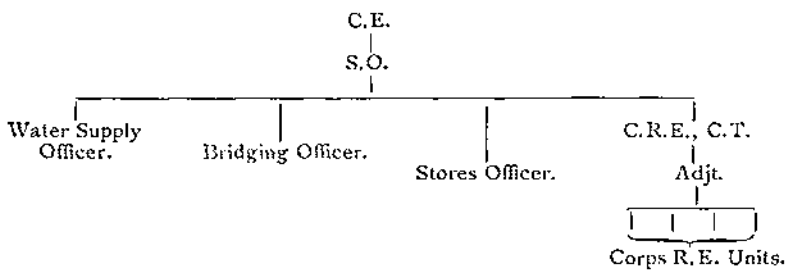
ENGINEER STAFFS.

1918.

ARMY.



CORPS.



Final Remarks.—Summing up to the subject of the lecture I think that efficient Control over Engineer Work in War by Engineers-in-Chief, Chief Engineers and C.R.E.'s, in their respective spheres depends upon the following :—

(*i*).—Possession of that intelligent appreciation of the other man's job which Lord Haig considers to be essential.

(*ii*).—Adequate previous experience of engineering under varied conditions.

(*iii*).—Clear official definition of their responsibilities.

(*iv*).—Standardized methods.

(*v*).—Due delegation of duties.

(*vi*).—Adequate transport for engineering staffs.

(*vii*).—Cordial relations between the many individuals of high and low rank in all branches of the service who can do so much to ease one another's burdens if mutual goodwill subsists.

ESTABLISHMENTS

H.Q. R.E.

1914		1918
1 Brigadier-General.	G.H.Q.	1 Maj.-Gen. 2 Brig.-Gens. 7 Lt.-Colonels. 5 Majors. 6 Capts. 1 Lieut.
1 Colonel.	Army H.Q.	1 Maj.-Gen. 2 Lt.-Colonels. 4 Majors. 2 Capts. 2 Lieuts.
1 Colonel.	Corps H.Q.	1 Brig.-Gen. 1 Lieut.-Colonel. 2 Majors. 1 Captain. 2 Lieuts.
1 Lieut.-Colonel. 1 Capt.	Div. H.Q.	1 Lieut.-Colonel. 1 Capt. 1 Sergt.-Major.

picture is clearer. A.H.Q. staff instructions prescribe that restoration of communications is to be first in order of engineering urgency and a map has been issued defining certain roads as army priority roads, viz., roads which must be made fit for heavy traffic promptly as the advance proceeds in order to secure lorry routes for supply and ammunition services, etc. From this map it has been possible to decide the bridges which have to be restored. Heavy bridge projects have been prepared by corps and approved by C.E. army who has had the materials and erecting gear sent up from the base direct to C.E.'s of corps and supplemented their transport by certain special army bridging lorries and M.T. and horsed pontoon wagons. An army Engineer Instruction has been issued which reads somewhat as follows :—

With reference to G.S. Secret Instruction — of —

Divisional engineers are responsible for clearing army priority roads of obstructions and rendering them fit for horse drawn traffic. Temporary bridges must keep clear of alignment of permanent bridges to be erected by corps engineers.

Corps engineers are responsible for further clearance of A.P. roads, including road-side drains, water courses, and for filling crate[redacted] They will make these roads fit for lorries and heavy artillery, using any material available locally such as timber and masonry from buildings, and road slabs when this method is unavoidable. They will also undertake erection of all heavy bridges on these roads.

Army engineers are responsible for complete restoration of A.P. roads using road metal and rollers.

Forward boundary of army road engineers will move forward from day to day so as to be 10,000yds. from the front line shown on the daily army situation map.

It must be noted that though specific road and bridge tasks have been assigned in the foregoing instruction, which must be performed, the corps and divisional engineers will certainly have other road and bridge tasks necessary for tactical reasons. In practice tasks are not definitely allotted until the whole engineering situation has been thrashed out and distribution made to the best advantage of the labour, transport and material available. Corps and divisional commanders will, therefore, have had an opportunity for considering whether their engineers are likely to be overloaded by the tasks proposed to be allotted to them for army reasons, and, if necessary, representing their case for modification of plan or increased engineer assistance. Before passing on we should note the necessity for keeping in each formation a reserve of engineers and material to meet unforseen contingencies; some labour and transport should also be kept in hand if possible.

with command and observation posts, tunnelled M.G. emplacements, concrete pill-boxes, and so forth. Any supplementary labour working with them would be entirely under engineer orders. Before a C.E. or C.R.E. decides how a certain job should be classified he must appreciate correctly the amount of engineering involved. The classification allotted must be clear to those concerned. Haziness on the subject leads to divided responsibility, friction and frittering away of one's engineers. For example, an unskilled labour unit, plus seven or eight sappers cannot make a job of repairing a badly shell-pitted, water logged road. If work is exposed to shell fire it is desirable to make it an engineer job even though it seems hardly necessary from the engineering point of view. In such circumstances the R.E. have a naturally steadying influence upon the labour units that may be working with them. They have *esprit de corps* behind them.

Comparison of Methods of Control.—The value of well organized engineer control and co-ordination may perhaps be shown somewhat more clearly by comparing an earlier and a later stage of development of army engineer control. An offensive is projected in each case. In the earlier example we find something of this kind. A.H.Q. [illegible] orders and instructions hardly refer to engineering. The [illegible]s. [illegible]eady as regards certain work, which will be under his direct control—but he is opposing an agitation by a certain branch to place some of his engineer units under their orders forthwith days before "zero." Such proposals are apt to crop up repeatedly, to the disgust of any C.E. or C.R.E. who appreciates the A B C of engineer control. The C.E. is not in agreement with the arrangements of some C.E.'s of corps, especially a case in which labour provided for engineer work has been handed over for ammunition supply work. Co-operation as between divisional, corps, and army engineers relieving each other on partially completed work seems to be somewhat hazy. Some C.E.'s of corps know very little about the engineering programmes of their divisions. *Liaison* work, right and left, seems weak, especially in the divisions. One division will use its engineers for the construction of strong points under brigade arrangements. Another will devote them to improvement of roads and communications. The next proposes to employ them on strong points and improvement of communications under divisional control. There are different policies all along the line. The corps engineers are to be chiefly employed on road restoration but not in close touch with the army road engineers, so that the latter express fears as to whether the work of the corps engineers will accord with their practice when they come to take over from them as the advance proceeds. Briefly put, we may say that the separate compartment system is in full swing and co-operation of engineers with engineers leaves much to be desired. In the later example the engineering

direct control engineer units nominally at the disposal of his C.R.E. army or corps troops. The C.R.E. may not be able to supervise work because it lies so far forward and he has much work in progress in his back area. In such a case the C.R.E. and the units concerned must be informed that the latter are temporarily placed under the C.E.'s direct control. During the war engineering staffs and C.R.E.'s of army and corps troops could seldom develop their full power of work owing to lack of personal motor transport facilities.

Delegation.—The only way in which a C.E. or C.R.E. can avoid the paralysing effect of masses of detail is by delegating definite responsibilities and powers to his staff and to his C.R.E. corps or army troops. No officer R.E. can be efficient unless he knows how to trust his subordinates and work them to their full capacity. At the same time he must be careful to keep the main threads in his own hands otherwise "delegation" degenerates into a condition of affairs commonly called "The tail of the dog wagging its head."

Classification of Work.—The old slipshod statement that work "will be carried out under engineer supervision" is quite out of date and should never be used when co-operation of engineers with other troops is meant. Works in the field are either

(*a*).—Engineer jobs, or
(*b*).—Contract jobs.

By the latter I do not refer to civil contracts such as are entered into on the L. of C. The difference between the two is that in an engineer job the R.E. are entirely responsible, whereas in a contract job the commander of a brigade, a battalion, a company, or some other unit is entirely responsible. Portions of a big job will often have to be executed by both these systems simultaneously. Erection of a heavy bridge may be cited as a typical example of an engineer job. Here the engineers do all the technical work, having under their direct control any auxiliary labour required for carrying material and gear to site and so forth. Tunnelling is another example.

A typical contract job would be the construction of trenches and entanglements in a rear defence zone. The R.E. may perhaps roughly indicate by a furrow in the ground, the approximate location of the trenches and approaches. They may perhaps peg out the location of tactical wire swept by M.G. fire; dig a sample length of model trench and indicate the style of revetting. But some unit commander should be entirely responsible for exact siting of trenches and for pushing on work in accordance with a plan and specification provided for his guidance. Officers R.E. would visit the work from time to time to assist in any way possible. A few sappers might also be placed at the commander's disposal to work under his orders. Meanwhile the units R.E. detailed to work on the scheme push on

Liaison must not be overlooked. Touch should be kept, not only with R.E., but also with commanders, staffs, and others, by informal visits to their H.Q.'s. Important matters come to light on such occasions which may be otherwise overlooked. It is also much easier to conduct business satisfactorily between individuals personally acquainted with each other.

Duties of Engineer Staff.—Effective engineer control is facilitated by careful distribution of duties among the members of one's staff, and as already stated it is important that this distribution should be made known to the engineer staffs of lower formations by the issue of a circular. A C.E. or C.R.E. requires time to ponder, to foresee and to plan ahead. He must also be out and about constantly or he will be out of touch with men and matters. To secure this leisure he should leave details to his staff, dealing, himself, only with the larger questions and matters of policy. He must give full power to his staff to deal with ordinary business on their own responsibility. The senior engineer staff officer should act as deputy C.R.E. or C.E. Deputies should know everything there is to know about current questions, and see, as far as possible, everybody and everything that their chiefs do. They should know their seniors' views and intentions and have full power to act for them in their absence except in questions involving a new policy which should be reserved for their C.E. or C.R.E.'s decision unless too urgent to await their return. The other members of an engineering staff should be regarded as the administrative heads of their respective branches. If there is a bridging officer for example, he discusses projects with the C.E. or C.R.E. concerned, makes recommendations to his own C.E., and when the project has been approved he deals with all subsequent details without further reference to his C.E. He is not an executive officer, and should never have engineer units placed under his orders, though he should constantly visit work in progress, and act generally "for the C.E." verbally and in writing. The water supply officer's duties are similar, viz.: Examination of W.S. Projects; Recommendations; Regulation of Details; Inspection of Work in progress, but no executive charge. A C.E. or C.R.E. can easily keep touch with the work proceeding in the different branches of his office by glancing daily at the office copies of letters and messages dispatched and by short interviews with the members of his staff. A C.R.E. of army or corps troops is an executive officer. He commands and controls the work of his own units and should have his own area, workshops and stores depôt, in stationary warfare. He should be in executive charge of the army workshops and parks, taking orders as regards policy of manufacture from the C.E. personally and orders as regards issues from the S.O. for stores as representing the C.E. Situations sometimes arise in which it is necessary for a C.E. to take under his own

Engineer instructions are secret. They deal with the engineer work of a specific projected operation or possible contingency. They are issued in numbered copies to H.Q.'s of formations at the same time as issued to H.Q. engineers of those formations. They quote the G.S. orders or instructions on which they are based. If it is desired to issue an engineer instruction not definitely based on such orders or instructions concurrence of the G.S. with the proposed engineer circular must be previously obtained.

Inspections should be personal visits of the C.E. himself as far as possible, but he cannot cover all the ground in a large area sufficiently often, so much inspection work has to be done by members of his staff who make verbal or written reports as necessary. Adequate motor transport must be allotted to engineer H.Q.'s of all formations if these important duties are to be performed efficiently.

Reports should be cut down to the minimum. It is better to see things for oneself than to read about them. Certain progress reports however cannot be dispensed with. Sometimes, as during an advance, reports showing the restoration of roads and bridges must come in daily in order that the H.Q. engineer situation map may be kept up to date. Other progress reports will probably deal with matters like "Defences," "Bridge and Road Crater Mines," "Water Supply," "Pillboxes," "Tunnelled Dugouts," etc., etc. Standard symbols to be used in maps should be prescribed to facilitate compilation at H.Q., also standard forms and headings in written reports.

Conferences of C.E.'s, C.R.E.'s, etc., are best limited to explanations regarding the engineering to be carried out during a projected operation, or of some possible contingency. Unless this is their *raison d'être* large conferences are apt to degenerate into rambling discussions arriving at no decision. Specific points requiring elucidation can generally be settled better at a small meeting of the few concerned in that particular matter. A record of decisions made at a conference must be issued promptly to those concerned unless the issue of an engineer instruction follows the conference. C.R.E.'s can order the attendance of their unit commanders but C.E.'s must obviously arrange attendance by request.

Correspondence includes the telephone, telegrams, letters. Telephone calls from a lower formation should be made in the first instance on the particular officer of the superior engineering staff concerned in the matter in reference. If not satisfied the C.R.E. or C.E. should call up the C.E. by name. This procedure acts as an S.O.S. signal or safety valve for use in emergencies. Letters are apt to fade into oblivion very rapidly in war. Matters required for future quick reference are best embodied in circulars.

(*ii*).—Strict adherence to the order of urgency prescribed by that command.

(*iii*).—Non-diversion of labour, materials, or transport to engineer work outside the prescribed policy—*except* in case of urgent tactical necessity.

(*iv*).—Strict adherence to standard specifications and plans.

(*v*).—Issues of engineer tools, plant and materials.

It should be clear from the foregoing that engineering control deals only with technical matters, supplementing the chain of military command so as to ensure that all engineering in progress is in conformity with the expressed will of the commander. Units R.E. cannot of course be moved under engineer orders—movement orders must be issued by the staff. But allotments of engineers, labour, and transport should be made on engineer recommendation. This amounts to a 6th "Principle."

Methods of Control.—Effective engineer control within the limits above defined can be achieved by a combination of the following:—

(*i*).—Engineer circulars.

(*ii*).—Standard specifications and designs.

(*iii*).—Engineer instructions.

(*iv*).—Inspections.

(*v*).—Reports.

(*vi*).—Conferences.

(*vii*).—Correspondence

Circulars are much like standing orders. Each deals with some specific matter which is not confidential or secret, *e.g.*: "C.E.'s staff—distribution of duties," "Periodical Returns and Reports," "Issue of Engineer Stores," "Heavy Bridge Projects," "Water Supply Projects," "Replacement of Pontoon Equipment," "Issues from Army Workshops," etc., etc. They are a guide to procedure. They must be revised to date constantly. New circulars regulating procedure will be found requisite from time to time. Circulars are issued to H.Q.'s engineers of formations with spare copies. It is essential to file them in an engineer circular file, kept always to hand for immediate reference.

Standard specifications deal with matters such as designs for:—"Horse Watering Points," "Water Cart Filling Points," "Lay-out of Sedimentation and Filtration Beds," "Mobile Water Points," "Tunnelled Dugouts Battalion and Brigade H.Q.'s," "Tunnelled M.G. Dugouts," "Plank Roads," "Accessories for Hutments," "Engineer Railheads," "Accessories for C.C.S.'s," etc., etc. Enforcement of strict adherence to standard specifications and designs is just as important in war as in peace. The fewer the patterns in use the quicker will work be done and the cheaper as regards expenditure of time, labour and material.

in other ways, but remember that variations in procedure cause loss of time and increase the strain on individuals. Time is a factor of the utmost importance in war, and increased strain on hard worked individuals produces increased casualties in *personnel*. Doubtless there were excellent reasons preventing clear definition during the war of the engineer control to be exercised from G.H.Q. and H.Q.'s of armies and corps and divisions. Also the introduction of standardized methods of effecting such control. Presumably the omission will be rectified in due course by the issue of an official manual regulating both these matters. If in sufficient detail such a manual will be a useful guide for commanders and staffs in handling their engineers, and to the E.-in-C., C.E.'s and C.R.E.'s in the exercise of their functions..

Policy Dictates Engineering.—It is the military policy, programme or plan in force for the time being which dictates the engineering policy to be pursued. The converse can only hold good in very exceptional circumstances. Nevertheless, engineering considerations are nearly always so important that they cannot be safely ignored when some military operation or course of action is being designed.

Influence of Engineering.—If this view is accepted the following principles should also be accepted. :—

(*i*).—The engineers should receive information in sufficient time to be able to express a considered opinion upon the engineering aspect of a projected military scheme

(*ii*).—That opinion should be duly taken into account before the scheme is approved for action.

(*iii*).—The engineers should draft the engineer instructions involved.

Unless these principles are conceded and acted upon, control of engineering in war is rendered difficult, and success in the engineering part of a scheme cannot be guaranteed. At the same time, we must not be disappointed when our views do not always carry all the weight which we think they should. The outlook of a G.O.C. formation is higher and broader than ours. He has to balance our pros and cons against others unknown or imperfectly known to us, and will often come to a decision adverse to our views. It is for us in such a case to accept his decision loyally, and do our utmost to carry out the engineering part of his scheme to a satisfactory conclusion.

Scope of Engineer Control.—Clear definition of the matters which can be appropriately assigned for control in the engineer channel is necessary. They are :—

(*i*).—Strict adherence in a lower formation to the engineering policy prescribed by the command of a higher formation.

(4).—Recovery, repair and upkeep of the roads through the battle zone upon which the whole heavy artillery ammunition supply depended.

(5).—Sinking and equipping with power-driven pumping machinery tunnelled wells in the shelled zone, in readiness for the pipe lines which were pushed on following up each successive advance.

(6).—Construction and maintenance of reservoirs, horse watering points, and water cart filling points with miles of pipe lines buried 3 ft. below the surface.

(7).—Buildings, roads and water supply for several Casualty Clearing stations.

(8).—Construction of approach roads and "Cours" for ammunition and other rail heads.

(9).—Buildings, water supply, etc., for aerodromes and miscellaneous army and corps units and departments, and corps workshops.

At this period of the war the staff of a Corps C.E. normally consisted of 1 staff officer and 3 field engineers, and he probably had permanently under his orders

3 A.T. Cos. R.E.
2 or 3 Tunnelling Cos. R.E.
1 Co. of a Labour Bn. R.E.
½ M.T. Pontoon Park
1 Infantry Labour Bn.

supplemented by a varying number of Field Squadrons and Cos. R.E. and working parties drawn from miscellaneous units such as the Special Brigade R.E., the Corps Cavalry, Corps Cyclists, Squadrons of Cavalry, etc., etc., and as much horsed and lorry transport as he could persuade the D.A. and Q.M.G. of his Corps to place at his disposal.

Control End of War.—Under the pressure of such circumstances all C.E.'s of armies and corps evolved their own systems of engineer control, but its extent in any particular case was a variable quantity up to the end of the War, dependent upon the personal and many other factors. No standardized system of control was imposed so that there was presumably diversity in the 5 army systems, 18 corps systems and 50 to 60 divisional systems. Many disadvantages are inherent in such lack of standardization. I will cite one example: officers, units R.E., and whole formations moved constantly from one command to another. On each occasion a new set of engineering "ropes" had to be learnt, *e.g.*, "What is the procedure for replacing pontoons in this army," "How does this corps run roads," "How are the pioneers dealt with in this division," etc., etc., etc. Some may regard standardization as stifling initiative and pernicious

the engineers of lower formations were not understood either by the army in general or the R.E. in particular. A prevalent impression was that they advised the G.O.C. of their formation upon engineering matters when their opinion was requested and that they regulated the issue of certain engineer stores. Their position was regarded as one of considerable dignity and much leisure. The engineers of formations considered themselves to be self-contained groups with little or no responsibility in engineering to anyone beyond the G.O.C. of their own formation. Too much interest in their doings by the C.E. of a superior formation was to be deprecated. If a crisis arose, such as a shortage of sandbags, he might be useful, as it was up to him to produce them. Any other assistance he might be able to give was gratefully received, but not much was to be expected. *Vide* War Establishments 1914.

Later Developments.—Later on as the British Army grew in size, and especially when offensives on a large scale began, armies and corps became the only more or less permanent institutions in a given area. Through them flowed a constant stream of divisions attacking or recuperating after heavy lossess. So it became increasingly necessary for the larger formations to take control of many matters formerly left to divisions in order to secure continuity of policy. This applied equally to engineering. As a result the functions of C.E.'s expanded. They were expected to get much more grip on the engineering work of their areas, and to turn the engineering picture into one connected whole, instead of there being a series of poorly developed snapshots of jobs ever starting but never finished. Lack of continuity was producing disappointing results in out-turn of work compared with heavy expenditure in time, labour and material. C.E.'s in the eyes of their Generals at all events, soon ceased to be regarded as mere advisers and storekeepers. They were expected to exercise some measure of control over the engineering of lower formations and, besides, to undertake themselves work of all kinds extending far forward into the battle zone as well as far in rear of it.

For example in 1916 during the battle of the Somme, a Corps Chief Engineer might find himself held directly responsible for :—

(1).—Constructing and completing by a given date three pairs of up and down communication avenues, each about 1,200 yards long, trenchboarded throughout, provided with splinter proof runner posts at 200-yard intervals and debouching on to the front infantry support trench.

(2).—Watching and reporting on the conversion by Divisions of an old German trench into a "Second Line."

(3).—Constructing a new "Third Line" wired throughout and provided with tunnelled dugouts for M.G.'s, etc.

CONTROL OF ENGINEER WORK IN WAR.

(*A lecture delivered at the S.M.E., Chatham, by* MAJOR-GENERAL P. G. GRANT, C.B. C.M.G.).

Synopsis. Co-operation Essential—Pre-War Engineer Control—Early War Engineer Control—Later Developments Engineer Control—Engineer Control at end of War—Military Policy Dominates Engineering—Re-action of Engineering on Policy—Scope of Engineer Control—Methods of Engineer Control—Duties of Engineer Staff Officers—Delegation to Engineer Staff Officers—Classification of Work—Comparison of Methods of Engineer Control—Final Remarks.

Co-operation.—F.M. Lord Haig, reviewing the Work of the Arms and Branches of the British Forces during the War, said in his Final Dispatch:—

"An intelligent appreciation of the other man's job is the first essential for successful co-operation."

Taking this maxim to heart we engineers must study the work of other arms and branches as well as our own. And we must not let ourselves become so engrossed in our own point of view that we fail to realize that of others. So we shall go far to secure successful co-operation between the R.E. and other arms. But besides this we must have successful co-operation of engineers with engineers, if we are to develop our full power. However efficient we may be, individually or as units, we shall not produce the best co-operative results if the engineers of armies, corps and divisions work in separate compartments, each entirely free of any higher engineer control. I shall try, therefore, to explain how the technical control exercised by an E.-in-C., Chief Engineers and C.R.E.'s enables all these groups to act in combination as parts of a single engineer organization though each group remains under the command of its own particular formation.

Pre-war Control.—In pre-war days the "Division" loomed in the eyes of the British Army as a very large formation. The R.E. certainly did not think of war in terms of armies and corps, any more than the bulk of the Army did. So we devoted much thought to the functions of a Divisional C.R.E. but little to those of a corps or army C.E. and still less to those of an E.-in-C. In fact there seemed to be little necessity for higher engineer control in those days.

Early War Control.—It is not surprising therefore that in the early days of the War, the functions of the E.-in-C. and C.E.'s in regard to

country, of the weather, and of the nature of the operations; and above all, how vitally important it is that there should be the closest co-operation between the directing staff in the field and that at home. This last reason is why I resisted every proposal to hand over the work to a new department, not because one wished to claim any superior knowledge of engineering, or any special administrative capacity, but because of the close personal relations which I had—and my staff had—with the leading engineers in the field. We enjoyed the confidence of Sir Douglas Haig and his army commanders, whom I used to consult freely when I visited France (which I generally did before a big push came on), and I felt that with any new organization there might be a risk of failure which would be fatal to success, and which we could not afford to risk in this death and life struggle. When it was proposed, therefore, in 1917, on the formation of the Department of the Surveyor General of Supply, to take the whole of the supply of engineering materials out of our hands and put it under a new civil organization I represented the case fully to Mr. Andrew Weir, now Lord Inverforth, pointing out—what I think was a new consideration to him—that the regular and adequate supply of engineering plant was so intimately connected with military operations, that certain military responsibilities devolved upon the supply officer which he would have to accept if he took over the whole task. I think he quite saw my point and stated that all he desired was that the working and organization should be subject to his scrutiny as to whether or not sound business methods were being applied, and whether the country was getting full value for its money. He took steps to assure himself on this point, sending one of his principal staff to investigate in full detail the whole of the working. Being quite satisfied on the subject he left matters as they were, only insisting—rightly—that I should keep him informed of any alterations or improved steps which were being taken.

The description which I have endeavoured to give above has failed in its purpose if it has not proved to you how great a field there is in war for all classes of engineering, and how great have been the services of civil engineers of all special branches in this country. I think you will recognize that in this, as in many other national matters, we cannot stand alone, and it is by playing the game together, by each contributing his own share, and by all working in harmony, that great results, such as the victory over the enemy, can be accomplished.

for eight powerful pumps and engines as a first instalment, and also for spare parts for some hundreds of pumps and engines of British manufacture which had fallen to the army as prizes of war. It was no easy task, in the absence of detailed information, to obtain all these spare parts, but the matter was accomplished. Further demands for all sorts of agricultural machinery were obtained and despatched in the spring of 1918. The establishment of camps for refugees from Armenia, the Caucasus, etc., necessitated the supply also of miles of piping, disinfectors, refuse destructors, and hospital necessaries of all sorts.

I might describe at some length the supply of the needs of the armies in North Italy, in Macedonia, and in East Africa, but to a great extent it would only be a repetition of what has been previously described for other places. The demands for Italy were met, to a very great extent, from supplies in the depôts which had been established in northern France, but as the nature of the country was mountainous it was found necessary to send certain stores, such as aerial ropeways, which had not been found to be required in northern France. The best pattern of this particular class of plant had been settled after much careful experiment. Some had been sent to Macedonia and others have been more recently despatched to the mountainous frontier of India, where it is understood they have been used in the operations against the Afghans.

The supply of timber to the armies in France, and the organization for working the forests in that country, assumed very great dimensions towards the close of the war. Canadian lumbermen were employed in large numbers and large forests were taken over from the French Government. Wood-working machinery of all sorts had, however, to be supplied, and in most cases the various armies and corps established workshops of their own. In Egypt, where there was no means of obtaining timber in the country, it was found necessary to obtain timber from India, but the difficulties of shipping and the cost of the timber so supplied were so great that it was thought desirable to look about for some other source of supply. Ultimately, arrangements were made for utilizing the forests in Cyprus and a certain number of Canadian lumbermen were sent to that island for the purpose of making the best use of the forests which existed there. The timber so supplied was sent to the depôt at Alexandria which furnished materials for Macedonia and all the operations in Syria. Mesopotamia obtained its supplies from India.

Though I have mentioned only a few samples of the varied classes of engineering plant sent from this country during the war, I think I have now said enough to indicate how the problem of engineering supplies to an army differs from the supplies of food or of ammunition, or clothing, or any of the other ordinary munitions of war; how it varies with the peculiarities of the

Turning now to other theatres of war, in the winter of 1915–16, the line of defences east of the Suez Canal required some 80 miles of 4in. steel pipes with pumping plants. These pipes were partly obtained from Holland and some from India, but most came from America. We were fortunate in obtaining the services of an expert in that particular branch of industry who went to America and made the purchases, seeing them on board ship. The enemy got wind of it and tried to intercept the ships, but apparently blew up the *Persia* instead. The whole of the consignment arrived safely, and the line of works in the desert was amply supplied with water. The success of this encouraged the General commanding in Egypt to ask, in July, 1916, if we could arrange for a much bigger scheme, namely the supply of piping 12in. to 10in. and four complete pumping stations across the desert by the caravan road to El Arish on the Palestine border. This was undertaken by the same arrangement as before, with American firms, the expert adviser travelling with the material, which was delivered in the autumn of 1916, and the work was rapidly put in hand so that by February, 1917, water from the Nile in ample quantity was pumped into Palestine through 87 miles of 12in. to 10in. piping. This was the most notable water supply scheme ever carried out in the annals of war. The attack on Gaza which followed was not at first successful, and the summer of 1917 was spent in consolidating our gains, providing new wells and pumps, installing workshops, and making roads. In November Gaza was captured and Jerusalem fell a month later. Water supply through pipes from sources in the Judean hills was one of the first tasks undertaken for the Holy City. Demands for plant and material from England steadily increased. Monthly reports in full detail were sent to me by the Director of Works in Egypt, whose work was admirably organized and executed.

Reports from Mesopotamia were not, however, so easily obtained owing to the lamented death of the Director of Works there. Demands had come in in 1916 for hot water apparatus for the hospitals, for portable huts and bridges of spans up to 60 ft., while the port of Basra was provided with small independent electric power stations for lighting, and with ice plants of one ton capacity. These small installations, however, were found insufficient and in the autumn of 1916 we were called upon to supply Basra with a power station of 1000 K.W. for lighting, for 7,000 electric fans in the hospital, and for manufacturing 20 tons of ice in a day. The first consignment of boilers for this large plant was lost at sea by enemy action, but by strenuous exertions these were replaced in eight weeks and the central supply station was operating in April, 1917. After the Turkish armies were driven out of Bagdad it was decided to encourage the cultivation of crops in Mesopotamia, and as a canal system of irrigation would take too long to develop, demands were sent to the War Office

by hostile artillery, and the ever increasing wear of the roads demanded numbers of road rollers, many of which had to be requisitioned from local authorities in England as they were not obtainable otherwise. After 1916 the roads behind the front line (5 miles and more from the line of actual operations), were taken over by the newly-formed Department of Transportation.

As the country in the vicinity of the fighting armies was now an absolute wilderness owing to the terrible intensity of artillery fire, it became necessary to provide for hutting the troops in winter. In June, 1916, corrugated steel sheets, which had been already in great demand for the accessories of trench warfare, were now required for housing purposes, and the supplies sent averaged 14,000 tons a month. A new type of corrugated steel hut had been invented by Major Nissen in 1916 and the first lot of 27,000 were delivered in the autumn of 1917. Shortage of steel, and the great demand by other departments for that metal, delayed delivery of the second order of 20,000 until well on in the winter of 1917–18. Demands also for stoves came pouring in and it was with the utmost difficulty, owing to the same reasons of shortage of materials and labour, that we were able to ship 43,000 to France by the end of 1917.

During that year the water supply problem became more and more acute. Although the plant ordered in 1916 aided materially, it was clear that it was not sufficient, and in June, 1917, 150 portable pumping sets and 156 larger plants, suitable for more permanent installation, were ordered. It was found necessary to bore, in many places up to 300 feet, and drilling plant was obtained from America, the water being raised by special pumps and air lifts. The latter called for a compressor and engine carried on a lorry chassis so that the outfit could move from one bore hole to another, filling up successive service tanks. For shallow wells centrifugal pumps were used to deliver from two to three thousand gallons per hour against heads up to 115 ft., while other classes of pumps were used for deliveries up to 12,000 gallons per hour against heads up to 300 ft. Water purifying plants of various kinds were also required, some of them being of a portable nature designed to fit into the ordinary general-service waggon. In addition to all the above, laundry and wood-working machinery, fire engines, destructors, disinfectors, cranes, motors of various kinds, and many other miscellaneous machines were demanded and supplied. A regular monthly supply of all ordinary requirements such as cement, steel sheets, entanglement posts, wire netting, steel joists, etc., was also sent which, apart from all special machinery, alone amounted to about 35,000 tons a month. During the last year of the Boer War the average monthly tonnage of all stores, ammunition, food, clothing—everything in fact for the army—only amounted to 20,000 tons. This figure gives an interesting index of the scale of the two campaigns.

and at the same time keeping us, at home, fully informed of their requirements from Great Britain.

Meantime, in the winter of 1915–16 preparations were made for a big push on the Somme. It was known that water supply there would be a matter of the greatest difficulty, and early in 1916 very special arrangements were made to send pumps and piping to that part of France and to train the troops in the rapid laying of mains. Ultimately the big push did not come off until July, but when it did take place the arrangements made worked out splendidly. At the attack on one fortified village, for instance, the water mains were laid into the captured village, some miles ahead of the front line, on the same day that the position was taken, and in spite of the many bursts by shell fire, the network of pipes and watering stations was maintained and pushed on all through the fierce fighting of the autumn. By November, 1916, 800 sets of power-driven pumps had been supplied and 200 miles per month of 4in. pipes were demanded and delivered.

The supply of timber had by this time become so exceedingly difficult, owing to the shortage of shipping and the requirements in Great Britain—our chief source of supply up to that time being the Baltic—that it became necessary to enter into some negotiation with the French Government as to a supply of timber from forests in their country. A certain amount had already been done by local negotiation, but the demand was far greater than any local supply could afford and it became necessary to make an arrangement between the Governments concerned. I visited the War Office at Paris with some of my colleagues early in 1916 to discuss with the French authorities the questions of road metal and forest timber, and as a result of these negotiations we had handed over to us some forests in the North of France which we worked with our own labour, and various other forests for which Canadian Forest units were specially obtained. Machinery, however, for all these services was required in large quantities—quarry machinery for supplying the roads, and wood-working machinery for sawing the timber felled in the forests. Ultimately the Forest Administration formed one of the special branches of the Royal Engineers in France, but it depended upon F.W. 8 for the supply of its machinery.

The heavy artillery which the Germans brought into use towards the close of 1916 required the provision of deep shelters, and this brought into use the heavy corrugated steel arches known as "elephant shelters" which had to be specially designed and sent over. Several types of tunnelling machinery were tried and after many experiments some electrically-driven machines went to the front to construct deep dug-outs and communication tunnels.

Another urgent call related to the provision of machines for rapidly burying signalling cables which otherwise were quickly destroyed

utilized as fast as they could be manufactured, the daily waste owing to the enemy's fire being enormous.

I shall mention below, the steps which were taken to supply the necessary timber. Meantime, another urgent supply of a different character was in connection with the roads. Thousands of tons of road metal had to be supplied daily, and for this purpose a small fleet of ships was continually plying between the Channel Islands to ports on the Flanders sea border. Many road rollers and millions of gallons of tar were also sent to repair these roads, and in the summer of 1915 special battalions of navvies were enlisted in England for the purpose of supplying the necessary labour.

Deep mining came on about March, 1915, and powerful motor pumps were required to keep the shafts dry; of these the maximum weight of any part was not to exceed 300 lb. and the motors had to be driven by generating sets located in safe positions in the rear. Air pumps for ventilating the galleries, special surveying instruments for laying out the mines, life-saving apparatus, and other special mining stores had to be obtained at the shortest notice. Many demands for mechanical trench excavators and mining machinery came in, and many patterns were tried, but after exhaustive experiments it was found that none were entirely satisfactory and suited to the peculiar needs of modern war.

Concurrently with all these demands for the fighting lines there were vast stores needed for the many miscellaneous services on the Lines of Communication. Hospital accessories of various sorts and laundry machinery were among these. Materials for facilitating the unloading of ships at the ports and the docks at various bases on the English Channel had to be hurried over frequently at very short notice.

Early in 1915 the Dardanelles campaign came on, and the uncertainty as to engineering stores in connection with this venture was one of the great difficulties which we had to encounter. Moreover, misfortune seemed to dog the steps of that campaign in engineering as in other matters. One instance may be mentioned, as it is typical. A complete outfit of water-boring plant had arrived off the coast and was transferred one calm evening to a lighter with a view to being taken ashore at daybreak the next day. The naval transport officer decided not to take it ashore until the morning and during the night a gale sprang up, swamped the lighter, and the whole lot went to the bottom. Language is insufficient to describe one's feelings on the subject.

Lord Kitchener's visit to that region at the end of 1915 was the origin of the Alexandria base depôt above mentioned, and from that time forward this auxiliary base proved of inestimable service, in collecting stores from India, Cyprus, and other parts of the East.

But I may mention that these light bridges were of special value in the fighting which took place towards the end of the war. Some of them have been erected in Italy and were invaluable in the operations which culminated in 1918 in the Austrian defeat. In Palestine one at least is now spanning the Jordan. It is, perhaps, sufficient to say that this invention was one of the most useful in connection with the work undertaken by the engineers of the new armies.

Early in the war it was anticipated that siege operations might be possible, though we little imagined that they would be on the huge scale which actually was the case. A committee considered the plant necessary for a siege ; and among other items was an outfit for narrow-gauge railways 2½ft. gauge, of which 100 miles of permanent way, 40 internal combustion engines with corresponding rolling stock, repairing shops complete with various tools and machinery, were placed on order. For reasons which I cannot now explain, this plant was not acceptable in France and so a year later I sent it all to Egypt where it came at a very opportune moment for the construction of the line of defence 6 miles east of the Suez Canal. In fact, one may say that this light railway plant and the water supply plant which was sent at the same time, made possible the Canal defences which baffled the German-Turkish attack and were the first step towards the great victory in Palestine.

As the army in Flanders, after the first battle of Ypres, settled down to the grim winter campaign in 1914–15, the call was for trench pumps, loophole plates, sap-shields, wire entanglements, posts, trench diggers, steel joists for dug-outs, and any quantity of timber. To keep fire and communication trenches dry became a vitally urgent matter, and this country was scoured for any pattern of hand pump, also for power units varying from 2,000 to 9,000 gallons per hour against a low head.

During the first 15 months of the war 15,000 pumps and 250 miles of hose were either sent or being manufactured.

The quantity of timber required was enormous and any stocks found in the towns near the frontier of France were speedily exhausted. Workshops were established in convenient places, and where such shops already existed they were utilized to the fullest extent possible, but very frequently, and more and more as the campaign advanced, local resources were found inadequate and we had to supply, from home, wood-working machinery and all other accessories for workshop equipment. The quantity of articles required in trench warfare made of wood is not very varied but amounts to an enormous total. For instance, I understand that in the first winter of the war the amount of duck boards used in the trenches at any one time would have reached from London to Inverness. Dug-out frames, revetment frames, and other similar articles for ordinary trench use were being

unfit for service overseas. These trials disclosed weak points or suggested improvements, and as each was remedied, the improved plant was ordered on a scale sufficient for need in the field.

In order to keep pace with the enormous demands, orders were placed as widely as possible all over the United Kingdom. Many firms took up work to which, ordinarily, they were quite unaccustomed and it was necessary to keep in constant touch with them, advising as to improved designs and processes. These advisory duties fell to the lot of a staff of inspectors, of whom 74 ultimately were employed, and who did admirable work. The total value of the stores inspected and despatched during the war was 32¼ millions, and it may be inferred from this large sum how great were the responsibilities and how serious was the task devolving on the inspectors. Very close record was kept of all despatch. One little incident may be quoted to illustrate this. In the autumn of 1917 the Director of Works in Egypt complained that one out of a batch of pumps delivered in Palestine, leaked owing to faulty packing at the joints. He quoted the identifying number and we were able to at once trace the inspector, date and place of inspection, and to call for an enquiry into the circumstances. Of course, in ordinary practices, one can get a faulty article replaced, but in war one cannot afford to have any failure.

I now propose to give in brief outline some account, necessarily very imperfect, of how the varying fortunes of the war affected the supply of different engineering material.

The retreat from Mons involved the destruction of many bridges, which, in the subsequent advance after the battle of the Marne, had to be rebuilt. The reconstruction of one of these over the Aisne took three weeks with local material. Obviously this was far too long, and consequently we were asked to design and despatch girder bridges which could be quickly transported and easily erected, capable of taking the heaviest loads current in the army, and of spans varying from 12 to 85 ft. Such bridges were designed by F.W. 8 and orders placed for a certain number at once. There were some 300 of these demanded and sent to France in the first year of the war, and special schools for instruction for men to learn the methods of erection were established. In March, 1917, when the Germans retired, blowing up all bridges, these girders were invaluable and (to quote one instance only, among many) a big bridge over the Somme at Brie, which under normal conditions would have taken two or three weeks to restore, was actually completed in four days in the worst winter weather. A special pattern of light bridge rapidly erected was invented by Major Inglis, who in peace time is a professor of engineering at Cambridge. It is unnecessary, I think, to describe at length this remarkable and ingenious invention, as it already has been the subject of papers read at the British Association and re-published in the technical press.

demands from other departments for shipping increased, trouble began with the Ministry of Shipping and the Admiralty—a matter of grave anxiety, for demands from the fighting troops for engineering stores were becoming daily more and more urgent. In the summer of 1915 it was at last agreed by the Ministry of Shipping and Admiralty that a fleet of 10 vessels should be detailed for F.W. 8 stores to France. This was a considerable relief but the number of 10 was not always forthcoming and there was constant anxiety and uncertainty to make the best of the allotted vessels.

In addition to shipments from London a regular service of vessels left Liverpool with corrugated sheets, Rochester with cement, and the Channel Islands with road metal. The submarine menace in 1917 stopped the Liverpool services, and shortage of shipping by that time prevented the Channel Islands supplies being continued, but the new port at Richborough had now, to a limited extent, become available and made up for the loss of the other places.

A few figures will illustrate the growing magnitude of the problem.

The tonnage of engineer stores shipped to France in January, 1915, was 10,000, in January, 1917, it was 55,457. For many months at the latter part of the war it averaged over 40,000 tons a month. All this had to be collected after careful inspection, from contractors' works all over the country, piloted through the congested railways to various seaports, and dove-tailed into a shipping programme month by month. Moreover, the stores had to be sent where they were most needed. There were two main depôts in France, and according as the needs were, either, for instance, for the armies on the Belgian front or on the Somme, the stores had to be despatched accordingly. Then there were other theatres of war which, had to be supplied, and the difficulties were increased by the fact that we could not communicate with them so easily and readily as we did with France. However, in December, 1915, a subsidiary base was established at Alexandria and very excellent work was done there by the officer in charge in keeping us in touch with all the needs of the near East.

As the shipping problem increased in difficulty and magnitude it was found necessary to have a suitable storage depôt as near to the docks as possible and there to receive supplies pending shipment. Such a site was found at Abbey Mills in the East of London, near the huge gas works, and there, not only were stores collected, but a certain number of useful experimental trials were carried out. In a war of this magnitude many novelties were brought forward, the efficiency of which it was necessary to prove, and as this in some cases had to be done under conditions reasonably similar to those obtaining in the field, another site was also selected near Surbiton, at Claygate. A disused brick field was hired, and there extensive instructive trials of various types of tunnelling plant, trench diggers, light and heavy ropeways, were carried out for some three years, by officers and men

Several times attempts were made to take away this power of placing contracts but the attempts never succeeded. Often we were able to settle details by telephone and then to follow up immediately by written confirmation, and reports were made regularly to the Director of Contracts informing him of what we had done. The guiding principles in placing orders were :—

1. Rapidity of delivery.
2. Economy in price.
3. Efficiency of inspection.
4. Complete records of every order from manufacture to docks, thence by ship to overseas depôt.

The staff of the branch rapidly increased from a total of 25 all ranks in 1914 to 192 in 1918. The percentage of the cost of all administration during the war worked out to between 6s. and 7s. per £100 of expenditure. Considerable difficulty was experienced in obtaining War Office sanction for these increases of staff and for the necessary office accommodation ; the normal administration of the War Office secretariat not understanding the need for such continual growth. No doubt if F.W. 8 had been a new Department of State there would have been no difficulty ; some large hotel would have been commandeered for their accommodation and the staff would have been increased to any extent, but being only the branch of an old-fashioned, already-established organization, there was considerable reluctance to allow it to expand.

It will be explained later why the policy of not handing over the work to a new department was continually and successfully resisted. It may be of interest to record the fact that the officers who joined the branch after the first few months of the war were all civil engineers who had been serving in the field and who had been wounded or otherwise unfit for active duty.

At the outbreak of war it was clear that special arrangements must be made to watch the shipping of engineer stores complete in all parts, with due procedure of details and with promptitude. Experience in past wars had shown the need of this and of supervision over the work of loading ships. An officer was at first stationed for this purpose at Southampton, but it was very soon evident that however zealous he might be—and he was one of the best—he was heavily handicapped by his distance from headquarters. Accordingly, arrangements were made early in 1915 to utilize the South West-India Docks in London, whereby the shipping officer was in touch with contractors, railways, Port of London Authority, the naval transport officer, the consignees overseas, and F.W. 8 who could control the relative importance of consignments. By improving the railway facilities at the docks the deliveries of cargoes to ship or shed were speeded up and for a while ships were plentiful, but as

of Works, but also plant and material for the Director of Railways. Later on he had to obtain for the Inland Waterways and Docks, barges, cranes, and other plant, and for the R.F.C. he had to obtain special waggons, machines and tools, as well as motor ambulances, aeroplane trailers, mobile and stationary workshops, etc. Each of the branches mentioned formed eventually a supply organization of its own, so that by the end of 1915 as regards railways, and 1916 as regards the R.F.C., each was able to stand on its own legs, but during the earlier stages F.W. 8 had supplied the Railway and Inland Water Transport branches with materials valuing £700,000, and the Royal Flying Corps with stores value £1,500,000. Further, when the German advance in 1914 placed the French Chemin de Fer de l'Est in a difficult position and they applied to England for assistance, F.W. 8 placed many orders for girders and permanent way for them, the value of such stores being over £92,000. These stores were ordered, inspected, shipped and delivered to the French engineers who thanked the War Office, not only for good quality and workmanship, but for punctual delivery and care taken to meet all their needs. Later in 1917–1918, when the American armies came into the campaign, they too had to come to us for their engineer stores. Urgent orders came rapidly pouring in for ordinary huts, hospital huts, water piping, pumping plant, steam navvies, and many other articles, the names in some cases being very unfamiliar. These orders came at a time when the steel and labour problems were very acute in this country, but long before the American Army had their own shipping organization in working order, we were sending over for them to France a steady stream of plant and materials, and with very harmonious relations between us. The value of the orders placed for the United States Army between August, 1917, and December, 1918, was £1,500,000.

It will be seen, therefore, that in addition to supplying the needs of the engineers of the British Army on all fronts, F.W. 8 was acting as a step-father to other departments of our own army, and to two, at least, of the Allies.

Before relating how the vicissitudes of war were reflected on the work at home, I should like to say a few words about the home organization.

The first step was to have absolute control over contracts. This was a notable departure from ordinary War Office procedure, but fortunately at the outbreak of war the Director of Army Contracts was a man with breadth of view, and he knew us sufficiently well to trust us. Ordinarily a contract of this description for machinery or other plant would take from a fortnight to three weeks to complete, but by having the power to settle contracts by telephone if necessary, or in any case directly, we were able, on a constantly rising market, to save not only huge sums of public money but precious time, and possibly precious lives.

To give an adequate account of all this work would far exceed the limits of an ordinary paper and therefore it is proposed to limit our attention to the other subject, namely, the supply of engineering stores for purposes other than electric signalling and searchlights.

It is perhaps unnecessary to say that a huge organization, comprising 12 important branches under one head, was only practically workable by having each branch under very capable management, a senior officer being in responsible charge of the operations in each. There were extraordinarily able men in charge of these, and their loyalty and energy were as conspicuous as their technical capacity. They kept the head of the department fully informed of all the important phases of their work, and took no vital step without his knowledge and sanction, consulting him freely in any difficulties; but beyond that they had freedom to act as they thought best. Some left for active service in the field, some died at their posts, but for the most part the same staff remained all through the war.

It is necessary at this stage to point out the difference between what are known as "Vocabulary" and "Non-vocabulary" stores. The former include ordinary tools of all sorts and all the equipment authorized for the use of technical units. The patterns of these have been authoritatively fixed and the Ordnance Corps is responsible for arranging for their supply, after technical inspection by F.W. 9.

But there must be in every work of engineering other stores, or special articles, or technical plant, which vary according to the particular needs of the case, and it is these that are called "Non-vocabulary" stores. In ordinary times of peace any such special plant or machinery either forms the subject of separate estimate and contract, or is included in a comprehensive scheme for some large work. In war, however, this procedure is impossible. The conditions of the problems are frequently so varied that it is impossible to forecast, except in very general terms, what materials, plant or machinery will be required, and it is equally impossible to maintain a reserve of such stores.

At the War Office, in August, 1914, there was the beginning of an extensive stores organization, in that there was an officer called the Inspector of Iron Structures, whose duties included the design and provision of fixed machinery for military purposes at home and abroad, and also the arrangements for shipment (in consultation with the Director of Contracts and the Admiralty) of engineering stores to Colonial military stations. The officer who held this appointment at the outbreak of war, Major (now Colonel) Oakes, was a mechanical engineer of large experience. He had been locomotive superintendent for six years on the South African railways, and had other varied experience which very thoroughly qualified him for the heavy task before him. He had, on the outbreak of war, not only to purchase stores for all branches of the Directorate

bodily to the Ministry of Munitions, the Directorate, however, remaining in an advisory capacity. (2) The Directorate of Movements, which had as one of its branches the charge of railway operations. In peace time the engineering questions involved were obviously very limited, and the outbreak of war brought upon the branch concerned a great strain, and so great an expansion that ultimately the existing machinery broke down. So a large new Directorate of Transportation, including railways, roads, harbours and inland water transport was, after some two years of war, formed in the field with a corresponding Member of the Army Council at home. (3) The Directorate of Barrack Construction, an architectural branch which dealt in times of peace with the designs of large new permanent barracks and hospitals. This was abolished during the war as it was no longer required. (4) The Directorate of Supply and Transport, which dealt with mechanical transport, a most important and valuable, though obviously limited, branch of engineering. (5) The Directorate of Fortifications and Works, which dealt with buildings of all sorts, and all civil, mechanical, and electrical engineering as applied to military needs other than those already enumerated.

It is with reference to the work of this last Directorate that attention is now invited and to consider one special phase of that work.

From the skeleton nucleus of an organization which existed in 1914 the work of the Directorate expanded rapidly, shortly after the outbreak of war, into 12 branches or sub-divisions, designated in the War Office list as :—F.W. 1, F.W. 2, and so on. Of these 12 branches probably the most important were :—

F.W. 2, which dealt with the enormous programme of hut, barrack and hospital accommodation in the United Kingdom.

F.W. 3, which had to carry out all the coast defences, the largest programme of its kind for half a century.

F.W. 8, the Chief Mechanical Engineer's branch, about which I propose to speak presently.

F.W. 9, whose work as Chief Electrical Engineer was marvellously important and extraordinarily interesting. All the work of the signalling branch, of the wireless experimental work, both on the ground and in aircraft, all the searchlights, both fixed and mobile, all fixed electric lighting, and all inspection of authorized engineering *equipment of every description*, came under the duties carried out by this branch. The scope and value of its operation increased as the campaign went on, until at last electrical supplies in civil life became so inadequate that we had to take over and work five factories in and round London for the manufacture of field telephones, cables, and wireless sets both for ground work and aeroplanes. A large and important wireless experimental station formed part of the work, and it was largely due to the experiments carried out here that wireless telephony between aeroplanes in the air was successfully accomplished.

THE SUPPLY OF ENGINEERING STORES TO THE ARMY IN THE GREAT WAR.

(*Lecture given to the Engineering Faculty, University of Liverpool, 5th March*, 1920, *by* MAJOR-GENERAL SIR GEORGE K. SCOTT-MONCRIEFF, K.C.B., K.C.M.G., C.I.E.)

IN modern times we have learned that a nation at war must avail itself to the fullest extent of all developments of engineering science, not only in the manufacture of weapons and ammunition, not only in the supply of accessory adjuncts of war such as railways and transport vehicles, but also in the actual operations of battle. Engineering must be closely and intimately allied with military operations.

The experience of the South African war, carried out against an enemy composed largely of mounted troops skilfully handled and possessing an initial advantage in their knowledge of their country, tended to obscure the fact that a campaign in a closely populated European country called for very different procedure; and consequently the vital connection between engineering and operations of war was not realized by the General Staff.

It is here proposed to consider a special phase of the engineering problem as it existed in 1914, to sketch the steps which were taken to grapple with that problem, and show how the work at home had to be in close touch with the operations in the field. This problem was how to meet in the most expeditious and thorough manner possible the supply of engineering stores and plant to the armies.

It is probably unnecessary to dwell upon the importance of this matter. Any one who has had to carry out engineering work at a distance from the centres of organized labour and the markets for materials, knows how vitally important is this question of supply, how it varies with the progress of the work, how necessary it is that supply and demand should synchronize, how it necessitates the closest co-operation between the engineers on the spot and the consulting engineers at home, and how any failure to maintain this co-operation leads to delay and expense. It is important that there should be a controlling head who understands at once the nature of the problem to be solved and the means, both locally and at the base, for enabling that problem to be successfully and economically handled.

At the outbreak of the war there were the following Departments of the War Office connected more or less with engineering science :—
(1) The Directorate of Artillery, whose duty it was to provide weapons of war and ammunition. This duty was afterwards transferred

MONTGOMERIE PRIZE.

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.

MILITARY WIDOWS' FUND, BRITISH SERVICE INDIA.

THE Military Widows' Fund, British Service, was established in India in 1820 to alleviate the distress of families of officers of the British Service *serving in India*, and to enable them to return to England without unnecessary delay. Whenever an officer of the British Service, who is a subscriber to the Fund, dies, his family receives at once the following assistance, namely, six months maintenance allowance ranging from Rs 2,400 to Rs 3,600 according to the rate subscribed, plus Rs 1,500 as a donation for the widow, plus Rs 500 or Rs 300 as a donation for each child according to whether the child is over 12 and under 21 years of age or under 12 years of age. These benefits are secured by a small subscription of Rs 4, 3 or 2 per mensem, which is regulated by the amount of pay an officer draws. An officer, on becoming a subscriber, secures for his wife and children quite irrespective of his length of service in India, the full benefits of the Fund in case of his death after having subscribed for fully three months. In the event of an officer dying within that period, his case is specially considered by the Committee of General Management. Copies of the regulations of the Fund and other particulars relating thereto can be obtained from the Secretary at Simla.

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