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A lecture delivered at the United Service Institution of India, Simla, by Colonel the Hon. Sir S. D'A. CROOKSHANK, K.C.M.G., C.B., C.I.E., D.S.O., M.V.O. (Published with kind permission of the U.S.I. of India).

My audience will no doubt realize that the subject of my lecture this afternoon on "Transportation with the B.E.F.," comprising as it does—

Organization and Administration,	Light Railways,
Cross Channel Services,	Ropeways,
Port Construction,	Roads and Road Transport,
Dock Working,	Workshops,
Inland Water Transport and	Stores,
Traffic,	Accounting and Statistics,
Standard and Matro-rouge Lines	<b>Q</b>

Standard and Metre-gauge Lines and Railway Traffic,

is not only so vast, but also so replete with technical detail that it were impossible to deal with it at length in the short space of time at my disposal. I propose therefore to give only a brief descriptive review of the operations of the D.G.T. organization in France.

2.—In order to assist me in doing so, I would, at the expense of being sentimental, ask those present here who were with the B.E.F. to take themselves back for the time to France and bring to mind those four and a half years of relentless and intensive warfare, and those of you who were not so fortunate as to have had the opportunity of service with the B.E.F., to try and realize the severity of the conditions which obtained, and the onerous difficulties encountered in that hard-fought struggle.

Picture to yourselves the cold winds, rain, snow, and damp of the winter in Flanders, and the strenuous nature of the fighting under winter and summer conditions all along the British front throughout the whole period of the war. The strain on the troops engaged was no doubt relieved by many pleasant interludes and happy recollections of rest billets in the land of France, sunny as France can be, but although relief was possible to a certain extent for the fighting troops, there was little or no rest for the Transportation troops under the Director-General of Transportation.

3.—They had firstly to make up for lost time in building up the immediate transportation requirements of the army. They then had to keep pace with the rapidly increasing numbers and the enormous

amount of materials which were being poured into France and sent up to the Front. Following this there came the period of intense pressure by which the enemy's line of resistence was eventually smashed, and finally, the severest test of all on transportation, the organization for the advance of practically the entire British army over the devastated zone from 30 to 50 miles deep (Arras to Mons) along the whole front, which had been scientifically and systematically demolished by an enemy who understood demolition and devastation to a nicety, and carried it out with the systematic practice and painstaking detail for which he had a justly high reputation. For the transportation troops this meant ceaseless work under high pressure and under great difficulties and discomfort. This was especially the case with the light railway men whose duties lay almost entirely within the shelled areas. Thus the tractor driver had to take up ammunition or supplies to his batteries or battalions on many a wild winter night, in inky darkness, under a heavy bombardment, over a road which had been trampled under foot into the mud. Their work was exceptionally heavy and extremely well carried out.

Other services like the Broad Gauge Construction and Operation, Roads and Quarrying, Docks and Inland Water Transport, Port Construction, Stores and Workshops, all had heavy leeway to make up and their task was more than fully cut out. Their splendid record was shared with the Labour Corps of various nationalities.

4.--I must, however, now proceed with the subject matter of my lecture. I think I am safe in saying, and I speak from personal experience as a Divisional C.R.E. at High Wood and Corps C.E. at Bouchavesnes, that in 1916 on the Somme the British Army was practically immobile. As you know, the pre-war arrangements for the B.E.F. in France were that with the exception, of course, of their own wheeled and motor road transport, and of a quota of R.T.O.'s, the traffic requirements of the British Army would be provided for by the French. It was very early seen that the French railways and French roads were not capable of maintaining the stress of war which was put on them, and little by little arrangements were being made by the Quartermaster-General's Department and the Royal Engineer Services to assist in railway construction and traffic and in road repairs and quarrying. In spite of the strenuous endeavours of stalwarts like Colonels Freeland, Murray, and Waghorn, the progress made was, owing to lack of supplies and administrative difficulties due to inexperience of warfare on this scale, wholly insufficient, and conditions were rapidly going from bad to worse. By the year 1916, the British Railway Companies had, however, commenced to carry out purely British Army works on a limited scale, but the transportation position on the railways and on the roads in the Somme forward areas was altogether inadequate, and it is probable that, had the Germans fallen back after the big British attack in September,

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1916, as they did in the early part of 1917, effective battle pursuit could not have been given. Light railways were in their infancy and only sufficient for purely local purposes.

5.—Realizing the position and foreseeing the difficulties that great leader, Sir Douglas Haig, had called in Sir Eric Geddes to investigate the transportation situation at large. The result was that the Director-General of Transportation's organization was formed as a separate entity towards the end of the year 1916. I daresay quite a number of you in my audience are asking themselves what exactly is a D.G.T. and what are his functions? He is not referred to in F.S.R., Part II., and where does he come into the military machinery? Why not have the ordinary directorships and departments under the O.M.G. and let them rip on their own? My reply to all this is that the D.G.T. is to transportation men, machinery, and materials, what the Financial Adviser is to funds, and directly it becomes a matter of conservation of technical personnel and plant, and for the matter of that of unskilled labour also, a position which very rapidly arises. then central technical control over the technical directorates and departments becomes necessary in the shape of a Director-General of Transportation. Whether the D.G.T. is under the Q.M.G. or is an independent agency is neither here nor there. The General Staff plan the operations, the Q.M.G. lays down the requirements-the when and the where, the nature and the amount-and the D.G.T. does the collecting and forwarding agency. His raison d'être is a scientific combination of the various transportation resources with a minimum utilization of *personnel* and power. Thus in the case of the B.E.F., to serve as an illustration, it was seen that metre gauge railways and 40 c.m. tramways could be neglected. Docks would have to provide for berths, cranes, guayside railway facilities. transit sheds, electric and gravity runners, overhead conveyors, etc., for a possible 100 per cent. increase of imports. Light railways, by comparison with the French intensity of 12 to 14 kilometres per -kilometre of front, for an 80 mile British front would require to organize for 800 route miles of line. The I.W.T. was to be supplemental to, and not in competition with, railways, and also in view of the demands for river craft for Mesopotamia it would suffice to limit their activities to 60,000 tons per dicm. Railway Traffic had their objective in relieving the French of the whole of the British Standard Gauge traffic in Northern France, and Roads had their work cut out to do all the new construction and practically all the repairs of the roads in the British zone, finding their own materials, plant and machinery. However, to return to my subject, with the B.E.F. in France at any rate, the D.G.T. worked independently of, but hand in glove with, the O.M.G., and in close co-ordination with the Headquarter Staff and Army Commanders, and with the G.O.C., L.O.C., and his commandants.

6.-At its birth the organization consisted of Sir Eric Geddes as D.G.T., Sir Phillip Nash as Deputy D.G.T., and General Freeland and myself as the Forward Area Deputies. Subsequently, Sir Eric went to the Admiralty, Sir Phillip to Paris as Inspector-General of Transportation, and General Freeland to Mesopotamia and India. Directorates and departments were organized as I have already detailed, and by the spring of 1917 the baby was already a flourishing infant ; by the end of the year, when handed over to me with Brigadier-Generals Brodie-Henderson, Hildvard, and Brough as my Deputies, it had grown to strength and vigorous manhood. In the army areas there were Deputy Assistants to the D.G.T. together with Traffic Officers, and the armies and corps also had light railway and road officers. Traffic demands were made on the Deputy Assistants to the D.G.T., who were in close touch with the D.G.T., H.O., and the technical directorates. The Forward Deputies prepared schemes, made inspections and gave co-ordination.

7.—I will now briefly discuss the doings of each department of transportation, inflicting you, I fear, with a flood of figures, my excuse being that this is a lecture on a technical subject.

Organization and Administration .- Seeing that the D.G.T.'s organization was practically a new and separate branch of the Army which carried out its own recruitment, training and administration, and that at one time the technical personnel against an establishment of 365 units comprising 95,518 skilled troops, amounted to an actual strength of 83 500 technical men, with transport, to which were added 78,800 unski led labour, making a matter of 162,500 men under the contro of the Director-General of Transportation, it will be seen that the dema ds on this department were very heavy. But mere numbers do ne cover everything in dealing with the immensity of the transportation problems of the B.E.F., and never at any time during its 21 years career did the D.G.T. possess a sufficiency of technical What our administration aimed at was to get and personnel. maintain a greater output from every unit, whether man or machine: These demands were, at the beginning, successfully dealt with by General Hardinge-Newman and later on by General Charteris, whose well-known pushfulness and zeal met with every success. This department, working in with the special depôt in England at Longmore, dealt with the D.G.T. personnel from the time of recruitment until the time of demobilization. It was in touch with, but independent of, the Accountant-General's branch, this being necessary because of the large number of technical men of various trades which were required in the different branches. The trades enlisted were in many cases quite outside the ordinary recognized trades for Royal Engineer Services, and it serves to illustrate the variety of trades to tell you of the diver recruit who, on reporting himself in France, was jovfully welcomed for underwater work, and on being asked what diving experience he had, stated that he was employed in that capacity at the Carlton Hotel! It transpired that he was the gentleman who dived for spoons and forks in the plate wash tub of that famous hotel restaurant.

The doings of the organization branch of the Director-General of Transportation are a lecture in themselves, as they comprise the organization of an entirely new branch of the army from its inception, and the development and maintenance of the same until the close of the operations, when D.G.T. was amalgamated with the Quartermaster-General's services. With the exception of the overseas railway troops all transportation troops were enlisted in the Corps of Royal Engineers.

8. Cross Channel Services.—The Naval Transport Service was represented at the D.G.T.'s headquarters by the Principal Naval Transport Officer, who with his Royal Navy district officers at the ports worked in with the D.G.T. Docks Directorate, with whom were also associated the Directorate of Inland Waters and Docks on the other side of the Channel. The features of the Cross Channel Service were the Cross Channel Barges and the Train Ferries.

The former was based on Richborough and the Thames, and went up into the canals on our side to the inland ports and depôts. The Cross Channel Barge Service, which in October, 1918, was handling a traffic of 25,000 tons a week, was also most useful in importing and evacuating stores and materials and was invaluable in releasing shipping.

The Train Ferry Service commenced in February, 1918, with three vessels intended to ply between Southampton and Richborough, and Dunkirk, Calais, and Dieppe. A fourth ferry boat was later on purchased from an American Lake Service for the Southampton-Cherbourg Service, but was found to be too top heavy for sea traffic, and was never usefully put into service. The advent of the Train Ferry Service made a marked advance in cross-channel transportation facilities in dealing with certain traffics. Each ferry was designed to take 52 standard guage 10-ton unit wagons, and the tying up and off-loading was completed in a matter of 15 minutes.

British wagons to loading gauge were thus run from collecting centres at home to depôts in France without unloading; the advantages of which in handling aeroplane parts and fragile stores, cranes, road rollers, artillery, and transport may well be imagined. But the greatest value of the service was in bringing over the railway locos. and wagons, the tanks on special tank wagons, and the rail-mounted guns. Hitherto, at great trouble and delay, these guns, of which there were no less than 84 with the British Army in France, had been landed from ship by crane, whereas now the gun in its travelling position was run aboard in England and run off in France straight to its destination. We were thus able to import guns like the Japanese

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14-inch, which weighed a matter of 296 tons and having an over-all length of 87 feet, without any craning and remounting, the difficulties attendant on which were enormous. For instance, just imagine having to handle a 90-ton barrel with our one and only 100-ton crane at the Bombay Dockyard at the end of a narrowjetty with turn-table manipulation. The vessels were decked to take mechanical transport wagons or loose horses if so desired. These ferries, which handled a to-and-fro tonnage of about 7,000 tons per week, were, when I left France in August last year, fully engaged in evacuating British rolling-stock and materials, and I contend that the service more than repaid the cost of the vessels and landing staging. It is possible to visualize very great use for these train ferries in India in Bombay Harbour and on the great inland waterways of Bengal, Assam and Both the Cross Channel Barge and the Train Ferry Burma. Services were run from home in combination with the D.G.T. organization.

9. Port Construction.—This Department was not called upon to carry out any extensive new works like the Americans had in constructing a new port on the Garonne, but they had a difficult and interesting job in the construction of the landing stages at Dunkirk, Calais, Dieppe, and Cherbourg for the train ferry termini. They also undertook the construction of railway facilities at quayside, and carried out hut and workshop construction. After the Germans had evacuated Ostend and Zeebrugge we sent some of our port construction engineers and skilled construction troops to help open up the docks and make a preliminary clean-up preparatory to handing over to the Admiralty and the Belgium authorities.

Dock Working .- The operations of the Docks Directorate το. under Brigadier-General Wedgwood, the brother of the well-known M.P., were very striking. The improvements effected in dock working were very far-reaching and we were able to raise the rate of discharge of ships from 12 to 34 tons per hour in port with an efficiency of 12 cwts. per man hour, and when, as was often the case, the D.G.T. organization was scoffed at on the score of expense, one was able to realize that the practical value of these figures applied over a week or so probably more than counterbalanced the whole cost of Geddesburg and its inmates. The ports operated were Dunkirk, Calais, and Boulogne in the north, and Dieppe, Le Havre, and Rouen in the south. Etaples, St. Valery, and Le Tréport were also used to a certain extent. The organization, handling the cranes, took over the import cargoes from the naval in-board service and passed them into depôt, barge or wagon according to circumstances. It made its own arrangements for cranes, conveyors, power and gravity runners, sheds, etc., and supervised the wharf labour handling the cargoes. The Docks Directorate also handled the export traffic which averaged 10,000 tons per week. It is interesting to note that the Americans made dock and depôt preparations for an import of 100,000 tons per day, but never actually reached that figure.

11. Inland Water Transport and Traffic.-The value of this Directorate, which conducted the barge services on the inland waterways of France and Flanders, was very great. At the end of 1918 the length of waterways operated was 474 miles, and our fleet consisted of 591 barges and 389 tugs, etc., or a total of just on 1,000 craft, and the organization was to take overside deliveries from ship to inland port, and again to move cargoes from inland depôt to the forward areas. The I.W.T. also operated on the Somme up to Amiens and Peronne, and on the Seine into Paris. Private civil canal traffic was controlled by them in co-ordination with an International Committee. This Directorate carried out very successful ambulance services for the evacuation of serious cot-cases from hospitals in the mid areas down to the base hospitals, and also moved sick horses for the Veterinary Service and sound horses for remounts in considerable numbers, and troops as required. On the Scarpe and Lys river canals the light craft were put to good use in handling materials and also the wounded by water in the battle areas. The tonnage handled by the I.W.T. in 1918 with a capacity of 130,000 D.W. tons averaged 60,000 tons per week. This Directorate, ably presided over by Brigadier-General Luck, late of the Royal Indian Marine, was also of great use in helping the Royal Engineer Services with their bridge construction work, and their assistance generally was much appreciated by the French, Belgians, and Americans. They built their own wharves and guays, and carried out their own repairs. Altogether a highly efficient and most useful branch of Transportation.

12. Standard and Metre-gauge Lines and Railway Traffic.—We now come to the construction, telegraph and telephone working, signalling, operation and traffic handling of the main lines. It is quite out of the question for me to deal here with this big subject, but to commence with I will give you in figures some idea of the extent of standard gauge line construction for the B.E.F. In 1914, 15 miles were laid ; in 1915, 104 miles; in 1916, 417 miles; in 1917, 814 miles; and in 1918 and during the first two or three months of 1919, we put down 1,314 miles, making a total of 2,650 miles of new line. In addition, during 1918 and early 1919, 1,750 miles of track demolished by the retreating Germans were reconstructed, making a grand total in all of 4,400 miles of track opened to traffic.

The rate of construction in 1917 reached the very high figure of  $6\frac{1}{2}$  miles of new line per day, that is to say not mere track but formation, bridging, ballasting and track laying complete, and in 1918 we were reconstructing lines at the rate of over 20 miles a day. As an example of the work done by Colonel Lyell, the Chief Railway Construction Engineer, and the British Railway Companies, I may

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mention that, although Lille was only evacuated by the Germans on 17th October, 1918, they had by the 25th *idem* reconstructed the line from Bailleul across the trenches of both sides, built a temporary bridge over the Lys River and were able to run the first supply train for the relief of the civil populace into the city that day, opening a passenger service the following day. We used a certain amount of chaired track picked up from Home lines, but nearly all our lines were laid with a specially rolled 75lb. rail which gave great satisfaction.

The bridging operations were on an equally large scale, and 37,000 running feet of single track timber bridging were constructed by the railway troops.

 $S_{\frac{1}{2}}$  million tons of ballast were procured and laid on the formation, being  $3_{\frac{1}{2}}$  times the amount of excavation for the Channel Tunnel from Dover to Marquise.

It may interest you to know that for the big attacks it was found that it was necessary to push forward standard gauge lines at intervals apart of about two miles; thus for the Messines-Wytchaete operations on an eight-mile front we had temporary forward lines on the Ypres-Roulers, Ooderdom-Dickebusch, Lindenhock, Douve Valley and Neuve Eglise alignments.

On the traffic and operating side the Railway Operating Division under Colonel Paget worked at one time 1,333 kilometres of line with 1,471 of their own locos and 70,346 10-ton unit imported wagons, the average haul being 60 kilometres with 33 wagon trains. On the metre gauge we operated up to 62 kilometres of line with 67 locos and 1,200 wagons imported. The minimum weekly average number of B.G. trains worked by the Traffic Department for the British Army amounted to 287 trains per day, and the *personnel* carried during August, 1918, averaged 350,000 all ranks per week. For the evacuation of the sick and wounded, we had in use 40 ambulance trains and for leave men we ran a dozen rakes of made-up "Noah's Ark " stock.

Troop movements were worked to the scale of one train per three hours at each of three stations, making 24 trains per 24 hours maximum. The capacity of single lines with passing stations about two miles apart was 16 to 24 trains per day each way, according to the terminal facilities. On the Bergues-Proven double line which we opened for the Passchendaele operations we operated up to 56 trains per day each way, but here we experienced great difficulties with the sand ballast, as the Flanders slush working into the ballast flooded the sleepers. It will perhaps convey some idea of the traffic handled to state that in the bombardments in the major operations 40 broad gauge train loads of animunition per day were often fired from the gun, which worked out in some cases to  $1\frac{1}{2}$  tons of metal per day per yard of front attacked. The all-in allowance for Divisions in the

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fighting line averaged nearly  $2\frac{1}{2}$  trains per Division per day, the pack trains carrying the daily supplies at the rate of two Divisions per train. The big ammunition depôts were worked entirely by our R.O.D., the layout of that at Dannes Camiers near Boulogne, for instance, having a 75,000 tons capacity and 45 miles of B.G. line, and great credit is due to General V. Murray, Colonels Magniac, Russell, and Birney and the staff of the Traffic Directorate for their successful handling of the heavy traffic of the B.E.F. under very difficult conditions.

13. Light Railways.—But the greatest progress in any branch of transportation was made by the Light Railways Directorate under General Harrison of the Argentine Railways.

In early 1916, although the Germans and French armies were by then working extensive light railways systems along their fronts, the British Army had only made a commencement with a small system operated by Captain Delphine, under General Nanton, at St. Eloi, alongside of which in my Division, the 47th (London)-the foundation of whose great successes in the war, I may mention, was due to the training and instruction given in its earlier incarnation by its late commander, His Excellency, our present Commander-in-Chief in India-we were putting down the Carençy, Souchez, Zouave Valley system to feed our front line on the Vimy Ridge. So that General Harrison practically struck out on a new line with a clear Beginning in January, 1917, with a tonnage carriage of 10,000 field. tons per week he had for the Messines operations in July of the same year reached 180,000 tons per week, and by March, 1918, the tonnage on light railways had amounted to no less than 280,000 tons of all traffics per week. The German offensives of the 21st March and 9th April brought this down to 120,000 tons per week, after which it again fell to the salvage and evacuation level of 40,000 tons per week.

I could yarn quite a lot on light railways, but I must content myself with giving a few figures of interest derived from actual experience.

All our light railway lines were on the 60c.m. (Ift. II $\frac{1}{2}$ in.) gauge and we had no use for the 40c.m. tramway track extensively used by the French. We had a 20lb. section by 5 metres rail, but recommended a 25lb. section to the Americans, who adopted it and, I understood, found it satisfactory. Besides the 20lb. rail we imported and supplied 8 and 16lb. track for tramway and R.E. Services. The locos were Baldwin and Hunslet 4/6/0, and American 2/6/2 and the tractors mostly 20 and 40 H.P. Simplex and 45 H.P. Petrol Electric, and all manner of wagons from 10-ton bogies down to  $3\frac{1}{2}$ -ton open wagons. Even smaller units were used, or obtained for the R.E. Services. On active fronts we put down an average of 10 kilometres of track per kilometre of front. On less intensive fronts the ratio was as 6 to I.

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Light Railways operated at times over 1,000 route miles of line, and they laid some 3,000 miles of track during the two years of their existence. The rolling-stock on charge was 640 locos, 875 tractors, and 5,918 wagons. These figures give a close comparison with those for the whole of the 2ft. 6in. and 2ft. oin. gauge systems in India taken together.

The traffic on each light railway system along our front was controlled from the local headquarters of the Assistant Director of Light Railways with each army, who kept card index logs of each loco and wagon, controlled the traffic and checked by selector telephone.

Corps systems were designed to take up to 3,000 tons per day with 80-ton load trains on a maximum 2 per cent. grade and 30-metre curve, but the corps traffic offered rarely ran to more than 1,600 tons per diem, the balance being available for railway ballast and material. For the advance of the 5th Army in the Passchendaele operations arrangements were made to run forward a separate light railway line for each corps at a rate of advance of two miles per day. A great feature of our light railways was that we used them to carry traffic of all natures, for moving field guns and howitzers along the front, and also extensively for gas projector attacks. They were of immense value in transporting working parties as well as fighting units up to the front, to save them the long march over crowded roads and tracks under shell-fire. As many as two hundred thousand men were transported thus per week, and the forward ammunition traffic often rose to 50,000 tons per week. The light railways also carried wounded and water in special wagons, and ran completely fitted up repair trains. Breaking load for transhipment from S.G. to L.R. was effected on the average :

Ammunition at 7 miles from the front line.

Stores 6 miles.

Stone, planks, etc., 4 miles.

Independent hospital or forest systems were based on a minimum traffic of 400 tons per *diem*, and the maximum lead for satisfactory working was found to be about 12 miles. The losses in rolling stock as a result of the German advance in 1918 were about 400 power units and a couple of thousand wagons. These losses were inevitable, as at Amiens the Germans overran the whole light railway system *cn bloc*, in spite of the fact that special run-back lines had been provided at intervals behind our line in anticipation of a set-back at any portion of it. All losses were, however, made good during our advance, during which the German L.R. stock was also captured.

14. Repeways.—Those being brought into use in France towards the end of the war were the Hamilton and Leeming ropeways. The former has an average capacity of 20 to 25 tons per hour, and is worked by a 25 H.P. petrol engine. The rope speed would be about four miles per hour, with a maximum single load of 300lbs. and a point-to-point gradient of 6 per cent. The Leeming ropeway is a lighter plant of about 15 tons per hour capacity. It has the advantage for forward area purposes of facility in being lowered to lie flat on the ground to escape observation by day, but this plant is not sectionalized like the Hamilton.

Although ropeways were in extensive use in Italy during the war, they were only just coming into use in 1918 for British front line transport in France by the newly-organized "Forward Transportation" Companies which were destined to work the tramways, ropeways, etc., in the Brigade forward areas ahead of the main D.G.T. Organization to a traffic of about 600 tons per corps *per diem* for 16 Corps.

15. Roads.—The B.E.F. was severly handicapped by the loss of the famous Quenast quarries near Brussels, held possession of by the Germans, which supplied the granite setts and superior macadam to Western Europe generally, and I believe also to Kent and other English counties. We had to depend for our road metal on the output of stone of average quality from the Marquise quarries near Calais and from quarries in Basse Normandie, together with superior granite imported from the Channel Islands and iron slag from Middlesbrough. Concrete ballast supplied to the R.E. Services was obtained from the gravel beds at Aire and elsewhere, and mine earth for standings from the coal pit heaps.

To give you an idea of the magnitude of the operations of the D.G.T. Roads Directorate, organized and controlled by Brigadier-General Maybury of the Road Board, I may mention that the stone utilized equalled that required for a road 12 feet wide by 12 inches thick, being the like of a first class Indian Provincial road, 1,997 miles in length, and the timber used in road construction, that is to say, the sleepers and 3-inch beech planks laid in timber roads, would have made a 9-foot wide road 374 miles long.

The Director of Roads obtained altogether 166,600 tons of granite from the Channel Islands, and 216,000 tons of slag from Middlesbrough, before shipping difficulties prevented further importation of these valuable road metals. He took three million tons of stone from the Marquise quarries, a fine performance on the part of the Quarry Companies and German prisoners, and at the rate of 4,750 tons per week from the quarries in the south.

At times we used to take 20 full train-loads of stone from Marquise every day, and even then we were not able to fully satisfy the requirements. For transport, quite apart from the army motor and wagon transport supplied on daily requisition, we had r,066 lorries, mostly of the 5-ton Steam Foden Tip type which were found to be particularly useful. We also had a matter of 930 special American dump carts for distribution of metal along the road. This is a very handy material cart having a drop floor and a good lock. The tarring

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operations which were carried out during the summer months gave a splendid travelling surface, and practically did away with the dust nuisance on the main roads, on advance roads under distant observation, and in and around hospitals and depôts. Practically the whole of the road *pcrsonnel* was obtained from England, and when one comes to think what a Herculean task it was to maintain the existing roads and to make roads through the mud of Flanders and across the trench zone, one can understand the difficulties which this Directorate had to contend with, and appreciate the successes which they obtained. Towards the end of the war the D.G.T. Roads Directorate was maintaining a total length of 4,412 miles of road.

16. Workshops.—Besides departmental local shops for running repairs we had main workshops at Andruicq (near Calais), Rang du Fliers and at St. Etienne (near Rouen), which latter shops were ably managed by Colonel Cole, now Secretaty to the Indian Railway Board, for main line stock, and at Berguette and later Beaurainville for light railway and road stock. Engine and wagon erection and heavy repairs of all sorts were carried out at these shops, so that the task imposed on Colonel Simpson and the mechanical engineers was a very big one. We were also greatly assisted in our heavy repairs by the South Eastern and Chatham Railway.

17. Stores.—The main depôts were at Andruicq in the north and at Oissel in the south, with expense depôts and dumps in the army areas. However good the organization of the Transportation Departments everything depended on the regular and sufficient supply of stores of all sorts and kinds, and the management of this very important department gave great credit to Colonel Kellner of the Indian Railway Audit Department who was in charge.

I may remark that the Andruicq depôts and shops covered an area of over 700 acres laid with 70 miles of S.G. track, and that we aimed at maintaining for an advance through Belgium a reserve stock of 700 miles of B.G. rails, fastenings and sleepers at this depôt.

18. Accounting and Statistics.—I will refrain from expatiating on the doings of this branch by whom an accurate record was kept in simple business-like form of all financial transactions and storekeeping. The Railway Accountants section was a particularly heavy one in keeping tally of haulage, loco and wagon hire, and such like exchange charges, and on the closing down of D.G.T. last year a complete debit and credit account running into millions was given in to the War Office for adjustment in the national settlements. Throughout the operations weekly reports of the transportation position and of the traffic of all natures handled were submitted punctually to G.H.Q., to armies and to the War Office. A summary was prepared quarterly, and at the close of the year a review was issued which briefly covered the whole working of the several branches of the D.G.T. organization. But special value was attached to the upkeep of graphs illustrating the progress made and traffic handled. By this means an immediate working check was maintained and an accurate record kept, and one was able to see at a glance the tonnage discharge per hour in port at each port, or the coal consumption per loco kilometre or petrol per tractor mile week by week. In the portfolio of 23 plates there exists a complete record of the D.G.T. work which can be seen at a glance and studied throughout in half an hour. We attached a very high importance to statistical graph keeping and secured very great advantages in economic working and good record therefrom.

19.—Time does not permit me to go into the actual working of the D.G.T. organization, but I may perhaps mention that for the Somme, Arras and Messines operations we put down 55, 65 and 90 miles respectively of new broad gauge line. At Cambrai in November, 1917, we had an interesting job in bringing up, under conditions of extreme secrecy, the 350 or so tanks which took part in the surprise attack.

Great anxiety was felt in the critical transportation situation which arose as the result of the enemy's advance in 1918 on the Somme and Lys as thereby our extremely important forward lateral, St. Omer, Hazebrouck, Lillers, Bethune, St. Pol, Doullens, and Amiens for Paris came within the range of his guns. We were thus driven back on to the Calais, Boulogne, Etaples, Abbeville coast line with weak forward lines and poor railheads. Quickly seeing this, the German airmen set out to bomb the vital points causing serious damage in Abbeville, Boulogne, and Calais. But his main aerial attack was directed at the railway bridge over the Conche River and the station at Etaples. Realizing the importance of this bridge, we had set about to lay a diversion line and it then became a keen contest whether he cut the old line or we opened the new line first. Eventually he got a direct hit on the track and blew in one span of the bridge at the same time causing great damage and heavy casualties at, and around, the station, but his supreme effort to interrupt communication between North and South was by great good luck foiled, as the diversion line which we were building, and we had to go over a mile upstream to get a good temporary bridge crossing, had fortunately been opened the day before and we were able to pass without delay a heavy French troop move in reinforcement of the Mount Kemmel operations. This incident was therefore a matter of satisfaction to all alike, French, Bosch, and British. In anticipation of aerial bombardment we had also steel decked and timber centred the railway viaduct at Wimereux, but this target escaped attack.

20.—Before concluding my lecture I must take the opportunity of rendering a tribute to the Engineers of all sorts and ranks from nearly every part of the globe who served in the D.G.T. Organization. These Engineers differed widely. The Home Engineers, highly

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technical and skilled, but at first lacking adaptability. The 14 battalions of Canadian Railway Troops under General Stewart, self-reliant and resourceful to a degree, and invaluable in the construction of standard and light railways and timber bridges. The rapidity with which they worked was little short of marvellous, being greatly facilitated by an extensive knowledge and use of laboursaving devices in the shape of mule hauled scrapers for making banks and cuttings, the 2-ton Marion steam shovel which eats into hard chalk like sand and fills a muck train in 15 to 20 minutes, the plough wound by the engine which clears the said train from end to end in one haul, followed by the engine plough which clears and levels the spoil from the side of the track. These and other devices more than proved their value. Three battalions of U.S. Engineers under General Harts, and the operating companies lent by General Atterbury, the American D.G.T., were thoroughly representative of the go-ahead American Expeditionary Force under the command of their magnificent leader-General Pershing. The Portuguese Railway Troops not only worked well, but stood up satisfactorily to shell-fire. The Australians, New Zealanders and South African railway men also put in splendid work of great value to the B.E.F. Perhaps the best all-round individual Engineers were the home men who had colonial experience, but the Indian Engineers, Royal and Civil, with good qualifications, considerable practical experience and administrative ability, held their own easily, and were in fact the foundation and backbone of the whole D.G.T. organization administration. The Belgians loaned us barges and engines, and helped as far as possible in their power. But the heaviest strain fell on the French railway organization, who had made the mistake, which we did ourselves in the earlier days, to send too many of their younger technical men into the firing line, consequently their railway men soon became worked out and it was only due to the pushfulness and resource of their transportation Chiefs, Colonels Payot and Boquet, and men like Colonel Dumont and Monsieur Javary of the Nord Railway, that they were able to carry on. Their wagon control was unfortunately very weak and our efforts to induce them to organize it on sound lines in co-ordination with our B.O.D. wagon control were unavailable. Consequently there was considerable wagon wastage and great difficulty in adjusting the traffic requirements at the different centres. However, all is well that ends well.

21.—The D.G.T. organization was subjected to non-professional criticism in connection with its arrangements for following up the general advance in the latter part of 1918, but the layman cannot possibly conceive the enormous difficulties which confronted transportation at this stage and throughout the winter of 1918–19. The men, mostly of advanced years, the glamour gone and peace in sight were absolutely worn out, and they wanted to return to their families and civil occupation. The demands were exceptionally heavy, and it was only with the greatest difficulty by ruthlessly shutting down light railways and other services, and sacrificing everything to the construction of roads and main lines and handling the traffic, that we were able to carry on at all.

22 .- My request to the General Headquarters that only contract and police troops should be pushed forward over the devasted zone was deemed impracticable and the best part of five British armies and the cavalry took up the advance into Belgium. As may be imagined, the transportation position became acute, but we have this to our credit that I believe only on few occasions did the advance troops find it necessary to requisition on the countryside for supplies. The French on our right and following in our wake under more favourable conditions, progressed but slowly, and the Americans at the pivot end of the line and on a much smaller scale were, I was given to understand, on the verge of starvation. Our difficulties were increased by the severity of the winter season on the destroyed communications, and by the large number of delay-action mines which the enemy had buried in the main lines. These mines were sometimes double action, and set over a period of four months or more, but the chief difficulties in maintaining main line traffic were in the lack of telegraphic and telephonic communications, signalling facilities and engine water supplies, which had been systematically destroyed right into Belgium, making intensive traffic working on the scale then demanded a super-human task. One of our chief difficulties at this stage was that the French and Belgians barged in with heavy civil traffic on the temporary lines which for political reasons the allied military authorities had to give in to. It will be seen that the layman was probably not in the know of all the facts on which to frame a fully considered opinion.

23.-However, troubles in plenty there were on every side, and D.G.T. was an endless struggle with the deficiencies of the past, the detection of mistakes at the time and the provision for the possibilities of the future. I was always at great pains to illustrate our mistakes to my numerous visitors at D.G.T. That this had its value was brought home to me by the remark made by an American Transportation officer who came to study our methods. After showing him round and telling what we had done and where we had gone wrong, on his departure with delightful candour he said : "Say General "-and I was a General in those days-" Say General, I have to thank you for your hospitality and the highly interesting and instructive time you have given me. I can say this that I have profited quite a lot by your mistakes." And, for the matter of ' that, in the preparation of this lecture for the most part by drawing on my memory I cannot claim exemption from inaccuracies.

24.-The wind-up of Transportation with the B.E.F. was that

the whole outfit of track on the ground, plant and machinery, craft and rolling stock was taken over by the Disposals Board. By that time the Army of Occupation on the Rhine was being maintained by Rhine barges viâ Rotterdam, ordinary train service viâ Antwerp and a fast leave and staff service viâ Boulogne on which we used converted Ambulance trains as sleepers. This daily passenger train was facetiously called the "B.C." Express, although we ultimately got it to run through from Boulogne to Cologne in 16 hours, which was not bad going. The evacuation of locos, wagons, motor transport vehicles, horses and carts, etc., was being carried out by Cross-Channel services to Richborough; and fixtures such as hutting, shops, etc., were sold off by auction as they stood on the ground. I need go no further.

I fear I have rather overwhelmed you with facts and figures, which I have given you, not in any way in glorification of "Transportation with the B.E.F.," as might appear to be the case, since it were superfluous to extol that wonderful organizer and great leader and driver, Sir Eric Geddes, and the splendid efforts of all ranks of D.G.T. speak for themselves, but for their practical value and in order to show what the transportation requirements of a big war actually amount to, if only as an object lesson and a study.

Transportation in France has, I claim, a great past, on the other hand transportation in India has, I maintain, an immense future. One has only to step outside to see how backward we are here in Simla with lifts, ropeways and such like local transportation facilities, and to look at the map of India with the country cut up into strips by the great rivers, and only as many ports as can be counted on the fingers of one hand, ill-connected by railway at that, to realize the situation and the importance of studying transportation closely in all its branches balancing its possibilities and improving it in all directions.

Sir George Buchanan has done good service to draw attention to our ports, and Lord Montagu of Beaulieu, Mr. Dorman and other writers to our roads. There is surely every reason to encourage more transportation by our inland waterways. However, these are matters for the General Staff and for the talked-of Transportation Department, and not the theme of my lecture, which I must now bring to a close.

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

REFERENCE has been made from time to time in The Royal Engineers Journal to the official war records which were in course of preparation, and portions of which have already been printed in the Journal. A proposed synopsis of the whole work was published in the Journal for September, 1919.\* At the time when this synopsis was first drawn up it was supposed that these records would be published by His Majesty's Stationery Office at public expense. For various reasons this has not proved feasible and, as agreed at the last Annual Corps Meeting and announced in the July, 1920, number of the Journal, the first cost of publication will be borne by Royal Engineer Library funds, and the enterprise therefore becomes financially a private one on the part of the Officers of the Corps. For this reason a more detailed account seems rightly due of the work that has both been done and left undone. Before going on to this account it is as well to make it quite clear that the available funds will only cover the cost of production of a very few volumes; and upon receipts from sales of the first volumes will depend the issue of further parts.

\*The proposed synopsis was as follows :----

Part I.—General. Development of the Corps. Causes that led to the formation of new branches and units. Charts to show organization and strength of the Corps in August, 1914, and Nov., 1918, etc., etc.

Part II .-- Work under the Director of Fortifications and Works.

Part III .- Work in the Field under the Engineer-in-Chief, B.E.F.

Section	1. General.	Section	9.	Inundations.
	2. Engineer Intelligence.		10.	Camouflage.
	3. Defences.		11.	Anti-Aircraft Searchlights.
	<ol><li>Bridging,</li></ol>		12.	Foreways.
**	5. Water Supply.		13.	Concrete Factories and
.,	6. Machinery, Workshops, Elec-		2	Defences.
	tricity.	.,	14.	Experimental Section.
.,	7. Mining.	**	15.	Hutting and Encampments.
"	8. Geology.		1Ğ.	Schools.
Part	IV Work in the Field under oth	ier Branc	hes	of the Staff (France).
:Section	I. Maps.	Section	4.	Postal Section.
	2. Gas Services.		5.	Meteorological.
	3. Forestry.		5	
Part	V-Work in the Field in other	Theatres	of	War
Section	T. Egypt.	Section	~	W Africa
	2. Gallinoli.	Dection	- <u>C</u>	R Africa
,,	2. Mesonotamia	,,	¥.	Miscollanooue
	4. Salonika.	**	7.	.mscenancous,
· · ·				
Part	v1,work under the Director o	t Works	(Fr	ance).
Part Section Part Section , Part Part	IV.—Work in the Field under oth r. Maps. 2. Gas Services. 3. Forestry. V.—Work in the Field in other r. Egypt. 2. Gallipoli. 3. Mesopotamia. 4. Salonika. VI.—Work under the Director o	er Branc Section Theatres Section ,, f Works	hes 4, 5- of 5, 6, 7. (Fr:	of the Staff (France). Postal Section. Meteorological. War. W. Africa. E. Africa. Miscellaneous. ance).

Part VII .- Work under the Director-General of Transportation.

Part VIII.-Supply of Engineer Stores and Material.

Many of the subjects must have a wide field of interest in the Civil Engineering world, and, to a much more limited extent among the general public; but the problem is how to explore these fields. The cost of advertisement on a large scale is entirely prohibitive, and the problem is not an easy one. Any solutions will be gratefully welcomed, but meanwhile it is evident that a good deal can be done individually in bringing the books to the notice of anyone who might be interested, but who would not in the ordinary course see *The Royal Engineers Journal*.

The general object of these books is to present a simple record of the military engineering activities of the War, which may serve not only as a reminder of what has actually been done, but as a guide for future generations to what they may have to do in other wars. On most subjects the information has been plentiful and the difficulty has been rather one of omission than of collation. In deciding what to include, the criterion has been general and permanent as opposed to personal and fleeting interest. No attempt has been made to record the full activities of formations or units, nor would it have been possible within the scope and time of this work ; and so individual actors in the great drama may look in vain for accounts of many of their most cherished scenes and triumphs.

The actual synopsis more or less explains itself. Each technical subject clearly had to be treated separately, the principal question being whether work in all the theatres of war should be included in each technical volume. This was ruled out for several reasons, the deciding factor being that full records were available from France much sooner than from distant theatres, and to await these would have caused a delay of many valuable months. The intention was to compile one complete volume for each minor theatre of war ; actually records are in most cases still far from complete, and, as it has been found necessary to finish off the present work before the end of September, these volumes have perforce been abandoned.

Possibly volunteers may be forthcoming to complete the work later on; meanwhile the available records have been placed in the Royal Engineers Library, Horse Guards, where they may be studied at any time. There is one important exception. The Water Supply operations in Egypt and Palestine, one of the most interesting exploits of the whole war, have fortunately been fully recorded, and a slightly condensed version of the official report has been prepared for publication among the first volumes that will be issued.

To revert to the original synopsis : Part I. "General" and Part H. "Work under the D.F.W." have not been proceeded with separately, but the work of the F.W.5, F.W.8 and F.W.9 branches is included in Part VIII., "Supply of Engineer Stores and Material." This Part is ready for publication, and, in view of the importance of the subject, • it is hoped to issue it as a separate volume at an early date.

As will be seen from the table appended to this article all the sections of Part III., "Work under the Engineer-in-Chief, B.E.F.," are ready with three exceptions :- Section 1, " General," would have been mainly recapitulation and has been abandoned; ; so has Section 15, "Hutting and Encampments," which is fully dealt with in the history of the Works Directorate (Part VI.). There was a certain amount of additional material in the shape of plates showing type buildings and lay-outs from various Armies, and these have been sent to the Construction School, S.M.E. The third exception, Section 3, "' Defences," needs more explanation. The fact that a volume on this subject was not among the first for publication has already aroused comment and criticism, and that no volume at all on the subject should be proposed will no doubt arouse still more. But a very little thought will disclose some of the difficulties of the task, difficulties that on closer examination have appeared to the writer to be insuperable. To begin with defence works are by no means the preserve of the Royal Engineers. The General Staff is mainly responsible for "Siting," whilst R.A. and machinegunners are at least equally implicated with the Royal Engineer. "Execution" of work is to a great extent in the hands of other branches than Royal Engineers, a point that is apt to be overlooked, with the result that execution and responsibility become divorced. "Design" is certainly the business of the Royal Engineer, but here there can be no finality, nor could the subject be treated separately. Emerson says " . . . it is as difficult to appropriate the thoughts of others as it is to invent," which may account for the embarrassing variety of design that was always to be found in all defence work. " Defences " have to be standardized for the Army in the same way as "Stores" and "Equipment." That is to say, that the most suitable types for general use are selected as the result of prolonged study and test by a Committee, and are finally described in an official handbook, training manual, or vocabulary, as the case may be. But wee to the historian who tries to relate in official form the work of defences in the Great War. Shortly, it cannot be done. Defence work consists principally in applying a few fixed principles to innumerable changing conditions, and the ways in which this may be done are infinite. And so an infinite number of volumes might be written on the subject; each one of them representing the views of one individual, which would never be quite the same as those of any other. No subject is more full of possibilities or gives a wider scope to a writer, and it is to be hoped that not one but many unofficial books may be produced in time. Anyone who wants some preliminary practice might do worse than try his hand at writing a

†For a General Survey see Major-General Sir G. M. Heath's lecture before the Institute of Civil Engineers.

sequel to Ch. XI. of General Thuillier's Principles of Land Defence.<sup>‡</sup> Those who have read this book will remember that the first half of it is devoted to a study of the development of fortification from the earliest ages in accordance with fundamental principles. A sequel covering the period 1914–1919 would supply a fascinating page of h'story. One might go further and suggest that an essay on these lines by students at the end of every Military Engineering course would provide a better test of the value of the course to the students than any number of ordinary examination papers. But this is a digression. Reports are in existence of the organization of Rear Zone Defences in France in 1914–15, and again in 1918 under the Engineer-in-Chief, and it is hoped to publish these shortly in the *R.E. Journal.* 

Part IV.—" Work under other branches of the Staff (France)" is complete. Sections 2, 3, 4, and 5 have all been published in *The R.E. Journal*, whilst Sect. 1, "Maps," has been written and is being issued separately under the General Staff.

Part V. has been dealt with already. Part VI., "Work under the Director of Works (France)" is ready for publication.

Part VII, "Work under the Director-General of Transportation," is understood to be in preparation, but it is not known when or how the records will be published. Most branches of Transportation are concerned with essentially Engineer services, and the special conditions that produced a separate organization in France are referred to more than once in the R.E. records. In the more distant Expeditionary Forces transportation (or communication) services formed, as has always been the case, a large part of the work of the Royal Engineers, and this was an added difficulty in the way of combining all theatres of war in the same volumes.

Finally, a word must be said about "Signals." Although the Signal Service has become partially independent it was throughout the War an integral part of the Corps of R.E., and no account of R.E. work in the War is therefore complete without some reference to "Signals." In the volume entitled "Supply of Engineer Stores and Material" much space is devoted to Signal stores, but Signal work comes in a category of its own and its history can only be written by members of the Signal Service.

To complete this short summary, a list is appended of the various manuscripts and files that have been placed in the R.E. Library and elsewhere, and another of the volumes that have been actually completed for publication.

It has been impossible to prepare these records without becoming more than ever deeply impressed by the remarkable range and

\*The Principles of Land Defence, by Captain H. F. Thuillier. Royal Engineers. Longmans & Co., 1902.

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variety of occupation that fall to the lot of the Royal Engineer; so remarkable indeed that there can surely be no other body of men in the world who have an equal scope of employment and interest. And yet science, and especially the application of scientific methods to war, which is the special province of the Military Engineer, is still in its infancy; so that however great the interests of the past they are overshadowed by the possibilities of the future. The aftermath of war always brings its changes and controversies, and the present is no exception; but he must be a sad pessimist who cannot see the sun shining through summer mists. That some such impression may also remain with readers is the earnest wish of

THE AUTHOR.

LIST OF MANUSCRIPTS, FILES, ETC., AND HOW DISPOSED OF.

# To R.E. Library, Horse Guards.

All reports on R.E. work from theatres of war other than France and Flanders.

Complete (nearly) set of E. in C. (France) Field Works Notes.

			-	,
.,		<b>,</b> .	,,	" Field Fortification Plates.
-,,	., .	• •		,, German Field Works
				Plates.
,,	12	**		" D.P. Plates (hutting, etc.).
Original	l (Typescript	t) repoi	t on Min	e Rescue Work, by LieutCol.
-				Dale Logan.
,,	**		by C.E.	., Second Army (France).
,,			,,	Fourth ,, ( ,, ).
,,		,,	,,	Fifth ,, ( ,, ).
**		,,	"	London District (Col. Russell).
77			<b>1</b>	

Foreways: original report, plates and G.H.Q. correspondence. Various reports by C.E.'s and C.R.E.'s on tactical employment of

R.E. Units (France).

# To S.M.E., Chatham.

Fortification School—Various defence plans, bridging photos, etc. Construction School—Hutting, etc., notes and plates. Workshops—Plates of Army Workshops productions.

# To D.F.W.

Complete original report by Director of Works, France (without plates).

# THE ROYAL ENGINEERS JOURNAL.

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# LIST OF VOLUMES PREPARED FOR PUBLICATION.

" "Bridging," with about 50 plates and maps.

"Water Supply," ,, 60 ,, ,,

"Water Supply, Egypt and Palestine," with about 23 plates and maps.

Mining, historical, etc., with about 34 plates and maps.

" technical, with about 67 plates and maps.

Experimental Section with about 65 plates and maps.

Geology with about 20 plates and maps.

Works Directorate (France)-letterpress only.

—91 plates only.

Supply of Engineer Stores and Material with I plate.

(The following sections are ready, but their exact composition into volumes is not settled).

Camouflage with about 22 plates.

Workshops, Machinery and Electricity with about 25 plates.

Concrete Defences and Factories with about 21 plates.

Forward Communications with about 29 plates.

R.E. Schools with about 10 plates.

Inundations with about 9 plates.

Chemical Warfare with about 5 plates.

|| A.A. Searchlights.

|| R.E. Intelligence.

- || Forestry.
- || Postal Section.

|| Meteorological Section with about 12 plates.

 $\parallel$  These sections have already appeared in the *R.E. Journal*.

# THE ARMY QUARTERLY.\*

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

THE British Army, not having Bolshevist funds at its disposal to finance it, has long lacked a literary organ. No army requires one more. First, to keep in touch with military thought and literature its regular members who are flung wide over the globe guarding the Empire, and its Territorial members who can only give part of their time to military study. Secondly, to bring to the notice of the general public, who give neither whole nor part time to military service in peace, something of the military art and of the problems and difficulties that beset soldiers, so that the army in its preparation for war, may receive at least the moral support of the nation.

The Journal of the United Service Institution and of its brother in India, the Cavalry Journal, the Journal of the Royal Artillery and the Royal Engineers Journal are not to be seen on bookstalls; they appeal to the professional reader only.

In April, 1907, an attempt to start a military magazine officially was made in a humble way with a little periodical called "Recent Publications of Military Interest." At first it contained only reviews of books, etc., then short articles and translations were added; and in July, 1911, it developed into the *Army Journal*. I notice that a writer of reminiscences has claimed credit for all this, but actually— I speak from first-hand knowledge—he was not even consulted; it was due to Colonel (now Lieut.-General Sir Aylmer) Haldane. The *Army Journal* continued to appear until the beginning of the war. Its last number is dated July, 1914. The last but one significantly contained an article on the "Causes of the Downfall of Prussia in 1805."

There are, however, obvious objections to official journalism, so that instead of reviving the *Army Journal* it has been left to the private enterprise of Messrs. Clowes and Sons to produce an *Army Quarterly* in the red cover and with the general form of the earlier official publication.

It is to be hoped that it will be well supported. I am not one of those who desire to turn the British officer into a bookworm, he would not be the wonderful fighting man he is if he was one, but a certain amount of reading, particularly when one is young, is good for the mind. As David Harum might have said, "it prevents an officer

<sup>\*</sup> No. 1, Oct. 1920. Clowes & Sons, 94, Jermyn St., W. 30/- per annum.

brooding too much that when war comes along he gets most of the barrage and few of the Bradburys." Reading the right stuff to some extent takes the place of experience. When one gets out into the world there is less and less time to read. Lord Kitchener said in my presence in 1902, that since leaving Chatham he had had no time to read, and had only his own experience to go upon, and that he hoped to find time to read in India. I asked one of his staff subsequently if he did, and received the reply that he read no books except when he was in bed with a broken leg. I once complained to my Chief, Sir John Ardagh, that he had kept me so busy in the previous twelve months that I had only read a couple of books not directly bearing on my He looked up, sighed, and said "I haven't had time to read work. one." This is drifting into anecdotage and the Editor asked for a review, but it contains the moral that the busy man still wants to read but has no leisure, or at best has only time to swallow some of other people's experience and research in the tabloid form of magazine articles and reviews.

The first number of the Army Quarterly seems to provide both for the busy man and the more leisured student. The articles it contains will be enumerated and briefly commented on. Lieut .-General the Earl of Cavan gives a short sketch of the British operations in Italy from the commander's point of view, under the heading of "Some Tactical and Strategic Considerations of the Italian Campaign, 1917-18." It no doubt gives us much that passed through his own mind when faced with the realities of war. It is condensed experience. Lieut.-General Sir Noel Birch in a most interesting article, "Artillery Development in the Great War," tells us why Sir Douglas Haig in 1916 asked for more guns, and what he did with them; and describes the organization and staff that controlled the guns, and the innovations introduced and scientific progress made by the British artillery during the war. In "The Staff" an unsigned article, the British organization of G.S., A., and Q. as against the single staff of foreign armies is discussed. Lieut.-Colonel the Hon. Sidney Peel, a Territorial officer, writes on "The Territorial Force, its discipline, peace training, organization and expansion." He advocates that on mobilization all serving forces should come under the same administration and under one label, and points out the absurd anomalies that arose from regular captains of ten and twelve years' service being junior to recently appointed majors of the T.F. Licut.-Colonel T.E. Lawrence's article "The Evolution of a Revolt," relates the story of the Arab revolt against the Turks in 1916, which he did so much to engineer. Those who bridged the Somme in 1917 and blew up or tried to blow their work up in 1918, and re-bridged the river a few months later, will hardly want to read Mr. Hilaire Belloc's " The Obstacle of the Somme Valley." He has overlooked in his historical retrospect that in the Agincourt campaign the French " cratered " the causeway at Voyennes by digging holes in it and that it took Henry V's sappers (" varlets " I am afraid the monkish War Diarist calls them) three hours to repair the roadway for traffic in single file.

Colonel Fuller of "Tanks" has in "The Foundations of the Science of War," as in every thing else he has written, provided a number of fresh and stimulating ideas. "The Flanders Battle-Ground" by Messrs. Fletcher and Atkinson of Oxford is an historical survey. "India at the Cross Roads" another unsigned article, points out that India escaped all the physical dangers of the war and should bear a fair share of the military burden.

The titles of the other articles explain their nature: "Educationin the Army," "Aircraft Co-operation with Infantry," "British Regimental Records," "Bernhardi on Reforms in Organization," "Notes on Foreign War Books."

At the end there are a number of pregnant short extracts from books on the war; busy people might read these, and these only, and learn a great deal. The *Journal* concludes with an official Appendix giving the Staff of the Army and Commands, Distribution of the Army, recent Army Orders, etc.

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# PROFESSIONAL NOTES.

# BRIDGING.

Mention was made in last month's notes that experiments were being carried out with a modified pontoon equipment for carrying medium and heavy loads in a somewhat similar manner to the Bridges B. and C. in S.M.E. Circular No. 25A. These experiments have now been made and may be briefly described as follows.

The ordinary standard pontoon was taken and strengthened or altered in certain ways. First of all two extra thwarts were fixed across the pontoon between existing thwarts and the pontoon decked in with  $\frac{3}{2}$  inch planking running longways. This decking was then waterproofed in the usual manner with canvas, marine glue, etc., and a second layer of  $\frac{3}{2}$  inch planking laid crossways. The pontoon was fitted with rowlocks which had special long shanks, and the usual anchor cleats were fixed to the decking. Small brass screw plugs were let into the decking for the purpose of pumping out the pontoons and cleats were provided to hold the saddle in position.

The next step was to strengthen the couplings. This was effected in the case of the lower couplings by using 3 inch by  $\frac{1}{2}$  inch mild steel bar which ran the whole length of the pontoon along the lower edge. The ends of these steel bars are turned outwards and the sections of the pontoons are joined together by cover plates which fit over these projecting lugs and are pinned in position. The top couplings took the form of a double eye and pin joint, the straps being fastened to the deck of the pontoon. With these couplings it was found that four half sections of pontoon could be joined together and the whole pontoon immersed by pressing down in the centre without any ill effects.

With pontoons altered in this way the equipment was capable of being made up in three different forms. For light bridge the usual bridging baulks and saddle were used, but as the pontoons are completely decked-in there should be no fear of their being swamped by water splashing over the bows—a difficulty which appears to have been very marked on the Italian front during the war. With the special rowlocks it was found that rowing presented no difficulty. A raft was made up and was rowed up and down stream quite easily.

For medium bridge a pier is made of six half sections (Fig. 1). Ordinary saddles are placed on the pontoons and these are connected by eight short baulks which are very similar to the old half baulks





FIG. 1.-Elevation, Plan and Section of Medium Bridge.







FIG. z.-Elevation, Plan and Section of Heavy Bridge.

which were used in the pre-war "heavy pontoon bridge." A special saddle is now placed across these eight short baulks; this saddle has cleats which are strengthened with steel plates. The span from one pier to the next pier is bridged with six 9in. by 4in. by 21ft. steel joists which fit on this special saddle and double chessing is used and held down with 6in. by 4in. steel angles.

For heavy bridge eight half sections are used; these are connected by sixteen short baulks. The same special saddle is placed on these short baulks and in this case eight 9in. by 4in. joists are used. Treble chessings is used in this case. (*Fig.* 2)

A trial with this equipment was carried out recently. The medium bridge was tested with a fully loaded lorry and the heavy bridge was tested with a 14-ton tractor. The equipment appeared to be quite satisfactory. More pontoons are now to be converted into this form so that further trials can be carried out.

The main object of decking-in the pontoon is to obtain extra buoyancy. With the usual allowance of 12 inches freeboard the buoyancy of a pontoon is 3.2 tons; with a decked-in pontoon 3 inches is a safe allowance for freeboard and the buoyancy then becomes 5.2 tons. This allows for the extra weight of the decking and strengthened couplings which amount to 300lbs. per half section.

The total dead weight due to the roadway of the bridge is 2.5 tons on each pier for medium bridge and 3.4 tons on each pier for heavy bridge. The medium bridge has six half sections and the heavy bridge eight per pier, so that the safe load which can be carried is 13.1 tons and 17.4 tons per pier for medium and heavy bridge respectively. Four half sections are sufficient to carry the ordinary 3.ton-lorry, but have not quite the necessary buoyancy for medium loads which include heavy commercial lorries.

With reference to last month's notes there was a mis-print in the load table ; the equivalent distributed load for medium loads should read :--

·6 tons, and not 6 tons per ft. run.

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# THE "NISSEN" STANDARD BUILDING.

THE following notes on a visit to the large wool depot under construction at Hull by Nissens, Ltd., may be of value to R.E. officers. The name of the designer will probably be a "household word" in the army for generations, and this development of the idea which created shelter for countless British soldiers in France and other war theatres and is still sheltering thousands of civilians, is particularly interesting.

The depot at Hull covers an area of over nine acres under one roof. It consists entirely of the Nissen standard building, eighteen 40ft. spans, each 552 feet long, erected alongside cach other and intercommunicating.



FIG. 1. - Patent Joint between Sheets of Inner Lining.

The standard building consists in essentials of a series of semicircular arched ribs. These are at 5ft. centres, at Hull; this spacing could be increased with larger dimensions of the members, to 6ft. or 7ft.; the normal spans are 20 ft., 30 ft., and 40 ft., and a 50 ft. span could be provided. At Hull the ribs are 3 jin. by 3 jin. Tees, in five

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equal lengths, fished together with the webs outside. At the base they are, at Hull, bolted to angle cleats which are bolted into longitudinal timber sleepers, the sleepers in their turn bolted into 2ft. deep concrete. In future patterns the sleepers will be omitted.

The sides and roof are a double skin of galvanized corrugated steel—outer covering 24 gauge, inner lining 26 gauge. In the inner skin the corrugations run horizontally; the sheets are not holed in any way, but are fixed in riveted "slides," the joint, shown in Fig. I, being a "Nissen" patent. The sheets lie in the re-entrant of the tees, and are kept down by wires strained along the circumference of the roof. This inner skin can be replaced by reinforced plaster slabbing, which gives a finish of excellent appearance without increased cost.

In the outer skin the corrugations are, of course, circumferential; the sheets are lapped and bolted and fixed to timber purlins, 4in. by 3in., at about 4ft. spacing. The fixing of the purlins is very simple, as in *Figs.* 2 and 3. The air space between the skins is about 8 in.

Glazing in Haywood's patent lead-bar system is introduced between the purlins where required—in most buildings over the adjacent purlin spaces on the north side. The lighting is excellent. At Hull, the arch-ribs have a flat tie and round sagbar at a height of



FIG. 2.-Fixing of Purlins. End View (No C.I. shown).



FIG. 3.—Fixing of Purlins, Circumferential view, showing Scarf Joint in Purlin. (Inner Skin of C.I. not shown). NOT TO SCALE.

about 16 ft. These are unnecessary and will be omitted in future designs. Ridge ventilation is not provided at Hull, but it would not be a very difficult matter to arrange.

Between adjacent spans, the sheeting stops at a height of 8 ft., and a galvanized steel gutter about 3 ft. wide is provided, with two down-pipes in the length of the building. The semi-circular gable ends are filled in with timber studding and a double skin of matchboarding, with a double door 11 ft. high and 10 ft. wide, two windows and a louvred ventilator, the whole painted. The ends could be of concrete blocks or corrugated sheets on framing.

The floor (tarmac or concrete) is not part of Nissen's contract. It is to be at the level of the bottom of the timber sleepers, the omission of which will, therefore, permit of a level floor without interruptions in future buildings.

It is claimed that :---

I.—The building being standardized, an order for so many feet run of any standard space can be executed very quickly.

2.—The building is permanent; proof against high winds and earthquakes; of even temperature, obviating condensation; light and economical in maintenance.

3.—The material packs well for shipment, the curved members all "nesting," and crection demands a comparatively low grade of skill.

4.—Speed of crection is extremely high, and cost is low.

All the above points can be conceded.

A comparison of cost between the Nissen building and an ordinary steel building is difficult to make at the present time, when prices of steel work of all kinds are unstable. A comparison of the weight of the building with that of one of ordinary construction, however, is interesting. The Nissen building for a 40ft. span weighs under 9 lbs. per foot super of floor, everything *above* the floor level being taken into account. A modern steel building with pitched roof, 40ft. span on stanchions 8 ft. high, with roof and sides covered with a single skin of 22 gauge corrugated sheets, with no ridge ventilation, will work out at about 12 lbs. per foot super, and it will have the disadvantages of the "single skin " and of headroom nowhere over about 9 ft.

In speed of erection, judging by the Hull contract, the Nissen building is astonishingly successful. The depot will have been completed, as far as Nissen's contract is concerned, in about four summer months, by 40 men on piece-work; the only additional labour having been 30 unskilled men unloading materials at the start. Railway sidings were laid to the site before work began, and the site was levelled. The effect of piece-work in the output has, of course, been very marked; the men have been able to earn as much as  $f_{20}$ or even over per week, and this when compared with the amount,

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 $\pm 5$  or so, which they could have earned in ordinary day rates has kept them perfectly satisfied with the piece-work arrangements.

It cannot, of course, be claimed that a building with curved sides possesses every advantage of a high building on stanchions, and there are certain limitations to the utility of the construction. For storage of material in bulk, or for high vehicles, probably only about go per cent. of the width of any building could be considered available. though the extra height in the middle could be made use of. Intercommunication between existing spans is not so easy as with stanchions at the normal spacing of 10 ft.-12 ft., though extra wide openings could be made by special arrangements. The same remark applies to doors on the long sides of a building. The carrying of heavy shafting would not be a perfectly simple matter. The arch ribs could, of course, be erected on vertical stanchions, and a two-storey building crected; whether the same advantages in cost and rapidity would still be gained is, perhaps, not yet proved.

In spite of the limitations suggested above, the construction has very obvious interest from the War Department point of view, its range of usefulness extending from store buildings, light workshops, etc., to gymnasia and drill sheds, while its simplicity and speed of erection are undeniable.

The photographs show the buildings under construction, and give an idea of the appearance when completed.

# PROFESSIONAL NOTES.

The "Nissen" Standard Building.



The Buildings at Hull.

# **PROFESSIONAL NOTES**

# REVIEW.

# NOTES ON THE "TABLES DE PROJECTION (SYSTÈME LAMBERT) " AND ON THE KILOMETRIC GRID (CARROYAGE) FOR MAPS OF THE WESTERN FRONT.

Mr. A. R. Hinks, C.B.E., F.R.S., Secretary of the Royal Geographical Society, and the author of the above pamphlet, has been good enough to send a copy to the R.E. Library.

Maps of the Western Front for the British Expeditionary Force were prepared upon the Bonne Projection in use in Belgium; and our British-made sheets were an extension of the Belgian series, in order that we should have no break or change in the continuity of our maps. Wise as this decision was, it introduced, unavoidably, a change of sheet lines between ourselves and the French troops, and, further, the development of scientific methods of gunnery and of artillery intelligence showed up the weak points of the Bonne projection. Comparatively early in the war the French substituted for their own Bonne projection an orthomorphic, Lambert's second (conical orthomorphic with two standard parallels), and in 1918 an international allied commission met in Paris and agreed to the use (by all the allies on the Western Front) of this projection. In order to ensure full uniformity not only were our maps to be gradually re-drawn on this projection but the Kilometre grid and the French system of reference in defining points with relation to that grid were to be brought into almost immediate use. This decision was, as a matter of fact, never carried into execution, for the course of operations, and the comparatively large movements of 1918, made it impossible ; but all preliminary measures and computations were completed. The calculations for the adoption of this new projection were facilitated by the existence of certain geodetic tables defining lengths on the meridian and parallel on the figure of the earth used by the "Service Géographique de l'Armèe." These tables were not, however, absolutely rigorous. Indeed they depend upon certain approximations or expedients which Mr. Hinks rightly describes as both "curious and doubtful." Projection tables for Lambert's conical orthomorphic derived from those geodetic tables were also prepared by the French and again certain approximations appear. The net result of this complexity of data was that plottable errors might well have been introduced by adhering rigidly to theory and that it became necessary to investigate, not only the details of the French solution, but how best to treat our own existing triangulation and maps.

Mr. Hinks' pamphlet tackles these questions with lucidity, and his paper was a most valuable contribution to the subject at a critical time. He refers in his concluding paragraph to the haste with which he had completed his work, but we must disagree with him when he says that many signs of this haste are apparent.

H. ST. J. L. WINTERBOTHAM, Lieut.-Colonel.

# NOTICES OF MAGAZINES.

MILITÄR-WOCHENBLATT.

No. 120.—A long list is published of those Prussian General Officers who complete in 1920 at least 50 years since their first commission. The M.W.B, thinks that their names are only too likely to be forgotten in these days of national humiliation.

The Superiority of the French Field Artillery in the War .- An article published in No. 114 asserted that this was nothing but a legend; the subject has evidently given rise to a good deal of discussion and in this number Lieut.-Gen. von Rohne supports a contention of his in the Artillery Monthly Review, that the French artillery was superior not only in its material, but also in its employment. As regards material, he instances the greater range of the French gun, its flatter trajectory, and the greater effect of its shrapnel. The reliance placed by the Germans on their 4.2 howitzer is declared to spring from the defects of the field gun, and the fact that the French developed the field howitzer but little, is held to prove that their gun fulfilled most of their requirements. As regards employment, General von Rohne says the real judges of this are the infantry, not the artillery. He is in favour of open positions only when the task to be fulfilled cannot be carried out from covered ones, but is no believer in those who say that "open position" is synonymous with " death "; still less in those who, at times during the - war, thought that as the infantry had to suffer losses, the artillery should not be allowed to escape and consequently placed the guns right out in the open. General von Rohne says he has been strongly criticized for his writings. This example of them does not lead one to doubt it.

Representative Assemblies of the Army and Navy .-- Following the general trend of the times, whereby every profession requires special representation, special " Chambers " have, by an order of the 3rd June, been constituted for the Army and the Navy. Now it is a question of taking the preliminary steps along a hitherto untrodden path, of collecting experience and leaving the door open for alterations. In the Ministry of Defence opinion is clear, that while in the days of a Supreme War Lord such an institution could be dispensed with, yet, under present conditions, it is desirable to establish means whereby the centre of the organization can be kept in touch with the circumference. These Chambers are consequently to be elected for this purpose, by secret ballot ; they will also be expected to voice the wishes of the troops and to support the execution of such orders as the Ministry of Defence may issue, even when these do not appear to take all views into consideration. The Chambers are therefore advisory bodies for the Chiefs of Army and Navy. That for the Army is to consist of 2 officers from Army H.Q., I General, I Regimental Commander, I Staff Officer, 2 Medical Officers

from each of the 7 Defence districts, 1 Captain or Subaltern from each sub-district, and 13 N.C.O.'s and 29 men from various arms of all districts together. Certain other medical and departmental representatives are also provided for. The Chamber is organized into one main committee and six sub-committees. The main committee consists of 17 officers and 17 other ranks; the sub-committes deal with officers, doctors, vets., ordnance, N.C.O.'s and men. Methods of election are carefully laid down, and voting is to take place between 1st and 1oth July. The whole project, which will to a great extent replace the German Officers' Union (D. O. B.) and the Federation of German Professional Soldiers, has been specially devised to avoid the danger of the Chambers turning into Parliaments, which could only work for their destruction, and with this in view, the size of the Chambers has been kept down and the time for which travelling, etc., allowances will be granted limited to three days at a time. The project is of an experimental nature only, but it is hoped that it will lead to the side-tracking of the many Army unions and federations which at present are often against good discipline and only foster unattainable and extravagant objectives. This apparently most important institution passes, curiously enough, entirely without comment from the M.W.B.

Germany and the League of Nations .- A writer in Wissen und Wehr advocates the earliest possible entry of Germany into the League of Nations, so that she may have a voice in the matter of her own armed forces. This, seeing that the League favours "Armament according to the requirements of national security and international obligations," could not be denied to her. The M.W.B. declares that the fears expressed outside Germany and particularly in French papers, that the destruction of armaments is not being carried out, are entirely ground-Soon after the Armistice and before the Treaty was concluded less. immense quantitites of arms were destroyed of which no record was kept and a vast amount of war material was dispersed, lost and wasted by the disintegration of the Army. In addition to this, between July, 1919, and March, 1920, the following have been destroyed, viz. : 5,000 guns, 14,000 gun barrels, 8,500 gun carriages, 31 million loaded shell, 31 million fuzes, 5,000 tons powder, and 32,000 tons of other explosives, 1,300,000 rifles, 24,500 machine guns, 94 million rounds of S.A.A., 4,000,000 hand grenades. On the 5th May, 1920, a further immense quantity of material had been set aside for destruction, including among other items 20,000 M.G.'s and 15 million shell. The whole of the aeroplanes, except 60 reserved for special purposes such as searching for mines, has been placed at the disposal of the Allies. The prescribed destruction of fortifications is said to have been carried out up to time. except when additional demands have rendered this impossible.

Roll of Honour.—Signal Corps: 112 officers and 3,323 other ranks killed or died of wounds or disease. It is remarkable that 67 of the officers died in the year 1918.

No. 1.—The M.W.B. now appears only once a week instead of twice, as hitherto. The price remains unchanged at 32 marks per annum, but each issue is slightly larger than hitherto.

The Further Disarming of Germany .- The writer protests against the

allegations made by the Entente, that disarming is not going fast enough, and declares that it is the one business in which the German Government is showing any energy. Speeches by Lloyd George and Churchill are quoted in support of his contention.

The Regimental Officer in the World War.—Lieut.-Col. von Weitershausen contributes an article in his praise. From the glorious days of 1914 to the terrible ones of 1918 it was the regimental officer who bore the brunt of everything. The many virtues, of which he gave proof, were the fruit of long, exact and detailed training and regimental duty. Nowadays things are different; games and education find a place in regimental routine and there is little room for the detail of pre-war days, but the young officers of to-day cannot do better than hold the examples of work and self-sacrifice, exhibited by their predecessors, ever before their eyes.

No. 2.—The usual appeal against any reduction of the 200,000 strong army appears and all the old arguments for it are repeated.

German Naval Chronicles .- The official German account of events by sea is now beginning to appear. It is edited by Admiral von Mantey, Director of Naval Archives, and is entitled "The War at Sea; 1914-1918." The first volume takes us up to the beginning of September, 1914. It states that the cruise to the Norwegian fiords was undertaken in order to avoid any alteration of programme which might increase the political tension. The Admiral, on arrival in the Sogne fiord, heard of the ultimatum to Serbia and on his own initiative got the Kaiser to order the fleet to return home. This, in spite of the efforts of the Chancellor to get the order cancelled, it succeeded in doing. The purposeful procedure of the British Admiralty is compared with the half-hearted action of the Germans. The plan of operations, together with the appreciation of the situation on which it was based, is given in full. It in no way corresponds to the idea, held by a leading German statesman, that the fleet should be preserved in order to constitute a powerful political make-weight on conclusion of the war, but the reviewer does not think the Commander-in-Chief sufficiently emphasized the necessity for a vigorously offensive policy, to include even the capital ships, with the object of wearing away the British superiority until a decisive action could be accepted with good prospects of success. The influence of neutrals on the British blockade policy was much over-estimated.

German Military Sports.—Great efforts are evidently being made to get German military sports into going order. To judge from an article by a Reichswehr battalion commander, the higher authorities are going rather too quickly, and regimental officers, handicapped as they are by constant changes in *personnel*, find it difficult to make their performances keep pace with the new-born zeal for sport and games that their superiors evince.

The Situation in Austria.—France is said to be so opposed to any combination between Germany and Austria as to be willing to give to England a free hand in Asia Minor, if, in return, she obtains the right to regulate Austro-German relations. In accordance with her plans to weaken and isolate Germany, she is said to favour a consolidation of the Danube States, including Bavaria. Austrian relations with Tchecko-Slovakia are described as good, with Jugo-Slavia as fair and with Hungary as distinctly strained. Austria thinks Hungary is trying to bring about the downfall of her Government, and Hungary is angry with Austria for not surrendering Bela Kun and his associates.

Hungary after the Peace Treaty of 4th June, 1920.—Hungary loses 230,000 square kilometres of territory and 18 million inhabitants, besides the greater part of her economic resources. Her army, at present nearly 100,000 strong, has to come down to 35,000. The Government is making great efforts to improve its relations with its neighbours and succeeding in the case of all except Austria. A military convention with Roumania, and possibly with Poland, directed against Soviet Russia, is discussed in the press. The firm stand Hungary is taking against Bolshevism has led the ill-informed Labour organizations of Western Europe to agitate against her, as having instituted a "White terror."

Alleged Murder of German Prisoners.—" The wholesale murder in the Roumanian prison camp of Sipote," written by a German chaplain, alleges that out of 4,000 German and 13,000 Austro-Hungarian prisoners, there were after 6 months only 187 survivors. Exposure, starvation, and disease unchecked by any medical aid are said to have accounted for the rest. It is stated that 39 witnesses have testified on oath to the truth of these allegations.

Nos. 3 and 4 of the M.W.B. have not been received.

No. 5 .- The Projected Defence Law .- Lieut.-Gen. Schwarte says that owing to limitations imposed by the Peace Treaty the scope of the new defence law can only be very restricted. It will, however, concern itself with the quality of the personnel forming the Reichswehr and in this connection he discusses the problems, so familiar to the British Army, but so strange to the German, involved in competing in the open labour market for recruits. He does not think that the requisite 96,000 men (the 100,000 includes 4,000 officers) will be forthcoming unless the unemployment increases or the standards demanded are lowered. Yet the small size of the army makes it essential that its quality be high and unemployment can only be harmful to the country as a whole. Further difficulties arise in connection with the liability for service of the contingents of particular states, outside the boundaries of their own territories. The proposal is to place responsibility for decisions in this matter on the military authorities, but considerable opposition is anticipated before this can be carried. It will call for the most careful thought to reconcile the requirements of the Peace Treaty, particularly that part of it which limits the number of premature discharges, with the consitutional rights of the citizen and the necessities of the Army. Undoubtedly these latter must have precedence over the rights of the citizen, says Gen. Schwarte ; they include loss of voting power and prohibition of political activities. This proposal is certain to be opposed. but yet it is essential if the Reichswehr is to form a trustworthy instrument in the service of the State. By judicious use of permission to take up part-time occupations and to marry, it is hoped to maintain high standards of personal efficiency. It is hoped that the Defence Law will not be made an occasion for party strife, but that all will combine to do the best that the circumstances of the case allow.

The Military-political Situation of the World.—France is declared, in spite of all her troubles, to be the country least likely to suffer from Bolshevism. The vigour, which her Government always shows, towards any factions which tend to upset the State, form an example which Germany would do well to imitate. Belgium, by instituting 10 years' active and 5 years' reserve service, contemplates possessing a mobile army of a half a million by 1923. The Flenish movement is active, but not expected to come to anything, although the prosecutions of the Activists who showed themselves friendly to the Germans during their occupation, is causing much ill-feeling. Relations with Holland are very strained.

No. 6.—National Defence Law.—There has been no time in the present sitting of the Reichsrat to pass the projected National Defence Law, so, in order to comply with agreements reached at Spa, a provisional law has been passed, abolishing universal service, limiting the numbers to be allowed on establishment and laying down the period of 12 years as the minimum continuous service for all "other ranks"; that for officers will normally be 25 years. The competition among officers still serving, for posting to the roo,000 men army appears likely to be considerable and the lines on which selections will be made are laid down.

No. 7.-1914: The Errors of the High Command.-A long critique of General Percin's book is given. In it the question as to whether the introduction of 3 years' service by the French followed or preceded the increases voted for the German army, is discussed, and it is declared that there can be no doubt that it preceded the German increase. The writer indeed says that it was introduced at the urgent request of Russia. As to the employment of reserve divisions at the beginning of the war, it is stated that Germany used hers, from the very first, as front line troops, because she was confident of their fighting powers; France, on the other hand, nursed hers because she was not very sure of them and because, being largely composed of fathers of families, they were very expensive in pensions. The M.W.B. seeks to prove that the German reservist was the better man, not by reason of better equipment or larger number of active officers, or even longer training, none of which advantages he is declared to have had, but simply because he was the better man, being German. General Percin's statement that the French plans for the deployment of their armies became known to the Germans through the imprudence of a French Staff Officer is declared to be based on the fact that in the Spring of 1914 a brochure entitled "The German Concentration" was published in France. This was alleged by its anonymous author to have been based on a document found in a German It is now known that the then Lieut.-Col. B. wrote railway carriage. the book, and General Percin's dictum that, by showing what the French knew regarding the German plans, it was indirectly valuable to the Germans regarding the French plans, is upheld by the reviewer.

Reconciliation v. Revenge.—On the 4th August the Vorwärts published an appeal by a "Republican Officer" to all who have learnt in the war to hate war, to persuade their unregenerate comrades to put aside all thoughts of revenge and to devote themselves to reconciliation with their former enemies, with, of course, revision of the treaty. The request is also made that this appeal may be brought to the notice of all ex-enemy officers in the hope that it may lead to better feelings. The M.W.B. is very angry with this idea, which it calls perfect lunacy, and says that all who value their honour higher than their life will have nothing to do with such grovelling and whining.

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L. CHENEVIX-TRENCH, Major, R.E.

# REVUE MILITAIRE GÉNÉRALE. March, 1920.

# THE PROBLEM OF PIERCING THE FRONT.

This article is by Capt. Raoul Hoff. After the offensive which saved France and has been called the Battle of the Marne, the Germans entrenched themselves, and were strong enough to impose the same defensive tactics on us. The possibility of such an eventuality had been more clearly apprehended by them than by us; they realized the terrible loss involved in attacking a prepared position, and all the possibilities of machine-gun fire, also the necessity for heavy artillery to destroy the enemy's defences, while we rashly relied on the value of forward movement.

In September, 1914, we were in no position to capture German trenches owing to our lack of heavy artillery, and to the exhaustion of our field gun ammunition. From the Oise to Switzerland no frontal attack was possible. An outflanking movement was only possible between the Oise and the sea, and this both sides attempted and failed to achieve. Both sides were now stabilized from the sea to Switzerland.

The offensive has always been conceived as combined with a judicious defensive, the object being to hold the enemy everywhere and prevent him from altering the distribution of his forces, while attacking him in force at some favoarable point. A general defensive is the negation of warfare; a war of movement can alone produce a decision, but this must be subject to the destruction, at least partial, of the opposing fortified line, to admit of the offensive being resumed on open ground. Such a result the Germans attempted to achieve from 20th October to 13th November, 1914, at Ypres.

The problem of how to break through was presented for solution. Dimitrieffhad been faced by the same proposition in 1912 when checked by the Chatalja lines. Having regard to the immense concentration of force involved, it appeared that the attempt could only be made on a narrow front. Land and air reconnaissance, and the necessary preliminary artillery bombardment, would preclude surprise.

The first French offensives took place in Champagne at the end of 1914 and early in 1915; they were mere trials and gave meagre results, but that of February, 1915, was not without use, in that it retained on the Western front a part of the German troops intended to take part in the offensive on the Mazurian Lakes. A gain of two or three kiloinetres is insufficient, it does not embrace the enemy artillery position, and therefore the consolidation of the conquered area is a costly process. The primary object of the offensive must be the enemy artillery.

The battle of Artois (9th May to end of June, 1915) which nearly succeeded, awoke the Germans to the necessity for organizing their positions in depth, so that the whole could not be simultaneously bombarded by the artillery. Thus the attacks in Champagne in September, 1915, only brought about the capture of the first position, and our infantry then found themselves opposed by a second line of defence.

Recognizing the difficulty of destroying the defences the Germans on 22nd April, 1915, between Steenstraete and Het Sas, introduced the use of clouds of poisonous gas to destroy the defenders. By this means our lines were penetrated for several kilometres, but our adversaries were so surprised by their success that they were not in a position to reap full advantage of it. The same phenomenon occurred later at the first appearance of the British tank, but the tanks, as the gas, were used in insufficient quantity, and only led to local successes.

The Germans made their first attack aiming at a definite decision at Verdun in February, 1916, but they made a great mistake in prolonging the battle after equilibrium had been established. Later on we repeated this mistake at the battle of the Somme. These two ineffectual attempts demonstrate that a battle of attrition on a narrow tront should always be avoided in view of the heavy losses it entails.

At the beginning of 1917 the Germans, foreseeing the imminence of our attack prepared on the Somme, retired on the Hindenburg line, obliging us to follow, and halt, in country deliberately devastated, but though our plans were upset our offensive on the Aisne was not prevented. Here the Germans had collected large reserves, and their counter-attacks were effectual, but we did wrong in abandoning the engagement, for the German reserves had all been absorbed while ours had hardly been called upon. Possibly political considerations intervened and prevented the termination of the war at this date.

A new element, the tank, made its appearance in the British attack towards Cambrai at the end of 1917, and proved that a surprise attack might still be possible. The British succeeded, after a formidable but short artillery preparation, in crossing the enemy's lines, the tanks opening gaps for the infantry. Unfortunately the initial considerable success could not be developed, but the tank gave grounds for great hopes of its value.

If the battles of 1917 showed that the break-through was difficult, the events of 1918 proved that it was not impossible, for twice, at the Somme, and on the Chemin des Dames, the Germans captured the whole of our defensive system on narrow fronts.' Still, from the middle of 1917 the French Great General Staff was convinced that a break-through would not ensure victory. It is a matter of regret that from September, 1915, the fact had not been grasped that the problem could be solved in a more rational way. We reached the truth before the Germans. The latter pinned their faith on breaking through subject to this being preceded by a surprise, but the apertures they forced were narrow, and could ultimately be closed again. In October, 1917, the instructions of the French General Staff were that successive attacks must be made on the same front to annihilate the capacity for offence, and weaken the defensive power, which could only be effected by a battle of attrition on a considerable front, executed as rapidly as possible so as to produce a general laceration of the whole body. Such a conception could only be brought to fruition by absolute superiority in men and material. Marshal Foch, the true genius of the war, knew how to embrace the doctrine proceeding from these fundamental truths, and thanks to the science of our leaders and the heroism of our soldiers, was able to turn it to practical effect.

A. R. REYNOLDS.

## REVUE MILITAIRE SUISSE.

# No. 6. June, 1920.

# REORGANIZATION OF THE INFANTRY ARM.

The article on the above subject by Major Schmidt begun in the number of the *Revue* for May, 1920, is continued in the number under notice. Attack formations of the infantry are dealt with in this part of the original article. The problem of breaking an enemy's front is, it is suggested, analogous to that presented to a woodman who is called upon to split a log of wood with a wedge and hammer. Consequently, the formations employed in the infantry attack should be such that the arms first brought into use should produce effects similar to that obtained by the wedge in the splitting of wood; then should follow the troops possessing the driving force analogous to that of the woodman's hammer. In the attack, machine-guns play the rôle of the wedge, whilst the infantry supporting lines behind these guns represent the hammer. The subject is developed from this point of view in the original article.

# ARMY REORGANIZATION.

The original article is contributed by Major Secretan, who deals with the subject of non-commissioned officers, their training and status. He points out that the Great War has proved that an army must be provided with an ample supply of subaltern officers and non-commissioned officers, thoroughly trained and organized on sound lines. He discusses matters relating to the training provided in the Swiss Army for the non-commissioned ranks and makes certain suggestions, which have in view the amelioration of their status.

## NOTES AND NEWS,

France.—A Special Correspondent deals with the Court of Inquiry which has recently exonerated General Fournier, and the officers who were under his command, from all blame for the surrender of Maubeuge in 1914. He points out how exceedingly difficult was the task that confronted many of the French officers placed in command of the frontier forts and fortresses in Northern France on the declaration of war in August, 1914. The troops that were detailed as garrisons for the forts

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and fortresses were brave enough, but they lacked military training, which proved a most serious handicap. Regret has been expressed, it is said, that the French Higher Command had, prior to the declaration of war by Germany, failed to appreciate the true importance of permanent fortifications. Had the military authorities kept up the defences of Lille, strengthened Maubeuge, and provided Laon and Rheims with defence works, the whole course of the war would, it is suggested, have been very different to what it was, and probably fair provinces of France would have been saved from devastation. But, it has to be recognized that in the same way that an artillery armament cannot be efficacious unless there are skilled gun-layers in the teams that work the pieces, so in the case of fortifications the defence works are of little value unless troops of the proper quality are available to make suitable use of such defences. The following works dealing with the Great War have been recently published in France: La Bataille de Foch by Raymond Recouly and Quatre années de commandement (1914-1918) by General Dubail.

United States of America.—A Special Correspondent points out that one of the results of the introduction of conscription in the United States of America has been to provide the military authorities with documents of unique value, documents which provide valuable information relating to the physical, economic, industrial and ethnographic conditions affecting a large proportion of the American people. America had four million men under arms, excluding those serving in the Navy, during the Great War; of these 2,086,000 men served overseas. The total number of men killed in action, died of wounds, etc., amounted to 77,118; a table is given in the original article classifying these casualties. The *American Legion*, an Association of the Veterans of the Great War, has pronounced in favour of compulsory military service; its propaganda is, however, meeting with much opposition among congressmen, both on sentimental and also on financial grounds.

## BIBLIOGRAPHY.

Notices are published relating to two works, *Reims devastée* by Paul Adam (published by the Librairie Felix Alcan, Paris, at 2fr. 75c.); and *Die Schlachten und Gefechte des grossen Krieges* 1914–1918 by Herman Sak (on sale at the Burgverlag, Nuremberg, at 23 marks.)

# No. 7. July, 1920.

# SEARCH-LIGHT PROJECTORS.

The original article is contributed by Lieutenant Sagne of the Swiss Army. He points out that, at the present day, with the setting of the sun there does not follow necessarily a cessation of active military operations as was the case in days of old; the military engineer can now at nightfall effect an illumination of the ground on which troops may be operating, or are about to operate, in every case as brilliant as that produced by the rays of the sun. Lieutenant Sagne briefly touches upon the crude expedients adopted in former times artificially to light up positions, in attack and defence, during hours of darkness. He refers to the employment, in modern times, of electric search-lights in warfare, and the uses to which this method of illumination can be put; and finally deals with the technical aspects of the problems involved in relation to the design of the plant required for the purpose.

# THE ARMY AND FINANCE.

The original article is by Colonel de Diesbach, who states that the late War involved Switzerland in considerable discomfort and vast expense. The financial burden which Switzerland has had to bear in order to keep inviolate her territory has impoverished her, and the pressing problem which requires solution to-day is that connected with the maintenance of an adequate defence force on a military budget reduced to very small dimensions. Colonel de Diesbach puts forward proposals as to the manner in which the existing situation may be met in Switzerland.

## FROM CHARLEROI TO THE MARNE.

Colonel Poudret is the author of the original article; he calls attention to the works which have recently been published in Germany dealing with the opening phases of the Great War, and points out that, the great protagonists having recently favoured the world with accounts of the part they severally played in the critical operations during the advance to the Marne, it now becomes an easy matter to follow in detail the operations of the three Armies which formed the German right wing. Colonel Poudret makes a critical examination of the operations of the German right wing in the light of the literature that has recently been published with a view to ascertain upon whom rests the responsibility (on the German side) for battle having been given on the Marne under circumstances so unfavourable to the German Army. Von Kluck, it would appear, was in too great a hurry; he seems to have disregarded both the letter and the spirit of his instructions. (*To be continued*).

# NOTES AND NEWS.

France.—A Special Correspondent who contributes notes in relation to military matters severely criticises those responsible for the decision contained in the ministerial decree forbidding the discussion, in public, of military matters by army officers. It is suggested that in view of the numerous works that have been recently published by officers of high rank in relation to the Great War, works which contain numerous quotations from official documents, the apparent attempt made to prevent the truth in matters connected with the War from leaking out has alone the effect of bringing the authorities into ridicule.

Italy.—A Special Correspondent deals with the violent oscillations in the political situation in Italy at the present day and the effect of these oscillations on the Italian Army. There have been four changes in the political headship of the Italian Army within the space of a few months. Sr. Bonomi is again Minister of War, having succeeded Sr. Rodino. The reorganization of the Army is still in progress; in the new organization the General Staff has ceased to be a *Corps* apart, officers are in future to be appointed *for a term of duty* to the General Staff. It is stated that although in relation to technical matters the officers of

the General Staff have rendered eminent services, yet as a Corps their influence on the Italian Army has been disastrous. Among the other reforms announced is the reduction in the number of regiments of Bersaglieri from 12 to 4. The disbandment of the regiments of this famous Corps is much resented in centres such as Milan and Ancona. The situation in Italy is still a troubled one.

W. A. J. O'MEARA.

# CURIOSA MATHEMATICA No. 2.

SOLUTIONS to the above have been received from Major F. R. H. Eustace, D.S.O., and Major C. R. Satterthwaite, O.B.E.

The following note has been received from a correspondent :---

NOTE ON "CURIOSA MATHEMATICA" NO. 2.

The numbers from I to 100 are for the most part quite casy to express by the use of "four fours," but when certain of the larger odd numbers are reached difficulties arise, and the question as to what mathematical symbols it is legitimate to use must be decided. The whole problem can be solved by the use of decimals, factorials, and the square root sign, but all solvers have employed some other symbols, the legitimacy of which is questionable. The integral sign must be rejected, as it surely involves x: once x creeps in  $\frac{x}{x}$  can scarcely be rejected. Tan  $\frac{\pi}{4}$  again is inadmissible, else cos  $\pi$  must be allowed. Colonel Cunningham's  $\Gamma$  symbol is not generally enough used to be really legitimate : " antilog  $\sqrt{4}$ " is cumbrous and of no definite meaning unless the base is stated,  $\Sigma 4$ , meaning I + 2 + 3 + 4, may be admitted, but one prefers to do without it : the same remark applies to the use of the signs for Permutation or Combination.

The following are some of the most difficult of the numbers, constructed without any of the adventitious aids referred to above :—

71. 
$$\frac{|4+4+\frac{1}{4}|}{\sqrt{\frac{1}{4}}}$$
73. 
$$\frac{\sqrt{4} \cdot \frac{1}{4} + \sqrt{\frac{1}{4}}}{\sqrt{\frac{1}{4}}}$$
77. 
$$\left(-\frac{4}{\frac{1}{4}}\right)\sqrt{\frac{4}{4}} - 4$$
83. 
$$\frac{|4-\frac{1}{4}+|4|}{\frac{1}{4}}$$
87. 
$$4|\frac{4}{4} - \frac{4}{\frac{1}{4}}|$$

These should be sufficient to indicate the methods by which all the other difficult numbers can be formed.

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# PROBLEMS.

PROBLEM 13 (Solution by Major C. N. Satterthwaite, O.B.E.).

Is it possible to construct a triangle other than an isosceles triangle such as (i) all the sides are rational, and (ii) the perpendiculars from each vertex on the opposite sides are all rational?

Note.—The following construction does not guarantee the resulting triangle against being isosceles. There is no reason, however, why it should be so, and in practice it will not usually be so.

First, let us attempt to draw two unequal rational-sided right-angled triangles having a common side (not the hypotenuse).

 $x^2 + y^2$ ,  $x^2 - y^2$ , 2xy, are the sides of a rational-sided right-angled triangle, where x and y are rational and x > y.

For the common side, choose an integer which can be written 2mpq, where m, p, q, are rational and -

p is	s not e	qual (	(0 q)	
mp	**	,,	q	 a۱
mq	,,,	**	P	··/·
m	,,	,,	1)	

This can be written

or

2.mq. p.

2.mp. q

These are the sides of rational right-angled triangles whose hypotenuses are

 $m^2p^2 + q^2$  $m^2q^3 + p^2$ 

These hypotenuses cannot be equal under the conditions at (i); hence two unequal rational right-angled triangles can be so drawn, with proper selection of the common side.

Now let ODB, ODC be two such unequal rational-sided right-angled triangles.

Draw CE at right angles to BO, cutting BO, produced if necessary, at E. Let DO and CE, produced if necessary, meet at A. Join AB, cutting CO, either produced if necessary, at F.

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The resulting figure will be either such as Fig. 1 or Fig. 2; and ABC will be a triangle fulfilling the required conditions.



Taking Fig. 1; since BE and AD are perpendicular to AC and BC, CF must be perpendicular to AB.

Now ODB, OEA, CDA are similar triangles; all sides of ODB are rational and so is CD.

 $\therefore$  DA, AC are rational, and so is AO (= AD - OD).

 $\therefore$  OE, EA are rational, and so is EC (= AC - EA).

 $\therefore$  BE (= OB + OE) is rational.

Again, OFB, OEC, AFC are similar triangles; all sides of OEC are rational and so are OB, AC.

: OF, FB, AF are rational.

 $\therefore$  CF (=OC+OF) and AB (=FB+AF) are rational.

Hence all sides and perpendiculars are rational.

Similar reasoning applies to Fig. 2.

The following solution is by Lt.-Col. Wade.

Is it possible to construct a triangle so that all the sides and altitudes are rational?



AD is an altitude. Denote  $\sqrt{s \cdot s - a \cdot s - b \cdot s - c}$  by N. Then AD =  $c \sin B = \frac{2}{a}$  N. Let  $s - a = p^2 s - b = q^2 \cdot s - c = r^2$ . Then  $3s - a - b - c = p^2 + q^2 + r^2 = s$ . 1920.]

Hence since a.b.c. are rational all the altitudes will be rational if  $\sqrt{p^2+q^2+r^2}$  is rational.

 $p^2 + q^2 + r^2 = (m^2 + n^2)^2 \left(\frac{g^2 + h^2}{g^2 - h^2}\right)^2$ 

Let  $p = m^2 - n^2$ ,  $q^2 = 4m^2n^2$ , then  $p^2 + q^2 = (m^2 + n^2)^2$ .

Let 
$$r = (m^2 + n^2) \frac{2gh}{g^2 - h^2}$$
,

then

The values of a.b.c are as under :---

$$a = (m^2 + n^2)^2 \left(\frac{g^2 + h^2}{g^2 - h^2}\right)^2 - (m^2 - n^2)^2$$
  

$$b = (m^2 + n^2)^2 \left(\frac{g^2 + h^2}{g^2 - h^2}\right)^2 - 4m^2n^2$$
  

$$c = (m^2 + n^2)^2 \qquad .$$
  

$$N = \frac{4 \, mngh \, (m^2 \times n^2)^2 \, (m^2 - n^2)}{(g^2 - h^2)^2}$$

It can be easily verified that with these values any two of a.b.c are greater than the third. Hence by giving any values to m.n.g.h. as many triangles can be found as are required.

If m=2 n=1 p=2 q=1we get the following values :---

*a*, *b*, *c*, are 
$$\frac{544}{9} \cdot \frac{481}{9} \cdot \frac{225}{9}$$
.  
*s*-*a*. *s*-*b*. *s*-*c* are 9. 16.  $\frac{400}{9}$   
*s*= $\frac{a+b+c}{2} = \left(\frac{25}{3}\right)^2$ 

Hence sin A, sin B, sin C are all rational and their values will be found to be < 1.

PROBLEM 15 (Solution).

Of all the pyramids standing on a given scalene  $\triangle$  and having the same volume, which has the greatest inscribed sphere?



Consider the tetrahedron DABC, the fixed base being  $\triangle$  ABC. AB, BC, CA are c, a, b, as usual.

The areas of the faces opposite the solid angles A, B, etc., will be denoted by A, B, C, D.

Then if R be the radius of the inscribed sphere

$$R (A + B + C + D) = const.$$

Then when R is greatest A+B+C must be a minimum, and this is equivalent to the condition fa+qb+rc must be a minimum where p, q, r are the lengths of  $\bot$ <sup>15</sup> from D on BC, CA, AB.

O is foot of  $\perp^{1}$  from D on ABC, and x, y, z are lengths of  $\perp^{16}$  from O on BC, CA, AB.

Then  $ap + bq + cr = a\sqrt{h^2 + x^2} + b\sqrt{h^2 + y^2} + c\sqrt{h^2 + z^2} = u$ , say ...(1).

Where (h) is the length of DO (constant).

We have also ax + by + cz = 2 area of ABC =  $\triangle$ , say.....(2).

We have to find the minimum of (u) subject to condition (2).

Differentiating (1) partially with regard to x and y in succession and equating to zero gives

$$\frac{x}{\sqrt{h^2 + x^2}} - \frac{z}{\sqrt{h^2 + z^2}} = 0 \qquad \frac{y}{\sqrt{h^2 + y^2}} - \frac{z}{\sqrt{h^2 + z^2}} = 0,$$
$$x = y = z.$$

whence

Hence the tetrahedron, with minimum superficies, is that in which O is at the incentre of triangle ABC, and the faces DBC, DCA, DAB consequently equally inclined to the plane of ABC.

Since writing this I have found this problem among the examples in Edward's *D* fferen ial Calculus, p. 430, No. 19. My result is the same as that stated in the "Answers to the Problemss"

## PROBLEM 17.

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

# PROBLEM 18.

An elastic string of weight (W) per unit of length when unstretched and of modulus of elasticity 2aW rests in contact at every point of a smooth vertical semicircle of radius (a) whose base AB is horizontal and whose arc is uppermost. The ends of the string reaching down to A and B. Find the unstretched length of the string.

J. M. WADE, Lt.-Col.

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