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THE ROYAL ENGINEERS JOURNAL.

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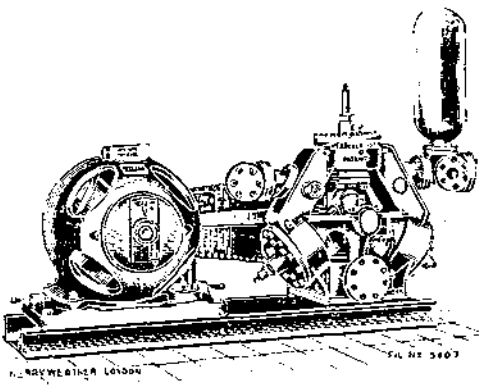

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By Major A. T. MOORE, R.E., 1904.

REVISED

By Major E. C. OGILVIE, R.E., 1912.

Reprinted by the Council of the Royal Engineers Institute.

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(*a*). You have no wire gauge—suggest a method by which Corporal C. could have ascertained the strength of the wire.

(*b*). Corporal C. did ascertain that the *breaking strain* of the wire was 456 lbs. How many turns will you have put on each transom lashing? Give your reason.

(*c*). If you had 1½-in. hemp rope available, how many turns would you make the transom lashing? Give your reason.

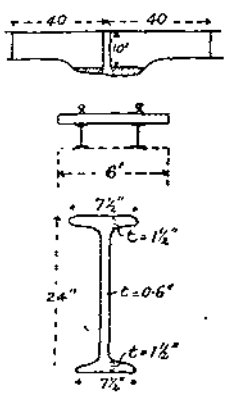
6. The column arrived at TENTERDEN on 25th May. A damaged gun has to be hoisted into a railway truck by means of a derrick which the section has put up. The main tackle consists of 2 treble blocks, a snatch block and a 3-in. fall. The gun weighs 24 cwt. There is much work to be done.

(*a*). How many men will you leave with Corporal C. to hoist the gun into the truck? Give your calculations.

(*b*). Lieut. A. gave you a sketch of the derrick showing strain on back guy to be 12 cwt. You can only get 3-in. rope. Is it strong enough? What will you do if it is not?

7. The enemy having received reinforcements, the column has to retire from TENTERDEN on May 26th. Lieut. A. has been wounded. You receive orders from the Brigade Major to destroy the TENTERDEN—HEADCORN light railway in the vicinity of HEADCORN, sufficiently to prevent the enemy making use of it for 48 hours. Your section, when you receive the order, is in rear of the main body and about 4 miles from HEADCORN; only four of your bicycles are by now in working order. You take three men, giving each 6 lbs. of guncotton, and you yourself take a handsaw, spun yarn, instantaneous and safety fuze, detonators and primers, and push on to HEADCORN Station.

You are delayed in pushing past the columns and by the time you reach HEADCORN Station, you calculate that you have probably only about 1 hour in which to do your work, before the rear guard which is being pressed by the enemy is driven back to HEADCORN. Hastening back along the line from HEADCORN towards TENTERDEN you find at ¼ mile from the station a bridge over the R. BEULT, constructed as shown in the figure. The centre pier is of concrete 2 ft. thick and 6 ft. wide, standing in about 1 ft. of water. The track is carried over each span by two steel I-beams of section as in figure. The railway fence is "post and rail."



(*a*). State how you propose to destroy the bridge, giving sketches of your arrangements of charges, fuzes, etc.

(*b*). Give calculations of any charges you decide to use.

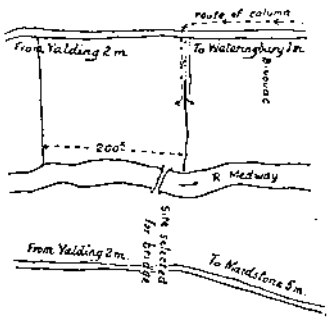
Formula:—For masonry demolitions charge $= \frac{1}{3}$ BT^3.
For destroying steel plates charge $= \frac{1}{3}$ Bt^3.

No. 23. YALDING MILL,
23rd May, 1912.

SERJEANT X., R.E.

I am proceeding to TONBRIDGE and do not expect to be back in bivouac before 7 p.m.

Construct a trestle bridge over the MEDWAY just below your watering places, to carry infantry in fours; with 15-ft. bays if you can obtain sufficiently long road-bearers.



Timber in plenty in a builder's yard in WATERINGBURY—1½ miles south of our bivouac. An infantry working party will arrive at 5 p.m. with tools to prepare the approaches.

By cyclist orderly at 2.30 p.m.

Y.A., *Lieut., R.E.*

You select a site and find by field geometry that the river is 55 ft. wide bank to bank. One of your sappers who is a swimmer finds that the bottom shelves gradually and that for about 10 ft. in the middle he is out of his depth; also that the bottom is muddy. The horses have by now (3.15 p.m.) been watered and fed, and the cook reports dinners ready.

What is your procedure?—very briefly.

4. On arrival at the builder's yard mentioned above you find the following stores:—

4 scaffold poles 30 ft. long, 9-in. butt, 6-in. tip.
20 ,, ,, 16 ft. ,, 7-in. butt, 5-in. tip.
120 planks 12 ft. long by 9-in. by 1¼-in.
100 9-in. by 3-in. deals, 14 ft. long.

There is also a 24-in. circular saw at work, and cross-cut saws are available.

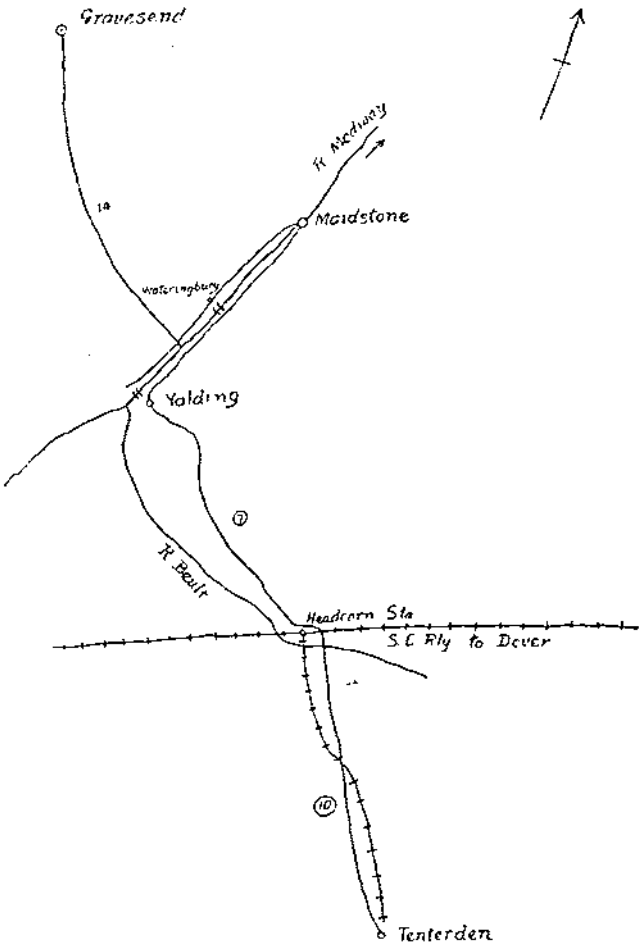
(*a*). Put down in the form of a table as under the stores you select, and the purpose to which you allot them:—

	No. Required.	Stores Selected.
Standards	..	
Transoms	..	
Ledgers	..	
Etc., etc.	..	

(*b*). Prove that the timbers which you have selected for transoms and for road bearers are strong enough.

Formula:— $$W=\frac{\frac{3}{4}bd^2}{L}.$$

5. You have been unable to obtain spikes or rope, but on your return to the site of the bridge you find that Corporal C. has collected a sufficient quantity of wire apparently of No. 12 gauge.



2. The Column marches from GRAVESEND on the 23rd May at 7 a.m. The Section R.E. is with the Advanced Guard, and reaches the R. MEDWAY at 2 p.m. Lieut. A., who has been forward with the Vanguard, meets you and directs the Section into a meadow on the south side of the road, ordering you to arrange watering for the column which is to bivouac north of the road. The MEDWAY at this point flows from south to north, is sluggish, and about 4 ft. deep near the bank. The meadow bank drops 3 ft. vertically to the water. The meadow is dry and hard and has a front of 200 yards on the river. There are several wire fences in the vicinity.

State exactly what arrangements you make and illustrate your answer by a sketch plan.

3. At 3 p.m. on the same day—23rd May—you have just finished the watering arrangements, when an Infantry orderly brings you the following message :—

CORRESPONDENCE.

"QUALIFIED INSTRUCTOR" EXAMINATION PAPER.

SIR,

The following paper was recently set at an examination for "Qualified Instructor." It is somewhat different to the style of papers usually given and proved most successful in testing the general knowledge of the candidates.

Yours faithfully,
R. N. HARVEY, *Major, R.E.,*
C.I.F.

Chatham, 15th May, 1913.

GENERAL IDEA.

In all the following questions you are the Serjeant of No. 2 Section, 17th (Field) Company, R.E.

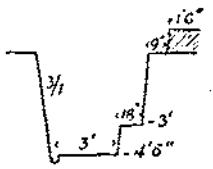
This section forms part of the following force :—1 Infantry Brigade ; 1 18-pr. battery R.F.A. ; 1 Section R.E. ; 1 Company Divisional Train.

The section consists of :—Lieutenant A——; 1 Serjeant—yourself ; 1 Corporal ; 2 2nd Corporals ; 2 Lance-Corporals ; 30 Sappers ; 4 Drivers ; with the following transport :—8 bicycles ; 2 R.E. tool carts ; 1 forage cart ; 1 pack mule.

This mixed brigade is at first at GRAVESEND and in the later questions is following a defeated enemy who is retiring *viâ* WROTHAM—YALDING—HEADCORN—TENTERDEN. That is S.S.E. from GRAVESEND across the river MEDWAY.

1. Whilst at GRAVESEND on the 21st May, 1912, it is decided to strengthen the outpost line to the south of the town.

At No. 1 picquet 200 ft. run of fire trenches of section shown in the figure are to be constructed.



A working party of 1 company of Infantry (4 Serjeants, 80 R. & F.) is to be ready to commence work at 7 a.m. on the 22nd May, and is to bring with it 50 picks and 50 shovels.

The ground is gravelly—similar to that on TOWER HILL at UPNOR—and the rates of excavation may be taken as two-thirds of those given in the textbook (M.M.E., 1911).

(*a*). Show on section what will be the tasks for each relief.

(*b*). Calculate when each relief will finish.

(*c*). What tools or stores shall you take with you assuming that you are lent to superintend the work.

within the projectile which opens out on leaving the rifle, and this causes irregular gashes in the envelope of the balloon thus allowing the gas to escape. A small spring is also put in action which strikes a fulminating cap. placed inside the projectile. Recent trials carried out at the polygon of Neumanswald would seem to have given satisfactory results.

Protection of Cruisers against Aeroplanes.—The same Journal of 1st October reports that the four cruisers which are being built this year in Germany will be provided not only with armoured bridges to resist the attacks of aeroplanes, but also with guns of a special type to fire against dirigibles and aeroplanes. The new cannon will be able to fire at an angle of 80° and will throw projectiles of 13 k.g. to a height of 8,000 m. These projectiles, which will scatter their fragments over a vast field, will contain a powder—producing smoke—thus helping to regulate the fire.

SPAIN.

Sections of Miners for Certain Infantry Regiments.—In view of recent experiments a section of miners has lately been created for each of the eight regiments of infantry constituting the 1st and 2nd Divisions (Madrid and Seville), and for the six battalions of sharpshooters constituting the 1st Brigade of sharpshooters (Madrid). Each section consists of 1 officer, 1 sergeant, 2 corporals and 10 soldiers, and is equipped with the following explosive material:—144 bombs, 96 detonators, in addition to the material necessary for the preservation of the explosives, and for practical exercises.

Creation of a Railway Regiment.—We read, in the *Bulletin de la Presse et de la Bibliographie Militaires* of the 31st October, that in Spain the railway battalion of four companies is transformed into a regiment with eight active companies, and eight depôt companies, the first eight being subject to active service, and the other eight companies being enrolled as on unlimited leave.

E. T. THACKERAY.

ordinary roads. The time employed from the commencement of the operations up to the starting of the convoy was 1 hour 30 minutes. None of the various types of machines were judged to be superior one to the other, but it was found that all possessed characteristics which rendered them useful in various circumstances. It was observed that the troops during the manœuvres tried to escape being seen by the aerial observers by concealing themselves as much as they could, and that they occasionally succeeded.

New Type of Aeroplane.—In the *Génie Civil* of the 9th November it it reported that, at the exhibition of aeronautics held at Paris at the end of October, a new type of aeroplane with automatic stability was exhibited by Drzewiecki. The machine is based on the principle that, in the case of external disturbing forces displacing the aeroplane from its position of equilibrium, it immediately and automatically rights itself.

The monoplane Drzewiecki consists of two superficies placed in tandem; the front one is slightly smaller than the rear one, and at full flight makes an angle of incidence of 8° whilst the angle of the hinder one is inclined at an angle of 5°. Besides this, the curvature of the two planes is so arranged that, with a variation in the general inclination of the machine, the force exerted on the front plane varies less rapidly than that of the rear one. It happens then that, if the aeroplane is disturbed in its flight under the action of external influences, the sustaining force increases more rapidly in the front than in the hinder superficies, and that the two tend to bring the machine into its position of equilibrium. And *vice versâ* if the aeroplane inclines downwards the sustaining force is exerted on the front and the machine rights itself. The rudders of direction are two and are placed in the rear. The motor is placed about half-way in the machine.

Germany.

The *Aéorophile* of the 1st October states that a meeting took place at Gotha for experimenting on the throwing of bombs from aeroplanes under the following conditions:—(1). Throwing bombs of 7·100 k.g. weight on a square of 100 m. from a minimum height of 200 m.; at a height exceeding 400 m. the value of the results was increased 50 per cent.; and over 600 m. was doubled. (2). Throwing bombs from a minimum height of 50 m. on an aerial target consisting of an anchored balloon, 30 m. in length and about 3 m. in diameter fixed at 4 m. from the ground. (3). Taking photographs from a height not less than 600 m. (4). Manœuvres of aeroplanes, with a view to impeding the dirigible Victoria-Luise, belonging to the enemy, employed in reconnoitring and carrying information of the friendly troops. The winner of the meeting was the biplane A.G.O. with an Argus motor of 100 H.P. In the first stage the target was struck by 7 bombs out of 10 which were thrown.

The same Journal of the 1st November states that experiments are being carried out in Germany with a special projectile designed to fire against dirigibles, and to be able not only to perforate the envelope but also to cause an explosion of the gas. This projectile is thrown with the old German rifle model 71 of 11 m.m. calibre. There is a small blade

AUTOMATIC ANGLE OF FIRE CONTROLLERS.

The object of these is to prevent a rifle being fired unless it is properly aimed for the given range. Two American types are here mentioned, that of Major W. A. Phillips, and that of Capt. and Qr.-Mr. F. D. Eley. The writer had been requested not to describe the first, but gives details, and photographs of two models of the second. The first of these models admits of firing at the given range or lower, the second can be adjusted to allow of fire at the given range, or at some angle above or below that range. The advantages claimed by the inventor for his controller are not altogether concurred in by the experimental committee at Monterey. However it is said that in the United States a large number of officers consider that, given the necessity of employing militia soldiers, some method of counterbalancing nervousness would be an advantage.

A.R.R.

RIVISTA DI ARTIGLIERIA E GENIO.

December, 1912.

FRANCE.

Aeronautics at the Great Manœuvres.—Some notices that were not previously reported are extracted from the *Technique Aéronautique* and the *Aérophile*, of the aeronautic exercises practised at the great French manœuvres during the current year. There were assigned to, (1), the blue army, one dirigible (Dupuy de Lôme), three squadrons of aeroplanes at two stations (the first two each with six Farman machines, and the third with six Blériot) and one squadron of aeroplanes to one station (three Borel and three Blériot); (2), to the red army, one dirigible (Adjutant Reau), two squadrons of aeroplanes at two stations (one of six monoplanes, Deperdussin, and the other of six Farman biplanes), one squadron of aeroplanes to one station (Hanriot), a mixed squadron of aeroplanes at three stations (two Brégnet, two Deperdussin, two Nieuport), three monoplanes, Blériot, to a station for cavalry, and three Blériot monoplanes for the artillery. There were in addition, in reserve :—one dirigible (Adjutant Vincenot) and five squadrons of aeroplanes.

The following was the order adopted for the "squadrillos":—In the 1st line, the aeroplanes, one automobile, and one motor bicycle for communication, six wagons with hauling ropes, which also carried a shelter tent for each machine. In the 2nd line, one aviation park with automobiles and motor bicycles for communication, autocars for offices, and for spare wings for the machines, etc. In the 3rd line, the reserve for reinforcements with automobiles, motor cycles and autocars. Altogether 60 aeroplanes and about 80 automobiles were employed.

In order to approach as far as possible the real conditions of war, the greater part of the aeroplanes arrived at the theatre of operations by aerial flight. Experiments were also made for transporting a squadron of aeroplanes from one position to another, taking the aeroplanes on

Valise Equipment for Infantry.

Capt. Strubin proposes a new equipment, the principle of which is the division of the valise into three parts :—

1. For clothes and boots; weight empty	...	850 grammes.
2. For food and ammunition; weight empty	...	430 ,,
3. For the great coat; weight empty	...	270 ,,
Total	...	1,550 ,,

(about 3½ lbs.), against the present weight of 2,850 grammes (6⅛ lbs).

Each part is described and a list of its contents is given. It is noteworthy that the second valise is to contain a spirit lamp and apparatus for boiling and roasting food. The third valise is a piece of tent cloth 80 c.m. x 56, which can be used as a shelter in bivouac. Any portion can be omitted, according to the task the soldier may be called upon to perform. The advantages of such an equipment are insisted upon, and figures are given to show that spirit for cooking is cheaper than using wood, and is much less heavy to carry.

Military Bridges for Mountain Warfare.

The description of a plank girder bridge constructed by a class of sapper recruits in 1912. It was built on the bank parallel to the stream, one end over one of the abutments, counterweighted, and swung across on a pivot in the abutment. Length 13½ metres, width 2 metres, the floor fixed to the lower flanges of the girders. The calculations allowed for a dead weight of 150 k.g., and a moving load of 200 k.g. per square metre. Only nails and wire were used for building up the girders. The pieces might well be cut to length in the shops, and by this means no useless weight is carried and the short lengths are more easily conveyed along hill paths. The bridge was completed in 166 men-hours. Dimensioned drawings and photographs are published.

Collective Ranging.

This method of ranging was introduced by France in 1899. The Swiss "lunette panoramique," or telescope sight, is graduated to 6,400 millièmes in a complete revolution, hundreds being read on the base plate, and tens and units on a drum. The larger angles of direction and site can also be read on the battery telescope.

The millième is the artillery unit of height and width, the range can also be expressed in millièmes, but in a different sense. A millième is very nearly the angle at the point of observation subtended by 1 metre at a distance of 1 kilometre, and owes its name to the fact that the arc of circumference it measures is the thousandth part of the radius. Thus on a circumference of 1,000 m. radius the millième is nearly 1 metre, on a circle of 2 kilometres radius the millième measures 2 metres, etc.

Open and covered positions and the aiming point are described, the method of obtaining direction and of opening fire, and also the duties of the battery commander and of the layer. The employment of artillery is touched upon, especially against infantry and artillery.

The collective fire of groups of batteries is then described.

THE QUESTION OF INFANTRY N.C.O.'S.

An examination into the causes of the difficulty experienced in finding efficient N.C.O.'s, with suggestions for overcoming this difficulty.

March, 1913.

OUR INFANTRY MACHINE GUNS.

Employment of Machine Guns.—Machine guns have been called "condensed infantry," but they are more. The tripod mounting, or the German wagon admit of reinforcing the firing line, but the impossibility of accompanying infantry at the same pace, and the difficulty of the ammunition supply limit their use for this purpose. These guns should form distinct forces at the disposal of regimental, or in certain cases, of battalion commanders.

In the defensive they should occupy the most vulnerable points of the firing line, or be used for flanking fire. For night work, they should be placed in position by day. They can also be used to search defiles, dead angles and obstacles. Their effect is overwhelming at 200 or 300 yards, but is useless at long ranges against thin lines.

In the offensive they should follow the infantry under cover, and fire over their heads. In their final position they should cover the last rushes of the infantry, and concentrate on counter-attacks. When the position is taken they should be rushed up to co-operate in the pursuit and check counter-attacks. In such cases means of rapid transport are necessary.

In attacking a prepared position, it is still open to dispute whether the machine guns should open fire from the beginning or be held in reserve. Cases are quoted from the Russo-Japanese War in which both methods were employed with success, and the moral effect of their rapid fire was very marked.

The Swiss regulations lay down clear and precise principles for their employment. These principles are much discussed, but it seems clear that the groups of two or three companies in reserve at the disposal of divisional commanders are very useful for surprises, and in actions of short duration against important points. The difficulty of ammunition supply precludes their use for long periods. Deep targets are most favourable. In the combat of encounter, machine guns at the head of the main guard will try to act against dense bodies of the enemy, failing these against his skirmishers. For decisive combats they must be brought up as close to the enemy as possible with ammunition supply complete; at 500 yards they can fire over infantry so long as the latter are 3 yards below the target. The regulations insist that the commander who has the courage to wait till the last moment for engaging his machine guns at close ranges is assured of success. Portions of these regulations should be embodied in the regulations of the other arms to prevent misunderstandings. At present groups of 12 are attached to divisions, later these will be raised to 18. Their mode of action requires more profound study on the part of the chief commanders.

brigade had a company of six guns carried by two horses each only. This proportion is being increased and it is probable that shortly each regiment will have its six guns. The weapon is an 8-m.m. Maxim firing the infantry cartridge.

France has some Hotchkiss guns, but has now decided to use a gun of the Puteaux model, which is described. It is not water-cooled.

Italy.—All infantry and cavalry regiments have a Maxim section of two guns, carried on pack-saddles.

Austria.—Each regiment of infantry, battalion of chasseurs, and brigade of cavalry has *Abteilungen* of two guns in the infantry and chasseurs, in the cavalry and mountain infantry regiments of four guns. These are on the Schwartzlose system.

England employs her machine guns on different principles to any other nation, *i.e.* singly. As a rule the section of two guns is the unit of fire. She also uses them at long ranges outside the lines of infantry, which explains the great vulnerability of these weapons in spite of their shields. It would seem that these tactics are tainted with the error that brought discredit on these guns in 1870–71; the confusion between their action and that of artillery.

Russia has 120 companies, part drawn on wheels, and part carried on pack-saddles. They are distributed in varying numbers to divisions and brigades. They are mostly Maxims, but the mounted units have the automatic rifle of Madsen model (also called Rexer or Rekyl), which is described.

Japan at the beginning of the war had only a few machine guns in certain cavalry regiments, but added to these considerably. At first companies of six guns were organized, now each battalion has a section, or even one gun. They are mostly Hotchkiss, but some are Maxims.

The conclusions drawn are (1) that the Swiss cavalry system has been emulated by other Powers, (2) that the infantry organization meets the advantages of all existing systems especially from the point of view of transport, (3) that the army possesses fewer of these weapons than is generally considered necessary. Their mobility however partly supplies this deficiency.—(*To be continued*).

The Medical Regulations of the Swiss Army.

The criticism of these new regulations is completed. The chapter on the measures to be taken during the combat is generally approved of. These measures differ according as the engagement is one of encounter or attack, in a fortified position, or during a retreat. The company and its duties, and methods for carrying out the latter are described. Chapter III. deals with the medical arrangements on the Line of Communications, which comprises the 3rd line, Chapter IV. with the arrangements in fortresses, Chapter V. with Reports, and Chapter VI. with the Red Cross. There are also several appendices dealing with various matters.

RUSSIA.

The railway lines purchased by Russia in 1912 from the Warsaw-Vienna Railway Company from Warsaw to Alexandrovo on the Berlin-Moscow line, and from Warsaw to Granica on the Vienna line, are to be converted to the Russian gauge 1·52 metres. The conversion will be carried out gradually and will cost £2,800,000.

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REVUE MILITAIRE SUISSE.

February, 1913.

SWISS INFANTRY MACHINE GUNS.

The introduction of machine gun companies into her cavalry in 1898, placed Switzerland in the first rank of progress. She was, however, quickly passed by neighbouring Powers, but fighting shy of additions to the cavalry machine guns on account of the difficulty of providing horses, determined to equip the infantry with them.

After numerous trials the Maxim gun was chosen, conveyed somewhat after the manner of the German *Abteilungen* (4-horse wagons, *personnel* on the wagons or on horses). The organization of the companies contemplates their employment as a fire reserve at the disposal of the higher commanders; they can, however, be distributed to the infantry. This equipment and organization is criticized as not being mobile enough to be brought into action sufficiently quickly at the decisive moment by the higher commanders, and too mobile for ordinary use with infantry. Germany appears to be neglecting her *Abteilungen* in favour of companies attached to infantry with two horse carts and *personnel* on foot, still it does not follow that German methods will equally suit Switzerland. Machine guns moving at the pace of infantry must be distributed at least two per battalion, but with greater mobility this proportion can be reduced.

The organization of the companies is then discussed, and the machine gun described, several photographs being given. The gun-carriage and limber is drawn by four horses and carry the *personnel*. The gun is fired from a tripod, and it and the tripod are so loaded in the carriage as to be easily withdrawn and secured to a pack saddle. It is the same with the ammunition. The off-side horses carry the pack saddles, and when wheels can proceed no further, these are unhooked and the loads transferred to the saddles, the rear leader taking the place of the off wheeler. Again when the country is impassable for horses, the loads can be transferred to the backs of the detachment. The wagon is treated in the same way, the off-side horses carrying extra ammunition. The cavalry machine guns cannot be carried by the men.

The gun and equipment is then compared with those of other armies.

Germany has 16 *Abteilungen* of six guns each, and is credited with the intention of giving at least one of these detachments to each *corps d'armée* for independent use. In 1910 one infantry regiment in each

NOTICES OF MAGAZINES.

Revue Militaire.

March, 1913.

Imperial German Manœuvres, 1912.

An interesting part of the manœuvres was the crossing of the Elbe between Riesa and Meissen by the Red Cavalry Corps. The German cavalry are equipped with steel double pontoons in the proportion of two to each regiment. Each double pontoon takes six men with their saddles and equipment, the horses swimming. In this manner the whole cavalry corps was passed across the river, which is here from 110 to 130 yards wide, during the afternoon of 9th September and the succeeding night. The horse artillery crossed on the divisional bridging equipment. Two days later the III. and XII. Army Corps and the 9th Division crossed on three pontoon bridges in the same locality. The bridges were constructed in three to four hours, and the whole of the troops were across within six hours from the time the bridges were finished. The new pontoons were used for the first time in manœuvres and were thought well of. Three airships and several squadrons of aeroplanes took part in the manœuvres, and two anti-aeroplane guns, a Krupp shielded gun, and an Ehrard, were attached to the troops. All the aeroplanes carried observers, and useful information was obtained on both sides although nothing particularly noteworthy appears to have been done.

America.

The fortifications at Pearl Bay and Honolulu will be almost completed by the end of 1913. The nature of the defences of the Panama Canal has been settled, and work has begun at the two ends and at certain vulnerable points on the canal. The guns of the batteries are to be delivered by June, 1913. Submarine mines will form part of the defences. The harbour of Guantanamo, in Cuba, has been fortified by anti-torpedo boat batteries, and further work is contemplated; it seems destined to become a place of great strategic importance when the canal is opened.

April, 1913.

Austro-Hungarian Manœuvres, 1912.

Use of Aeroplanes.—Fourteen aeroplanes took part, and in spite of constant rain the majority of them carried out daily reconnaissances, which were of great value as the country in which the operations took place was unsuited for cavalry reconnaissance. The commander of the Southern Army was, by means of them, enabled to locate both the opposing forces at an early period of the operations.

SOME IDEAS ON FORTRESS WARFARE (QUELQUES IDÉES SUR LA GUERRE DE PLACE).

By COLONEL ROUQUEROL of the French Artillery.—(8vo. 36 pp. Paris 1912. Chapelot).

THIS is an interesting essay on the effect on fortress warfare of high explosive shell, aircraft and other modern inventions. Amongst the various conclusions at which the author arrives are:—that nothing but permanent fortification is likely to be of value, the improvised methods that have been effective in the past will no longer serve, except of course in the case of a field army temporarily on the defensive; that sorties in force only play into the hands of the attacker; that assaults are out of the question, and that mining will be the best method of close attack. He considers that the defenders must be in absolutely bombproof works which permit of the use of machine guns. The so-called active defence is dead, advanced positions to delay the enemy only mean defeats and loss of *moral*. Small sorties to destroy isolated detachments, to damage new works and material will still be possible, but they must be surprises, carried out by not more than a battalion without artillery. Scouts with local knowledge will be of more service than cavalry or even aircraft in getting information. He ridicules the idea that aircraft can be of any use in observing the effect of and directing fire. He insists that for the maintenance of the health of the garrison every unit should have its own bombproofs, so that disease and contagion are less likely to spread, and its own bombproof kitchen and latrines, As regards the general organization of a fortress he proposes four lines:—line of forts, line of batteries, second line of forts and *enceinte*. The batteries must all be concealed from view, and the forts connected by tunnel with the central supply and ammunition depôts.

"E."

sent out about 100 pontoons to South Africa, they, however, proved useless. There was sufficient material for temporary bridges, but it was not prepared in time."

In his final comments after his account of the Siege of Ladysmith the author says :—"The engineers were present in much too small numbers, this is still the case in both armies. In bridge construction they failed principally for want of effective material and from insufficient reconnaissance. Draught horses are indispensable both for engineers and heavy artillery."

H. E. G. CLAYTON,
Major, R.E.

HOW TO ESTIMATE: BEING THE ANALYSIS OF BUILDERS' PRICES.

By J. T. REA.—(London: B. T. Batsford, 94, High Holborn. 1913. 7s. 6d. net. 4th Edition).

THE R.E. Division Officer needs no introduction to Rea's *How to Estimate*, a fourth edition of which has just been published by B. T. Batsford, of 94, High Holborn. But it is doubtful if anyone is fully acquainted with the whole of the really useful data and memoranda of which the book consists. The new edition contains much more letterpress and many more illustrations than previous ones, including a section on Reinforced Concrete and notes on Modern Road Construction, while the price is still 7s. 6d. net.

It seems a pity that the chapter on the Cost of Buildings could not have been brought more up to date—the date of the latest barrack building of which the cost and cube rate are given is 1905; while it may be doubted if all the illustrations are really necessary, and add to the value of the book. Most people know what a pair of scissors looks like, but a picture of one is given in the chapter on Paperhanger's Work!

Still no doubt every D.O. will wish to possess this new edition, and will find any amount of use for it.

C.R.S.

REMARKS ON THE FACTORS OF PROMOTION (REMARQUES SUR LES FACTEURS DE L'AVANCEMENT).

By CAPT. DE L'HARPE.—(8vo. 23 pp. Paris, 1912. Chapelot).

THE author discusses the unsatisfactory method of promotion, partly by seniority and partly by selection, in vogue in the French Army. He considers that selection, as at present exercised, opens the door to favouritism, and that the opinion of those serving under an officer might be taken into account. As he quotes "A Minister is easier to influence or to deceive than a whole regiment." Failing some improvement in the rules to limit favouritism, he would seem to advocate promotion by lottery, for he sums up by saying "Everyone prefers accident to injustice; and the act of fate to the decision of a secret tribunal."

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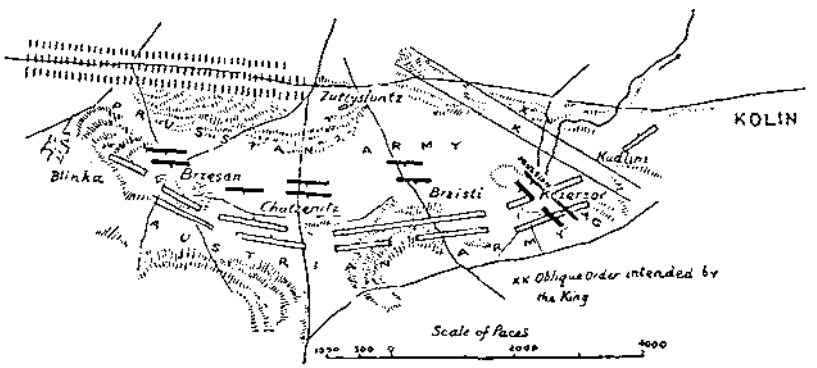
author of *German and English Tactics* quotes General von Bernhardi as follows:—"Positions should be strengthened by the supports against counter-attack, for the reserves often lie idle under cover for a long time, and even on manœuvres might be profitably employed thus during their involuntary leisure." He makes the following remarks on the passage of rivers:—"It so happened that Buller, from December to February, was unable to provide himself with more bridging train, and the preparations for the passage were begun as late as the 20th February, after the Boers had vacated the southern bank. If the reconnaissance and preparation had been taken in hand earlier and with greater care, they would have had at least three places ready on the 20th, the old bridge site and the sites of pontoon bridges Nos. 1 and 2. If the two bridges had been simultaneously in use both at Spion Kop and Vaal Krantz, everything would have been done under more favourable conditions of the river. For if the passage of the army had been accomplished on the night of 20—21st, they would have been able to attack on a broader front at dawn. No decision was come to till the 27th, and the English have only to thank the incredible inactivity of the Boers that they did not sustain more decisive defeats in their earlier fights on the Tugela.

In the English Cavalry Training it is now laid down as a fundamental rule that three bridges must be thrown across a river, one for the infantry, one for the cavalry, and one for the artillery and wagons. According to Section 108 they consider that a well-trained squadron can pass a river about 50 yards broad in about half an hour with the help of two boats.

The great engineer manœuvres at Rastatt in 1909, and Bromberg in 1910, have only confirmed these general principles. You cannot begin by throwing a bridge across a river in security in the face of a worthy foe. Until sufficient forces are on the spot one must content oneself with getting possession of the immediate surroundings of the passage. At Spion Kop, at Vaal Krantz, and at Colenso the English could ignore this rule unhurt; on the other hand how carefully the Japanese made their preparations for the passage of the Yalu. The cavalry reached the upper Tugela on the 10th January and seized the ferry boat at Potgieter's Drift in full view of Spion Kop. Warren's troops commenced the march from Springfield to Trichard's Drift at 5 p.m. on the 16th January, and reached it on the 17th at 2 a.m., his last wagon passed the bridge at 10 p.m. on the 18th. The condition of the river, the strong stream and numerous boulders, rather than the breadth (12 bays for the first bridge 78 metres long), made things especially difficult. The steep banks also hindered the carrying down of the pontoons. The reconnaissance was only made on the arrival of the troops, whose night march was rendered fruitless by the long wait at the bank at Potgieter's Drift. Lyttelton's Brigade were able to cross without loss by the help of a wire cable stretched across the stream, although the current was very rapid and the water came up to the men's shoulders. At Vaal Krantz building the bridge took 1½ hours under heavy fire from a Maxim, a quick-firing gun also had some shots at them so that the English lost eight men. At Colenso the Boers were completely inactive. Almost at the beginning of the campaign in order to meet the most pressing wants the English

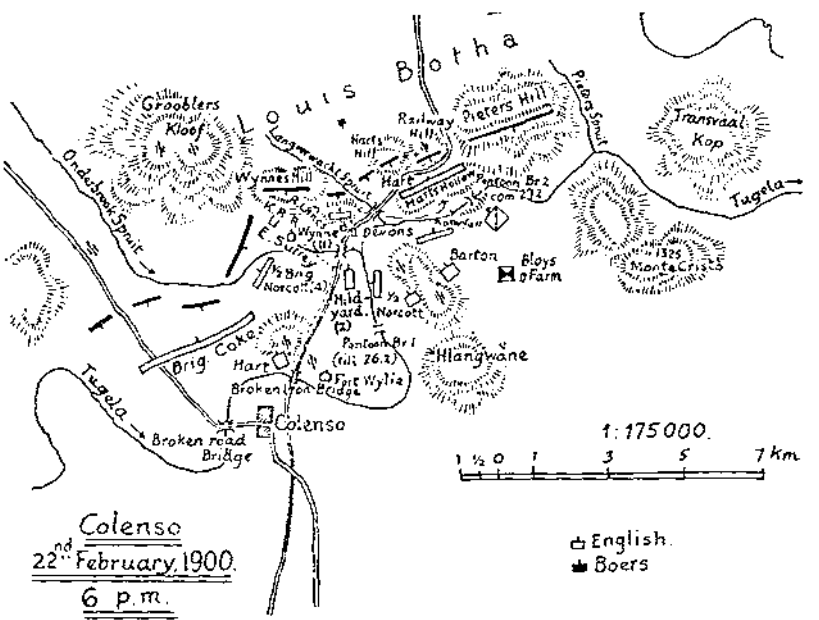
Chotzenitz while the leading portion continued its march, a large gap was thus left in the long columns, and the general commanding the first portion hearing the firing, looked back, saw the remainder of the army in action, and wheeled to his right and thus instead of forming the line XX, the Prussian Army made four disconnected attacks along the front. The Prussians fought well, and renewed the attack five or six times, but were unable to carry any of the Austrian positions, and were compelled to retreat with heavy loss." Napoleon's comment on this was:—"At the Battle of Kolin it is difficult to justify the attempt to turn Daun's right by the flank march made from 600—1,000 yards from the heights occupied by the enemy. The operation was rash and opposed to the principle of war. Never make a flank march before an enemy in position, especially when he occupies the heights at the foot of which you must march." Comment is hardly necessary, the parallel between Sir Redvers Buller's mistake and that of Frederick the Great is almost perfect.



The following extracts will be of more particular interest to R.E. officers. We find under the heading:—"Defence. Field Fortifications," the following:—"The history of the war excuses the bad work on Spion Kop by the fact that there was only 1 ft. of earth over the hard rock, that the stones were too heavy and too deeply bedded to be moved. The Japanese in such circumstances used sandbags, the Boers employed small pieces of stone very cleverly. On the Boer side the Kaffirs had dug narrow deep-cut trenches in the rocky ground and provided head-cover by heaping up big stones. At Colenso they also built false trenches in front of the position which drew the English artillery and infantry fire. The English commission which assembled after the war reported:—The personal skilfulness in the preparation of cover which was so remarkable amongst the Boers, was completely wanting in our regulars, who when entrenching followed orders with difficulty and with no regard to their own cover. At the beginning of the war the troops were neither trained in utilizing cover nor in the application of field defences." Lord Methuen, the commandant at Orange River, adds that:—"The Boers instructed us in the use of small deep trenches whose line was visible with difficulty."

Shortly afterwards, in comments on entrenching in the attack the

serve another purpose as well, though the analogy hereafter adduced did not occur to the author of *German and English Tactics*:—"Buller spent the 20th February in making a reconnaissance from Monte Cristo, and as the ground eastward of Pieter's Hill seemed to afford no passage for an army across the river, he determined to bridge the river north of Colenso and to drive the Boers back from the river to the west. But in spite of his reconnaissance it was still uncertain where the Boer flanks rested, and this was the cause of the unlucky flank march in the course of the next day between the river and railway which resulted in the brigades attacking one after the other and not simultaneously." This description is somewhat amplified as follows a few pages later on:—"As there was no passage over the Tugela north of pontoon bridge No. 1, the attack could not take place from the front, but Hart's whole brigade had to cross over the iron bridge over the Langverwacht Spruit singly under machine-gun fire; then singly in interminable ranks make a venturesome flank march between the river and its 40—100 ft. high northern bank, in order to make a front and about 5 p.m. take Hart's Hollow with little trouble."



Now to make the parallel, take the following extract from *A Précis of Tactics* by Home, revised by Lieut.-Colonel Sisson Pratt, page 232, on the battle of Kolin in 1757:—"The advanced guard moved as directed, wheeled into line and carried the village of Krzeczor. But while this was being done, the army in its march along the front of the Austrian position was much disquieted by the Austrian light troops, who continually attacked their right flank, a battalion leader being much pressed, ordered his battalion to wheel to its right, as this was the order to form line, it was taken up by the whole army in rear, who wheeled into line also and attacked the Austrians near

be trained:—study of history, study of the theory of war, conferences, examinations, essay writing, tactical problems on the map, staff tours, manœuvres. He insists that the second part of the Franco-German War proves decisively that it is indispensable that officers should receive a good theoretical training:—"to organize corps, whose leaders have no military instruction and know no more than the rank and file, should be considered a criminal absurdity."

He is opposed to examinations as the sole means of testing an officer's fitness; they are, he says, merely a means of enabling a general who is not sufficiently in personal touch with his officers to form some sort of opinion of them. If a general carefully watches his officers, he will get a better idea of their capacities than by judging as a result which depends more or less on a good memory.

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GERMAN AND ENGLISH TACTICS.

By COLONEL EGGERT VON ESTORFF.

THIS very interesting work is well worthy of careful study. It deals with the S.A. War and is divided as follows:—

A.—Fights before the Investment of Ladysmith;
B.—Fight at Colenso on the 15th December, 1899;
C.—Fights on the Tugela, January—February, 1900;
D.—The Defence of Ladysmith;

with comments in each case.

The Army Review of January, 1913, contains the following summary of the preface:—"Recent events have led people in Germany to pay more attention to the British Army and its tactics than they have done heretofore. Both the German and British Armies have submitted their tactical creeds and regulations to a searching criticism and correction since the Manchurian War."

The history of events under the above heads is an extremely clever condensation of the *English History of the War in South Africa, 1899–1902*, Vols. I. and II., but the comments are entirely the author's own. In these he criticizes or appraises our failures and successes almost entirely by the light of our own regulations. In doing so he shows so intimate a knowledge of them that few English officers can excel, if equal it. In many places he brings together apposite quotations from Field Service Regulations, Cavalry Training, Artillery Training, Infantry Training, Musketry Regulations and the *Field Service Pocket-Book*, so that by a general perusal of the book an almost better knowledge of the inter-relation of the regulations can be obtained than by reading the regulations themselves.

A few extracts will more readily serve to show the interest of the book than a further description would do. The following extract from the description of the battles north of Colenso, 20th—25th February, will

REVIEWS.

A SHORT ACCOUNT OF RAILWAYS FOR THE USE OF OFFICERS AND N.C.O.'S EMPLOYED IN GUARDING LINES OF COMMUNICATION (NOTIONS SOMMAIRES SUR LES CHEMINS DE FER À L'USAGE DES OFFICIERS ET SOUS-OFFICIERS DU SERVICE DE GARDE DES VOIES DE COMMUNICATION).

By A. LAPLAICE.—(85 pp. and 50 figures in the text. Paris, 1913. Berger-Levrault. 2 francs).

THIS is a very valuable little work. It gives a very clear idea of the French railway lines, rolling stock, signals, etc., and should be studied by all R.E. officers likely to be employed on railway work in Europe. The French methods of working are somewhat different from our own, in which for instance violet and yellow lights are unknown as are also the round disc signal and its attendant "protection post," the square signal to stop, the direction indicator, the chequered warning signal and the bifurcation signal. One has often wondered what three red lozenges on the side of a truck meant; it is an exclusion mark, indicating that the rolling stock in question is unfit for the transport of soldiers, horses and war material.

Apart from the subject matter of the work, it furnishes useful explanations of the meanings of French technical railway terms, which it might puzzle even an "interpreter" to translate, *e.g. en palier*, *accotement*, *tendeur* (this is not a "tender" but a "coupling"), *tirefonde*, *coussinet*, *pattes de lièvre*, though *boggie* (*sic*), *ballast* and *tender* present no difficulties.

"E."

APPRENTICESHIP TO WAR (L'APPRENTISSAGE DE LA GUERRE).

By COLONEL GORY.—(8vo. 135 pp. Paris, 1912. Chapelot).

THIS is a very thoughtful volume. The title is derived from the author's theory that as few of the soldiers of the French Army have seen war, they are mere apprentices, learning as best they can to play a military *rôle*. Whilst in all the other professions the members are trained by incessant practice of their art, officers may complete their service without ever having done anything else but simulate the practice of war. Army manœuvres are excellent to teach the preparation for, and preliminaries of a battle, but prove nothing regarding the actual fighting, and as all danger is absent a mere useless simulacrum is produced.

Colonel Gory next discusses the various means by which officers can

saving rockets carry a much heavier rope about 150 yards, so that there should be no great difficulty in obtaining our requirements. I believe that a marine rocket apparatus is very heavy: a light equipment is required that at all events can be got on two mules. These rockets could be kept in an Arsenal, a few being issued yearly to Sapper and Miner Corps for practice. When an expedition goes into a country where large rivers will be met, these rockets would be specially issued. The saving of one day in crossing a river might mean the saving of one day in the duration of the expedition, the financial gain of which would well repay the cost of the proposed equipment.

6. *Wheatley and Polianski Bags.*—Separate reports have already been submitted on these bags and I strongly recommend that some of each pattern be kept in reserve. Polianski bags should be stored in a hill station where extreme dry heat would not injure the rubber bags.

7. *Venesta Equipment Boxes.*—Twelve experimental boxes were made up in the 1st King George's Own Sappers and Miners workshops, smaller than the ordinary mule equipment box, to carry tools, etc., in 60-lb. loads suitable for coolies. For over five months the Sapper Company was entirely dependent on coolie transport, and these boxes were of the greatest value and stood the test well. A small reserve of these boxes might be maintained for similar expeditions.

The old boxes have been given into the 1st King George's Own Sapper and Miner workshops as patterns.

APPENDIX II.

List of Stores Expended from Engineer Field Park.

Axes, helves, 3½"	...	...	No.	84	Wire nails, 2½"	...	...	lbs.	40
Axes, helves, 16"	...	...	,,	30	Wire nails, 3"	...	...	,,	188
Mauls, helves, 3½"	...	...	,,	200	Wire nails, 4"	...	...	,,	388
Sandbags	...	...	,,	231	Wire nails, 5"	...	...	,,	230
Mamooties, helves	...	...	,,	36	Wire nails, 6"	...	...	,,	244
Shovels, helves	...	...	,,	55	Spikes, 5"	...	...	,,	84
Bars jumping, 1½"	...	(in anchorages)		15	Spikes, 7"	...	...	,,	700
Galvanized iron wire No. 14		cwt.		25	Spikes, 9"	...	...	,,	734
Barbed wire	...	...	,,	3-2-16	Screws, 1½"	...	...	gross	1
Dogs, 15"	...	...		19	Screws, 2½"	...	...	,,	1
Dogs, 12"	...	...		44	Screws, 3½"	...	...	,,	1
Pencils, carpenters	...	...		24	Screws, 5"	...	...	,,	1
Saws, handles	...	...		8	Composition, waterproof	...		lbs.	2
Cordage, Manilla, 3"	...	...	fathoms	150	Oil, Rangoon	...	...	gallons	5
Cordage, Manilla, 2"	...	...	,,	62	Oil, mustard	...	...	,,	1
Cordage, Manilla, 1½"	...	...	,,	150	Turpentine	...	...	pints	2
Canvas, sail	...	...	yards	25	Dynamite	...	...	lbs.	800
Canvas, Willesden	...	...	,,	41	Guncotton, primers	...	...	,,	50
Lines, Hambro'	...	...	skeins	10	Guncotton, slabs	...	...	,,	510
Twine, country	...	...	lbs.	20	Gunpowder	...	...	,,	150
Log line, 1½"	...	...	skeins	20	Cordite	...	...	,,	50
Log line, white, 4 lbs.		...	,,	10	Detonators, octuple	...	...	No.	800
Spun yarn	...	...	lbs.	20	Detonators, sextuple	...	...	,,	700
Solder	...	...	lb.	1	Fuze, safety	...	...	fathoms	500
Copper sheet	...	...	lbs.	4	Matches, Vesuvian	...	...	boxes	36
Tin sheet, 20" × 14"	...	...	sheets	6	Leather, buffalo, light	...	...	lbs.	30
Steel, round, ½"	...	...	lbs.	32	Ropes, steel wire, ¾"	...	...	fathoms	2,400
Steel, round, ⅝"	...	...	,,	12	Ropes, steel wire, 1"	...	...	,,	700
Steel, round, ¼"	...	...	,,	10	Ropes, steel wire, 1¼"	...	...	,,	1,100
Steel, round, ¾"	...	...	,,	40	Clips for wire cable, ¼"	...	...	No.	4
Steel, flat, 2" × ⅝"	...	...	,,	31	Clips for wire cable, ½"	...	...	,,	11
Steel, flat, 1½" × ¼"	...	...	,,	29	Clips for wire cable, ⅝"	...	...	,,	10
Steel, flat, 1½ × ½"	...	...	,,	18	Wheatley bags	...	...	,,	60
Steel, flat, 2½ × ½"	...	...	,,	2	Polianski bags	...	...	,,	125
Bolts, ¾" × 9"	...	...	No.	2	Pitch	...	...	lbs.	40
Bolts, ⅝" × 6"	...	...	,,	2	Sal ammoniac	...	...	,,	10

iron roofs, the roofs were built at a steeper slope to carry thatch. In seven days the clearing of the site was completed, including the removal of some immense trees; the framework and split bamboo flooring of all buildings was finished, one hut was thatched, and planks were sawn for flooring the officers' quarters.

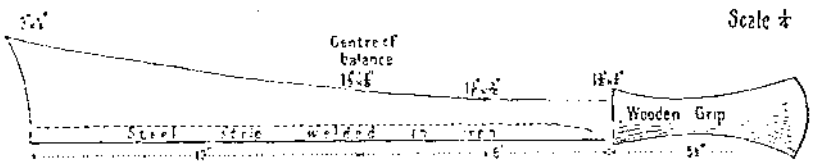
46. The Post being so far advanced that it could be finished by the Infantry and Carriers, the Sappers left Pasighat by half-companies on the 16th and 17th April and embarked on the *Kabul* at Pobamukh on 18th April.

APPENDIX I.

NOTES ON ENGINEER EQUIPMENT.

1. *Delisle Clinometers.*—At present only two Delisle Clinometers are authorized in the equipment of a field company of Sappers and Miners. I consider that this should be increased to four. The weight is very small and the addition could be made without reducing any other articles. These clinometers are essential for laying out hill roads and there should be at least one per British officer in the company, not to mention the Indian officers. These instruments are as essential on the North-West as on the North-East Frontier.

2. *Dahs.*—For the Abor Expedition a kukri or dah was issued to each Sapper. A kukri is perfectly useless in the hands of anyone but a Gurkha, who has been trained to its use from youth, moreover the kukries issued by the Ordnance Department were of inferior metal. The dahs also were of a bad pattern and material. Whilst awaiting the advance from the base at Kobo, I saw some Kamptc dahs belonging to an officer of the Lakhimpur Military Police and bought some for the Sapper Officers, and carried one myself in place of a sword throughout the expedition. This dah was invaluable for cutting jungle in aligning the road and with it I could compete on equal terms with the Gurkha and his kukri. The dah is shaped thus—



The weight is 1 lb. 6 ozs. The grip was rather too small for an Englishman. The blade is made of soft iron with a thin strip of steel on one side only: the other side is sharpened on a stone as required, the steel side remaining flat. The balance is excellent and the blade cut through young saplings with ease. This weapon should be issued to everyone except Gurkhas on another expedition on the North-East Frontier.

3. *Axes.*—I agree with Capt. Le Breton's remarks about felling axes used on the Mishmi Mission, that the slot in the head to receive the helve is too small: this necessitates a very thin helve which constantly broke just below the head especially when axes had to be lent to Infantry who were unskilled in their use. It must be remembered that on service it is not always possible to get spare English helves and the best local wood has to be used.

4. *Explosives.*—The explosives supplied from the Arsenal were very satisfactory and I had no trouble with guncotton, dynamite, fuze or detonators. In a damp climate like Assam one should always use a fresh tin of primers or else use dynamite as a primer to fire guncotton slabs.

5. *Crossing Rivers.*—The whole difficulty is to get the first line across. In the case of a big river like the Dihang, when boats are not available or the current is too heavy to let a boat take a line over, an "otter" appears to be the best method, but an otter will not work satisfactorily unless there is a fairly even current. At Rotung, the Dihang kept boiling up in eddies which upset the otter. On the other hand I got an otter at the first attempt successfully across the Cairal River in the Mohmand Expedition, 1908, width 200 yards. Maximum current 6 miles an hour, but there were no eddies. I think experiments should be made to devise a rocket to carry a ⅜-in. line 250 yards. I understand that marine life-

The result was most satisfactory, each set of six cables lying perfectly even at the required dip of 1-10th thus ensuring an equal distribution of the total load and it was unnecessary to readjust a single sling, which fully justified the time taken in stretching the cables. The slings were attached to flat iron plates bolted above and below the six cables.

40. Meanwhile one company of Pioneers working from Renging metalled the zigzags down to the new Sirpo diversion, where the road passed through soft wet ground which had become impassable for mules in the recent rain.

41. *Balek Post.*—On 25th March, the Sappers marched from Sirpo to Balek to build a Post for the Military Police. Lieut. F. S. Collin, R.E., and two companies Pioneers had already built the stockade and were collecting bullies and bamboos for the huts. Another company of Pioneers also arrived later. The Post was built for 100 men, the huts being of the same type as at Rotung, but were raised off the ground on piles instead of on stone walls.

42. On 27th March, the remainder of the Pioneers left Sirpo and moved down to Pasighat and Kobo, but two companies halted a week at Janakmukh to improve the road in that neighbourhood and also to make a new mule road from Janakmukh to Balek.

43. *Work above Yambung.*—Whilst at Balek, two detachments of Sappers rejoined the company. On 9th February, Lieut. Chater, R.E., and two Sappers had left Sireng for Geku, and had been followed on 21st February by 20 more Sappers. This party established a ferry over the Dihang below Geku, using a raft of Polianski bags. Between 28th February and 2nd March, the Tibet exploration and survey party crossed by the ferry to the right bank, and the ferry was dismantled. The Sappers proceeded to Riga and Arte Hill where they cleared the trees on the hilltop for survey work. Leaving Arte on 24th March the party reached Balek on 2nd April.

44. The other party, consisting of one squad of Sappers under Jemadar Sultan, left Rotung on 26th February and improved the path up the right bank of the Dihang above Yambung, made eleven footbridges and one ferry over various streams and assisted survey work by improving tracks and clearing jungle for observation stations. This party rejoined at Balek on 28th March.

45. *Pasighat Post.*—On 8th April, the Post at Balek was sufficiently advanced for the Military Police to complete. The framework of all buildings had been finished and it only remained to fix split bamboo for floors and walls. Sappers and Pioneers therefore moved to Pasighat to build that Post. The Pioneers left Pasighat for India on 10th April, and the Sappers were assisted in clearing site, digging the ditch, collecting materials, etc., by two companies 1-8th Gurkhas, detachment Military Police and 300 Gurkhali Carriers. The Post was built for 100 men, rectangular in plan, 50 by 66 yards, with a double-storey blockhouse at two opposite corners. A stockade was not considered necessary, but could be added. A breastwork was made inside the ditch from the trunks of trees felled in clearing the site. As no sanction had yet been received to the proposal submitted in January, to provide corrugated

supplied by the Supply and Transport Corps. Officers' bungalows and mess were floored with sawn planks. The Post was well drained being sited on ground with a slope of 1 in 10 to the west. The collection of materials, stone, logs, bullies and bamboos entailed a considerable amount of labour, and great assistance was received from working parties of 1-2nd Gurkhas and Carrier Corps.

37. On January 30th, the remainder of the Pioneers were now road-making, five companies being at Upper Rotung working on the road to Razor Edge, and one company at Renging. About the 10th February, the Pioneers completed the road from Rotung to Lalek stream, and moving to Renging, finished the road from Renging to the Lalek by the end of February, a new alignment giving a practically level road round the Marshing Nullah from Renging Col to Jhum Spur.

38. Between 1st and 5th March three sections of Sappers and five companies of Pioneers moved to Sirpo Camp. The Sappers built a suspension bridge across the Sirpo and made the approaches on both banks, whilst the Pioneers carried on the road by a new alignment, 2¼ miles total length, rejoining the old road just above the new Abor village at Roi. The gradient was 1—10 and the new line reduced the ascent from Sirpo Stream to Coolie Ridge by 300 ft., besides cutting out the old 1-7 zigzags, without lengthening the road.

39. *Sirpo Bridge.*—The Sirpo Bridge was 100 ft. span, 60 ft. above water level, with roadway of the same type as at Sireng Bridge. There were 12 cables 1½-in. steel wire, arranged in half parabola, dip 1-10th. On both banks the cables were carried straight to the anchorages without any frames. On the right bank the cables ran straight up from the longest sling into the cliff, to a shore transom resting on solid rock, behind which a platform was blasted out 12 ft. wide. On this platform an anchorage was made with boring bars. Each set of six cables was fastened to a hard wood anchor, 4 ft. 8 in. by 6 in. by 6 in. with a 1½-in. boring bar forming its core. This anchor was fastened behind a row of four jumpers set in holes 3 ft. deep. The heads of these jumpers were tied back to two more jumpers, whose heads again were tied back to one jumper, like a 3, 2, 1, picket holdfast. The whole anchorage was covered with dry stone walling to a height of 4 ft. With braced hand-rails and inverted parabolic wind-ties a good stiff roadway was obtained. The method for adjusting the main cables is worthy of mention. Each 1½-in. cable was fastened permanently to one anchorage, and after a turn had been taken round the other anchorage, was stretched as tightly as possible by block and tackle and temporarily fastened with clips. After all 12 cables had been stretched once, they were again stretched, as the first cables had sagged owing to the anchorages taking up their permanent bearing under the accumulated strain. This left the cables on a catenary with 1¼ ft. deep. The length of the cable in this catenary and in its final position on bridge, viz., that of a parabola with a straight back guy, having been calculated, it became necessary to pay out the difference, which in this case was 14½ ins. Four inches were allowed for stretching under full load, and 10½ ins. were paid out which length was carefully marked on each cable.

the capture of Kekar Monnying stockade. A strand of telegraph wire had been left up over the river on 5th December so there was no delay in getting the steel wire cable over the river.

31. *Permanent Mule Road.*—On 20th December, the Sapper Company commenced an 8-ft. mule road back towards the Base from Yambung. About 15th December a portion of the 32nd Pioneers had been released from escort duties, and three companies under Lieut. Burn-Murdoch had begun work on the permanent mule road from Razor Edge to Rotung. Lieut. Burn-Murdoch had obtained a good alignment from the Col, involving a 30-ft. cutting, which eliminated the zigzags made during the first advance.

32. On 28th December, the Sappers moved back to Puak where 1 company Pioneers was already working on the mule road. From Yambung to Rotung an excellent alignment was obtained between 80 and 200 ft. above the Dihang, as far as the Sireng, whence the road rises steadily into Rotung, the maximum gradient being 1 in 10. Sappers built bridges over the Puak and Sembong streams of 25 and 20-ft. spans.

33. On 13th January, the Sappers and one company Pioneers moved to Sidé and were joined by another company of Pioneers. The Sappers built a cantilever bridge of 45 ft. over the Sidé, and cut the road through Kekar Monnying in solid rock, some 100 yards.

34. *Sireng Bridge.*—On 30th January, a half-company of Sappers moved to the Sireng stream and commenced work on a suspension bridge 84-ft. span, dip 1-12. All woodwork was sawn out of logs. The timber available was all heavy, being as much as 72 lbs. per cubic foot. The roadway was 4 ft. wide between ribands and 6 ft. between handrails, to take laden mules and infantry in single file. Braces to the handrails and inverted cables gave great stiffness to the bridge. The left frame was on top of a rock cliff and the right frame on a cribwork pier built on solid rock foundations. Eight 1½-in. steel cables were used on account of the great weight of the roadway due to the high specific gravity of the timber. The completion of the bridge was delayed by the cables not arriving from Calcutta until 23rd February; it was finished on the 27th when the section remaining at Sireng marched to Rotung.

35. *Rotung Post.*—On 30th January, a half-company of Sappers and two companies of Pioneers marched to Rotung, whence they finished the road down to the Sireng Bridge and commenced building a Post at Rotung for the Military Police, to accommodate 200 men. The Post was enclosed in a stockade of bullies, 6 to 8 in. diameter, 8 ft. high, with barbed wire fence, ditch, and "panjies" outside. The stockade was rectangular, 73 yards by 63 yards, with two bastions at opposite corners.

36. The general type of building was 48 ft. long by 25 ft. wide (15-ft. room with two verandahs each 5 ft. wide). One barrack of this size was allowed for each section of 25 men. All buildings were raised 2½ ft. off the ground on logs resting on dry stone walls. Floors and walls were made of split bamboo. Roofs were designed for corrugated iron sheets, but pending sanction for necessary expenditure, roofs were temporarily covered with split bamboo and 18 ft. by 12 ft. tarpaulins

prepared, ready to lengthen the small raft. Work at dawn on December 3rd was again checked by the 350 yards of 1-in. cable having fouled a rock in the river and it had to be cleared by sending the raft out from the near bank along the cable. The large raft of 26 bags was then rowed over with Lieut. Cave-Browne and 12 Sappers. They at once pulled over a 1½-in. cable attached to the 1-in., and the cable was tightened up clear of the water. At 5.15 p.m. the large raft was pulled back to the near side by a ⅝-in. cable attached to a traveller running on the 1½-in. cable. At 5.30 p.m. the first party of 20 Gurkha scouts was ferried over, the crossing being completed in 19 trips at 10.35 p.m. when the Maxim gun detachment of the Assam Valley Light Horse, 2 companies, 1-8th Gurkhas, 1 company, 1-2nd Gurkhas with Maxim, ambulance and reserve ammunition carriers had crossed.

24. *Rotung to Yambung.*—On 4th December the Force advanced and captured the Kekar Monnying Stockade and camped at Sidé. The Sappers and 1 company, 1-8 Gurkhas, demolished the stockade, cut down 40 stone shoots and repaired the track through Kekar Monnying.

25. On 5th December, the Sappers improved the path back towards the Sireng River.

26. On 6th December, the Force advanced to Puak and Sappers worked on 6th, 7th and 8th on Coolie track from Sidé to Puak and 1½ miles on towards Kebang.

27. On 9th December, the Force destroyed Kebang. The Sappers and 1 company, 1-8th Gurkhas, worked on Coolie track towards Yambung, which was finished on 11th.

28. From 12th to 15th December the Sappers and Gurkhas cleared the site of the new Yambung camp. One company Pioneers at Puak improved the Coolie track near that post.

29. *Yambung Ferry.*—On 29th December, the Sappers established a ferry across the Dihang at Yambung. The first line was taken across by a Berthon boat, which had now been received from the Base. No difficulty was experienced, a good site being available for the crossing, where the river was very deep and current about 3 miles an hour. The crossing of the boat was covered by two Maxim guns, and two rounds were fired from the wooden mortars which threw shells containing 3½ lbs. dynamite well into the jungle on the far bank: the explosion of these shells was sufficient to frighten any Abors who might have been concealed in the jungle. As soon as it was seen that the line had been successfully taken over, a raft of 32 Wheatley bags, carrying 16 Sappers, was rowed across by five pairs of oars. With the help of the first line, cables of ⅜ and 1½-in. steel wire were pulled across in succession. As at Rotung, the raft was attached to a traveller, running on the 1½-in. cable and the traveller was pulled across by ⅝-in. cable from each bank. A capstan was built for winding in the cable. (Subsequently on 12th January a raft of Polianski bags were tried in place of the Wheatley bags and proved satisfactory).

30. On 22nd December, a section of Sappers under Lieut. Cave-Browne, R.E., re-established the Rotung Ferry which had been dismantled on 5th December on the return of the right flank attack after

16. *Rotung Ferry.*—On 30th November, the first attempt was made to cross the Dihang at Rotung. For tactical reasons the crossing was to be made at night. The narrowest site available for the crossing was in a stretch of the river just below a rapid and about half a mile above the next rapid. The width in the narrowest part was 180 yards and the current variable up to 6 miles an hour. On the far side was a cliff of rock rising some 30 ft. above water level and on the near side the bank was covered with immense rocks rising up at a steep slope.

17. The materials available for the crossing were *Wheatley bags*, line, wire, and steel wire cables $\frac{5}{8}$, 1, and $1\frac{1}{2}$ in. in circumference. The Wheatley bags were filled beforehand; to save weight, a small gabion, 2 ft. high and 1 ft. diameter made of split bamboo, was wrapped round with rope of rice straw, and placed in each bag. It was found that this method reduced the dead weight of a bag to 63 lbs. as against 80 lbs. when stuffed with straw only; moreover there is not so much straw to become waterlogged.

18. A raft of 10 bags was made up with bamboo framework, and Lieut. Cave-Browne, R.E., and five Sappers tried to row across with a line at 5.20 p.m. The current and drag of the line proved too strong and the line had to be cut to enable the raft to reach the far bank above the rapid. An attempt was at once made to run out an "otter," 5 ft. by $2\frac{1}{2}$ ft., which had been previously prepared, but the otter would not go further than half-way. Work was now being carried out by moonlight. After several attempts and various readjustments the otter dived and became fast in the river bed, so at midnight further attempts had to be abandoned.

19. At dawn on December 1st Lieut. Cave-Browne, R.E., recrossed with the raft. The failure of the otter appeared to be due to the whirlpools in the river which overturned the otter. During the day, therefore, two larger otters were prepared and an attempt was made to run one across at 5.20 p.m. Again this method failed. The otter 6 ft. by 3 ft. dived and broke away, and another 8 ft. by 4 ft. kept rising and falling over. At 1 a.m. work was stopped and the party bivouacked on the bank.

20. Next morning Lieut. Cave-Browne, R.E., crossed with a raft at dawn and seven successive attempts to run the otter failed. Various alterations were tried in the lengths of the bridles, etc., and finally, bamboos were lashed along the water line of the otter to increase its buoyancy and the weight of the keel was increased to give more stability.

The raft was attached to the far bank by a 1-in. steel cable and swung out about one-third across the river and at the eighth run of the otter, Lieut. Cave-Browne succeeded in catching its tail. The position now was that the raft and the otter were in midstream 200 yards from the near bank and 150 yards from the far bank. The joining of the two cables was a difficult and hazardous operation in the heavy water, and was successfully carried out by Lieut. Cave-Browne, who then cut the otter adrift. It was now 5 p.m. and there were only five men on the raft who were very much fatigued, so the raft was recalled. As it was, the crew could only just succeed in making the near bank.

21. As more men would be required on the far bank next morning, a rectangular raft of 16 more Wheatley bags, arranged in fours, had been

regardless of the descent or ascent involved. The names of these nullahs and intervening spurs or cols are :—

	Approximate Heights.	
	Abor Track.	New Road.
Renging Col	2200	2200
Marshing Nullah	1500	2300
Jhum Spur	2500	2500
Yernu Nullah	1900	2750
Yernu Col	3000	3000
Lalek Nullah	1600	1700
Razor Edge	2150	2150
Igar Bivouac	1600	2000
Rotung Col	2350	2350
Rotung...	1100	1100

This necessitated the finding of an entirely new alignment. From each Col, the next Col was visible, but the intervening valley was mostly out of view and its sides covered with dense jungle, precluded any accurate estimate of the nature of the hillside. It therefore only remained to determine the approximate gradient which would hit the next Col and to cut a line forward on it, trusting to chance not to run into a cliff which would involve a retreat and a fresh trial line above or below the cliff. On the steep hillside the jungle generally limited the view to 20 or 30 yards. The actual roadmaking was not difficult, the soil being soft and rock disintegrated; the chief delay being the cutting and removing of the larger trees.

12. During the halt at Renging the weather was very bad, the troops, with a bare 10-lb. kit, being wet all day with little chance of getting dry on return to camp. On arrival at Rotung the Sapper Company had 20 per cent. sick.

13. The troops available for roadmaking were the Sappers and one company each of the Pioneers and 1-8th Gurkhas. These latter were invaluable in cutting the jungle with their kukries. The remaining seven companies of Pioneers were required for garrison and escort duty on the line of communications, and were able to do but little work improving the road until relieved by the 1-2nd Gurkhas about the middle of December. Work was further delayed by the precautions which had to be taken, the steep hills and dense jungle affording the Abors ideal opportunities for stone shoots and ambuscades.

14. On November 18th the road was open into the Lalek Valley, and on the 19th the Force advancing to the Igar stream, captured the Igar stockade. On the 20th Rotung was reached. The road from Razor Edge to Rotung Col had to be made at once, as the Abor track was impossible even for Nagar carriers.

15. *Igar Valley.*—The Igar Valley proved to be the most difficult section between Kobo and Kebang, the ground being very steep and often rotten and treacherous: the alignment took three days and the making of the road another five. Time after time the trial trace ran into impossible ground and a fresh line had to be cut.

2. *Kobo to Pasighat.*—On 22nd and 23rd October the force advanced from Kobo in two columns, and reached Pasighat in four marches. As far as Pilung, the road had already been improved by the Public Works Department. Between Pilung and Lokpur the path was bad, being blocked by many falling trees, so that progress was slow. Sappers and Pioneers removed trees as far as possible or made hasty ramps over the large ones. Between Lokpur and Pasighat the path was better, the jungle consisting of smaller trees and less undergrowth.

3. During the halt at Pasighat, from 26th to 28th October, a defensible post was made for the advanced Base, the road between Lokpur and Pilung was improved, and the Sappers and Pioneers also worked on the road forward, reaching the top of Red Cliff, 4½ miles from camp, on 28th. At Red Cliff the path entered the hills, the ground hitherto having been flat.

4. *Janakmukh.*—On 20th October the force advanced to Janakmukh. During the march, Sappers and Pioneers worked on a new alignment of zigzags leading down from Red Cliff to Janakmukh Camp on the bank of the Dihang.

5. From 30th October to 1st November, during the halt at Janakmukh, the Sappers and three companies of Pioneers completed the road from Pasighat, made a post at Janakmukh, and carried the road forward 1¾ miles to the Sijon stream, where the road leaves the Dihang.

6. *Rammi Dumbang.*—On 2nd November, the force advanced to Rammi Dumbang. The Abor path rose at an easy gradient from the Sijon stream to camp, which was in a large clearing made for cultivation. The road was completed into camp.

7. From 3rd to 5th November, the Force halted at Rammi Dumbang. The Sappers and one company of Pioneers made the road forward to Sirpo Camp. Throughout this stage, a new line was taken to Coolie Col and down to the Sirpo valley. The latter part was a steep descent which had to be negotiated in the short time available by continuous zigzagging.

8. *Sirpo.*—As far as Sirpo Camp the gradient had been made at or under 1 in 7 and the path was passable by mules, but required widening before being fit for daily convoys; it was considered that the Pioneer companies on the line of communications could complete this widening gradually.

9. Beyond the Sirpo River was a very sharp rise of about 1,000 ft., the Abor track going straight up to a slope which in places was as steep as 1 in 2. To save time, it was decided to make a coolie track at 1 in 5. This was finished on 8th November. The road was also continued from camp down to the Sirpo River along a steep cliff down which the Abor track was carried by means of a ladder. A 25-ft. bridge was built over the Sirpo.

10. *Renging.*—On 9th November the force advanced to Renging, and the road was carried on from the Sirpo Col to a point above Renging Camp.

11. Between Renging and Rotung the road works round high hills on the left.

These are offshoots from Bapu Mountain, and form steep spurs and deep valleys radiating out to the Dihang, which lies hidden in a deep gorge on the right.

The Abor track crossed four nullahs taking a more or less straight line

TRANSCRIPT.

ABOR EXPEDITIONARY FORCE.

REPORT ON ENGINEERING OPERATIONS.

By MAJOR E. C. TYLDEN-PATTENSON, R.E., *Assistant Director of Works, Abor Expeditionary Force.*

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1. *Kobo.*—No. 1 Company, 1st King George's Own Sappers and Miners, and 32nd Sikh Pioneers arrived at Kobo on 28th September. The following works were carried out at Kobo :—

(i.). Enlarging and clearing site of Base camp.

(ii.). Water supply from Abyssinian pumps. These pumps were of the greatest value.

(iii.). A road was cut for 3 miles towards Pobamukh, which became the steamer terminus when the Dihang fell too low to allow steamers to reach Kobo.

(iv.). A landing stage was erected for steamers. This was made of crib-work, the logs being 18 ft. long by 4 ft. girth, and the piles were driven 6 ft. into the river bed. This was totally washed away on 12th October when the Dihang rose 17 ft. Such a flood at this season had been unknown, the river reaching summer flood level.

(v.). Salvage of the river steamer *Scinde*, which ran on to the fluke of an anchor and settled down on to the river bed. Sappers and Pioneers, working continuously in relief for 60 hours at 13 pumps, got the water out and the Sappers caulked the holes temporarily. But for the work of these troops, the *Scinde* would probably have become a complete wreck during the flood of 12th October.

(vi.). On 10th October ½ company, Sappers, with a detachment Pioneers marched to Kemi River on Oniyuk road and built a light trestle bridge for foot traffic. This was carried away by a 9-ft. flood on 14th October. On October 16th, the half company of Sappers commenced a "Jhula" or country bridge which was completed on the 17th. This bridge was made of bamboos interlaced between six 1-in. steel wire cables; the span being 140 ft. On October 17th a trestle bridge was commenced and finished on the 18th when the Sappers returned to Kobo.

(vii.). Various works in camp, roads, drains, incinerators, etc.

necessary for first-class siege operations. Owing to the reasons of our fire always being indirect, our ammunition heavy, and therefore not lightly to be thrown away, our rôle of attacking material demanding very exact fire, our methods have become very technical and requiring a high degree of training. It has also complicated our communications and these we are only partly responsible for. In *Military Engineering*, Part II., is given a diagram showing the whole of the telephone communications that are considered to be necessary to have the show running properly. It is a formidable lot when applied to a large force, and I think that another argument is added in favour of my suggestion of cutting the brigade ammunition depôt out of our system of ammunition supply. The artillery only carry, lay and maintain the lines in the artillery system below the station of the artillery brigade commander, which are necessary for the fighting of and control of the batteries. In the remaining lines of the artillery system there appears to be some reduplication. For instance the Brigade Ammunition Depôt is in communication with the battery commander, the brigade commander and also the advanced ordnance depôt. The channel for all reports on expenditure or wants of ammunition is through the officer commanding siege artillery, who issues the necessary orders to the advanced ordnance depôt for ammunition to be sent to the brigade depôts. However nice and convenient it may be therefore for everybody to be in telephonic communication with everybody else, there seems to be rather a waste of effort or rather an extra addition to an already rather complicated system.

Judging by Port Arthur, both artillery and command lines, in any places where they are liable to damage from hostile fire, should be laid underground. The Russians I believe used overhead lines almost exclusively and as a consequence their communications were always failing them at the most critical moments.

started always with the basis that Brigade Ammunition Depôts must exist, since it is laid down that they should.

The suggestion that I now venture to make is that they should not exist and that the batteries should be supplied direct from the A.O. Depôt over narrow gauge lines the whole way, the break of gauge occurring at the latter place where it would be very convenient. To this I would add that a larger supply of ammunition should be maintained at the batteries than one day's consumption. Both Russians and Japanese kept more in their batteries than we do, and a Russian authority has suggested that it ought to be still further increased, as communications are so liable to interruption. At Port Arthur the Japanese had several of the Russian communications to the city under observation, and the appearance of a single horse and cart was sufficient to draw an accurate fire upon it; this was carried on to such an extent that the Russians had to give up these communications in daylight and had to construct roads over much more devious routes.

At present 200 rounds a piece for medium howitzers is kept at the battery and is reckoned as a day's supply. For heavy howitzers half that amount is allowed, though if the new howitzer is going to be the siege howitzer proper, it is not easy to see why 200 rounds per heavy howitzer should not be considered a day's supply for them. It does not mean of course that 200 rounds a piece will be fired every day, but that it is an amount that may well be fired on important occasions and which we must be ready to replenish.

Computing only for medium howitzers, a day's supply works out at about 160 tons for a brigade of four batteries, or 40 tons a battery. Now I may as well go straight to the point and say that we want a great deal of information about the means with which this duty is going to be performed. Very little is mentioned about it in any official textbook. We do not know how much, or where, or in what form much of the necessary material exists, such as rails, trucks or engines. The form of engine is certainly important if it is going to work right up to the batteries either by day or night. What weights will it pull and up what gradients, and what weight will each truck carry, and also what may be taken as an average speed of a train under normal circumstances. Naturally the position of ammunition depôts and in fact the whole system of ammunition supply as exemplified by the suggestions I made about it, is bound up in the answer to some of these questions. It seems doubtful whether the time which we referred to before, as being likely to be given us to complete our preparations after the commencement of war, will be sufficient, unless these details have been considered beforehand.

As siege artillery only exists in very small quantities in peace time, our practical training only deals with small quantities. Consequently there is always a danger of our methods becoming more suitable for these small numbers than for the large body of artillery that would be

able distance. Concealment may give security, but with aerial observation will concealment be possible? Such a depôt may not be a very visible object, but if it is depending on concealment for its security from fire, it is possible that no work or movement can take place there in the hours of daylight. Besides which, if we are going to use any form of light railway to supply these depôts and also the batteries, these lines will afford an excellent guide to show the aerial observer where to look for depôts and batteries. The argument therefore is that we must not expect to get very much security from concealment, and that our depôts and batteries must be dug in and protected by artificial means. Now if we protect our ammunition in this way, we must just examine what work we expect to perform at such depôts and whether it is practicable. Of course this is assuming all the time that they are within range of the hostile artillery. I may mention here that there may well be positions within range, such as quarries or behind very steep slopes, where security from fire may be obtained entirely from the nature of the ground, and it would not matter a scrap whether depôts were located in such positions or not. No artillery fire could hurt them or the workers at them, and naturally full advantage would be taken of such places and the nearer they were to the batteries the better. Now the advanced ordnance depôt will be served by, and be situated on a broad gauge railway, whereas the batteries will have to be served by a narrow gauge line. We certainly cannot consider it practicable to supply them with the heavy weights of ammunition they will require by any other means than some form of light railway. Therefore somewhere between the A.O. Depôt and the batteries there must be a break of gauge, and the problem is where it should be. Wherever it takes place there will have to be a handling, unloading and loading, of these heavy weights of ammunition. The Brigade Ammunition Depôt is certainly the most forward position that we can consider such a change being made at, and will it be possible to carry out such work and display such movement at a place we are either trying to conceal or know has been located? Probably not. It would also seem an unnecessary thing to break the gauge at any point between the Brigade Ammunition Depôt and the A.O. Depôt. Again when we consider the gradients that may have to exist on the narrow gauge lines and the weights that have to be pulled up them, we are forced to realize that the tractive power must consist of some form of light engine. Besides it would be extremely uneconomic and a great waste of labour to use any other form of power. From a summary of all these arguments, it seems that there is scope for a considerable alteration in the system of our ammunition supply which at the best is only rather roughly outlined in our training manuals. The difficulties always become apparent at our staff rides, and aerial observation has increased them. We have

success if they can be located and our fire at them even temporarily observed. If we can be told that any round has fallen close to any target, we can direct our observation of fire instruments upon that point and then maintain an accurate fire upon it. I am afraid that if the target is in such a very concealed position that the smoke of our bursting shell cannot be seen or accurately observed, we should then have to rely on further aerial observation or on the expenditure of a large amount of ammunition to complete our task.

Now the supply of ammunition is a very large question, and one that the R.E. are directly concerned with as far as providing the means of carrying out this supply is concerned.

I should like to preface this question with a few remarks on the "front of attack." A French writer, "Rouquerol," has argued that the "front of attack" or "the part of the defensive lines against which the attack is going to concentrate its efforts," will have to be chosen during peace time, as so many arrangements will have to be made in good time to prepare for the handling and movement of the immense weight of stores necessary for the carrying on of the siege of a first-class fortress. He says it will be too late or cause too much delay to postpone this decision until after the investment has taken place. Of course there are such considerations as "suitable artillery positions," "success to give decisive results," "ground in the zone of attack to be favourable to sapping" which help to govern the choice of the front of attack, but the general topography of the fortress should be known beforehand. The chief practical problem will be the organization of the means of bringing up the immense weight of stores and ammunition to the front of attack, and Rouquerol estimates this is in the case of a siege of a place like Metz or Verdun to be something like 200,000 tons or more. This necessarily involves the use of a line of railway and such huge depôts as the advanced supply and ordnance depôts must be on a railway. It also follows that besides being suitably placed to feed the front of attack they must be absolutely out of all possible artillery range, or from 10 to 15 miles at least away. Our present arrangement is to keep one day's supply of ammunition at the battery, another day's supply at an intermediate depôt called the Brigade Ammunition Depôt, inasmuch as one of these is formed for each brigade, and to keep replenishing the supplies from the advanced ordnance depôt. The principles which should guide us in the selection of the positions for these intermediate Brigade Ammunition Depôts have often appeared rather obscure. Certain conditions, such as concealment and security from artillery fire and facility of access, are laid down for them in our training manuals, and naturally there is in practice a tendency to try and get them as far forward as possible to lessen the work and time involved in supplying the batteries from them. In a sense, security from fire can only be secured by getting out of range, which nowadays means a consider-

amount of experience in observing under such conditions, good results have been obtained by artillery fire directed by observations from captive balloons. It was possible to maintain communication between battery and observer. It remains to be seen whether an aeroplane can similarly act as an observer for artillery. The intercommunication will be difficult. I believe the French are trying a system of signalling from an aeroplane, by blowing off the exhaust of the engine through a box full of soot and making thereby a sort of dots and dashes business. It is a proud thought, the use of soot in the country's service, and should raise the social status of the sweep. We may find out something on this subject in the near future, as detachments of the flying corps are going to visit artillery practice camps this season, with this object in view. Assuming that the aerial observer cannot approach very closely, it has been found that the best form of battery emplacements to favour difficulty of detection, consists of perfectly plain pits, without any parapets or hard form lines; the howitzers to be sunk in these pits with their muzzles flush with the ground when elevated for firing, all the excavated soil entirely removed, and surface of any disturbed ground made to agree with its surroundings. If it was necessary to guard against detection by aerial observers, it would be necessary to construct the pits by night, and this, combined with having to assimilate them with their surroundings before daylight and the removal of excavated soil, is going to make it all a slower process. The R.A. are trained to construct their own batteries, but of course the necessary tools and materials for construction of splinter proofs and battery expense ammunition stores do not form part of the equipment they carry. In *Military Engineering*, Part II., a normal type of sunken siege battery is given, showing the general nature of its requirements, and the rough construction of such batteries is practised in our practice camps. It is probable that they would have to be rather more elaborate in actual war, if for no other reason than that they are going to be occupied, lived in, and fired from for some considerable period of time. The drainage and sanitary arrangements would have to be carefully attended to and, under certain circumstances, field casemates provided in addition to splinter proofs. In the same book it is stated that siege batteries should be protected by wire entanglements against capture by surprise. No doubt they would have to be if their position was such as to render a surprise attack possible, but in view of the distance that they will always be behind the advanced lines, it is difficult to imagine how such a necessity can arise, and the existence of such obstacles might well give away an otherwise concealed battery. The R.A. are not trained in the erection of such obstacles.

We have seen that we shall generally have to take on concealed targets, which we can claim to do with a fair amount of

information, and be of the greatest assistance in observation of artillery fire, but it would probably be infinitely easier to conceal things from their eyes than from an observer in a free moving and dirigible flying machine. It does appear that it will be impossible to conceal anything from the eyes of a trained aerial scout, and if both sides possess an efficient service of this form, it is difficult not to come to the conclusion that they will both have excellent information of each other's dispositions.

It has not yet been proved with what degree of impunity a flying machine can scout over an enemy's position. If only we could say that an aeroplane must keep above a certain height to enjoy a certain immunity, we might be able to gauge the amount that he could spy out the details of our dispositions. How is such an enemy to be destroyed? Can the usual destroyer of things at long distances, namely artillery, do the trick, or must we rely on aircraft to destroy aircraft? We know that most countries have produced, or are producing, artillery to deal with such targets, and are thinking out all sorts of scientific methods of dealing with them, but their success is purely theoretical. Certainly an argument against considering them as artillery targets is that no practice at them under anything like service conditions is imaginable, and it is dangerous to leave things to be decided in actual war. Unless we can get some sportsman, with a supreme belief in himself and a magnificent contempt of all artillery fire, it seems that we shall have to fall back on the hopeful business of "it will be all right on the night." Perhaps we shall have to rely on their destruction by their own kind, which should prove an operation containing sufficient excitement to satisfy the most ardent spirit. It is possible that we may develop some of the wild animal's instincts for concealment, and we certainly ought to gain information from our flying corps as to the best means of making observations difficult. One cannot help feeling that accurate observation will be vastly more difficult than it sounds, even when no attempt is made to interfere with it. We all saw the headlines in the newspapers after this year's army manœuvres, "War Made Easy," etc., etc., but yet a whole division of the defending force was never located at all up to the evening before actual contact. One could understand the troops hiding under hedges, etc., but how about guns, vehicles, transport and horses. Some of the former, one heard, were hidden under hay, but the animals cannot have been concealed under one of their staple forms of diet! I have never heard it satisfactorily explained. The next consideration is, whether the locating of batteries in positions only visible from the air by such scouts is going to involve their destruction. It seems doubtful whether the mere general locating will be very dangerous unless it is supported by some system of observation of fire. We know that under favourable conditions and with observers who had not had any very great

out blow and the one from which there is no recovery. The object of the defence therefore is not only to attempt to retain possession of its fortress from its own intrinsic value, but to detain as large an attacking army for as long as possible in front of its walls, and so prevent it from participating in the field operations which are going to decide the ultimate fate of the war. Similarly the object of the attack is not only the capture of the fortress for the reasons which made it necessary to attack it, but also to do it in the shortest possible time so as to free the besieging forces to take part in the really decisive operations. I do not think that, with modern appliances, any fortress, however impregnable its position, and however well supplied, could hope to hold out for an indefinite time, even if we consider only the actual operations of war and leave out such incidentals as the gradual failure of the resources of the defence. Time is therefore the great factor, and to gain this the defence must husband its resources by providing cover for its troops (which it does by means of its fortifications) and protecting its artillery, which it can best effect by concealment. "The attack perhaps can afford to be more lavish of its troops," but is compelled in a similar manner to conceal its artillery as far as possible. At Port Arthur the Russians apparently sacrificed a great deal of concealment in order to gain command, and they admit that a great portion of their exposed artillery was put out of action or seriously damaged in the bombardments at the commencement of the siege. In fact, it can only be a question of time, and not a very long time either, for guns in visible exposed positions to be knocked out by an efficient and well-served artillery in concealed positions. The accuracy of modern observation of fire makes it impossible for them to maintain themselves. On the other hand, certain Russian guns, which were well concealed and were never accurately located by the Japanese batteries, came unscathed through the whole siege. Concealment, so as to preclude accurate observation, is therefore the essence of artillery protection, and the problem is how best to attain it without preventing the guns from efficiently performing their duties. Concealment from terrestrial observers is a fairly easy task, especially as the vast majority of siege artillery weapons will consist of howitzers employing curved fire. The advent of aerial observers, however, has most enormously increased the difficulties of concealment and, incidentally, many other of the important details of siege warfare. I am going to leave out of consideration any questions regarding actual attack from the air and only discuss the effects of observation from the air. Further we will not dwell on the effects of observation from captive balloons, whose radius of action are somewhat limited, and whose comparative fixity of position does render them fairly vulnerable to artillery attack. I do not mean that such balloons could not often obtain most valuable

is specially organized for expansion into two batteries on mobilization. The organization in half companies and sections facilitates this expansion, and a double number of the many so-called specialists, which the exact and highly technical methods of siege artillery render necessary, are trained so as to be ready for this expansion. For any further expansion it is expected that the coast artillery will furnish the necessary *personnel*. For local defence many companies of coast artillery are trained in the use of movable armament, consisting of both guns and howitzers, light and medium, and obtain thereby some experience in firing over land ranges, which is so very different from firing over sea ranges. To form a basis of some knowledge in siege artillery methods, apart from the ordinary interchange of officers between Siege and Coast Artillery, courses in siege artillery instruction are held at Lydd, which are attended by Coast Artillery Instructors in Gunnery and about 20 officers and 100 N.C.O.'s from Coast Defence Companies annually. The companies themselves in their stations also go through a short siege course under the eye of the instructors before mentioned. It is not expected naturally that such limited training will produce any very high degree of efficiency, but it will certainly form a basis for the further instruction to be given after mobilization and the necessity for the formation of a siege train has appeared, and we have seen that in all probability some time will be available for this to be given.

As regards armament, two or three companies are armed with the 6-in. B.L. howitzer, called a medium howitzer, and the other with the 9·45-in. howitzer, or heavy howitzer.

The four batteries of 6-in. B.L. howitzers manned by the first two expanded companies will be formed into one medium brigade, and will be horsed and provided with two ammunition columns, one to each two batteries. This is the only brigade that will be a mobile unit, even if other 6-in. howitzer batteries are formed. The two batteries of the other expanded company will be formed into a heavy brigade with no ammunition column.

Other heavy guns in our possession in limited numbers are 6-in. B.L. guns. Also a certain number of 9-in. H.A.F. guns which were eliminated from our coast defence. The guns of the movable armament consist of field guns, 5-in. howitzers, 4·7-in. Q.F. guns and 6-in. B.L. howitzers.

Reviewing all these weapons, the newly designed howitzer will be the siege howitzer in chief, and judging from the results of Port Arthur the 6-in. howitzer (apart from its short range) cannot be expected to obtain any great effect against modern permanent fortifications.

Now, the capture of a fortified place, however important it may be, does not in itself mean that a war is going to be brought to a successful conclusion. The destruction of the enemy's field armies is the knock-

SIEGE ARTILLERY—METHODS AND REQUIREMENTS FROM R.E.

A Lecture delivered at the School of Military Engineering by MAJOR R. O. MARTON, D.S.O., R.G.A.

I FEEL that we should commence this subject with a review of the Organization of our Siege Artillery. Unlike perhaps any other branch of artillery, where it may be said that there is a comparative certainty that it will be used in, and is necessary to all operations in war, siege artillery proper is generally designed to meet only a certain set of circumstances, namely the attack of more or less permanently fortified places. Furthermore, it is possible that the necessity of engaging in such operations may only appear after the war has been in progress some time, or at any rate probable that the campaign will have had to have been conducted to some successful point before such operations can commence. (Examples, Adrianople and Port Arthur). Time is not such an important factor therefore, and, in a sense, the readiness and organization of a siege train is not so essential as in any other branch of artillery. There will be time enough, so to speak, to get our siege train together when we know what we are likely to have to attack, and we may feel fairly confident on having a certain amount of time in which to collect it, organize it, and polish up its training. What we shall probably not have time to do, however, is to make our guns and ammunition—they must exist. We may perhaps be able to buy them. We especially, from our geographical position, do not consider it necessary to keep any considerable establishment of regular siege artillery even on a peace footing. We have a very small and highly trained nucleus and do our best to prepare for a possible expansion on mobilization. It must be noted, however, that this nucleus has to be trained, not only to play its part in regular siege operations, but also to be ready to join in with the movements and fortunes of the field armies. It has really only just commenced its practical training for the latter function, and I think it may fairly be said that up to the present its employment in this respect is expected to be limited to the preliminary operations of a siege, in driving the defenders back into their main lines of defence (such as from the Battle of Nanshan to the final investment of Port Arthur). Dealing first with the *personnel*, our nucleus consists of three companies of garrison artillery, each of which is capable of, and

Japanese guns having just begun to shell it from Lan Ni Pu, but at this time it became apparent to Oyama that further pursuit with his weary troops was out of the question, and he decided to give them the word to halt and take a much-needed rest.

The losses on both sides were large. The First Army lost 1,200 killed and 5,000 wounded, while the total Japanese loss was 5,500 killed and 18,000 wounded. The Russians lost 2,600 killed, 15,000 wounded, and 1,000 missing, so that it is clear that the Japanese had to pay dearly for their strategical victory. By it however they convinced all critics of their ability to win battles against superior forces, and more than this can scarcely be expected of any army.

In the above necessarily short account little criticism has been possible. One of the most important lessons of the battle seems to be that in modern war a change of plans on a large scale is frequently fatal. There are two instances bearing this out in opposite ways. Take Kuropatkin's case first. He had massed his reserves behind his right flank and obviously meant to make his great counter-stroke there. He heard of Kuroki's movement, straightway changed his plans, and marched all his reserves over to the left. This took three days, during which his front line had such a bad time that they could not hold on till the counter-attack could be delivered, and he had to retire his whole force. Suppose instead he had adhered to his original plan, told Bilderling and Orlov that they *must* hold Kuroki for a day or two—and this they should have been able to do—and moved out his reserves on the 31st against Oku's left flank, they would have had a good chance of cutting up Oku's tired troops, who could not easily have been reinforced, and Kuroki would possibly have been ordered to retire back over the river and reinforce the left. The fact is there is no time in war to march the general reserve from end to end of a line 30 miles long, and it is often better to make the counter-attack in the wrong place at the right time, rather than in the right place at the wrong time.

In the second example, Kuroki crossed the river thinking that his task with Bilderling's rear guard was an easy one. He found he was utterly wrong. If any one of the Russian commanders (except perhaps the unfortunate Orlov) had been in command of his force, he would have changed his plans and gone back, and probably got badly cut up in re-crossing the river. Kuroki did not; he went on, and luck stood by him; and he scored a success after perhaps one of the most hazardous operations of war on a large scale that has ever proved successful in history.

announcing his retirement on Liu Lin Kou, stated that his corps was too exhausted to fight—it should be noted that this corps had suffered greatly during the 29th and 30th August south of Liao-Yang—and Bilderling, correcting his previous report, acknowledged the failure of his counter-attack and reported that his corps had fallen back on Erh Tao Kou and Hill 920. Perhaps these cumulative set-backs were too much for Kuropatkin, he still had overwhelming forces on the north of the Tai Tse Ho (much of the 3rd Division and X. Corps and all the 3rd Siberian Corps being untouched) but his heart failed him, and he ordered a general retreat on Mukden. This was at 6 a.m. The Japanese 15th Brigade had turned the scale, while Orlov's disaster had been the first nail in the coffin of the Russian hopes for that day.

On the morning of the 3rd, Kuroki, realizing that the Russian retirement which he had so often expected was really beginning, sent an order to the Guard Division to cross the river and help in the pursuit. On the previous day he had requested Hasegawa to attempt to cross and capture Hill 1057 from the Russian 3rd Division, but the Guards had not responded to his call. They were perhaps the least satisfactory of the Japanese infantry, being mostly men from the larger towns. Hasegawa again refused to attempt to cross, but finally towards evening was prevailed upon to send a brigade across by Chiang Kwan Tun. These troops had a long and difficult march and did not reach the bridge till the next morning; they were followed by the remainder of the Guard Division, and all eventually got across, too late to be of any use. Had they forced the passage near San Wa Tsu—which they should have been able to do—they would have been able to pursue the retreating Russians, which the remainder of Kuroki's troops were far too exhausted to do. During the day the 3rd Brigade replaced the gallant 15th on Manju Yama, but no forward movement was possible to the rest of the First Army.

We need not go into the details of the Russian retirement on Yentai station. Kuropatkin threw out a screen to cover his withdrawal, and a thick mist helped him also. Kuroki issued orders for a general pursuit at 2.30 p.m. Umezawa's detachment came into action on this day at Tu Men Tsu, where a much superior force of Russian cavalry were held in check, the action being indecisive.

During the night the Japanese were able to pursue to some extent. Between 2 and 3 a.m. the 12th Brigade ran into Stakelberg's rear guard near Post No. 8, and a desperate encounter took place. The Russians lost heavily, and at dawn continued their retirement, having successfully checked the pursuit. Kuropatkin had issued detailed orders for the retirement, and it went on all day, the block on the roads and in the villages being in places appalling. Had the Japanese not been too exhausted to pursue the retreat must speedily have become a rout. As it was, Yentai station was evacuated by 2 p.m.,

hang on, and these companies put up a game resistance, but were eventually withdrawn. The remainder of Dobrshinki's force, after an artillery preparation, advanced against the hill soon after 8 a.m., but they were met by a hot fire at close range, and were brought to a standstill about 1 p.m. It was now decided to wait for darkness to recapture the position. Kuropatkin heard about 3.30 p.m. of Orlov's disaster, and warned Stakelberg not to press on until he could be supported, though this officer had never shown any intention of doing anything so rash.

The preparations for the great attempt to recapture Manju Yama now began. At 2.30 guns opened, and by 5 p.m. 152 Russian guns were bombarding the hill. The Japanese did nothing, except for reinforcing Okasaki with some troops of the 3rd Brigade. Twenty-six Russian battalions were ranged in the front line for the assault, and strange as it may seem the chief command was given to Slutschevski, who commanded the X. Corps (the reserve behind Hill 920). This officer was new to the country and junior to Bilderling. He consequently placed himself under Bilderling's orders, and, as before, Dobrshinski was given the actual task of carrying out the attack. This began at 6 p.m., but no headway was made till dark. Between 7 and 9 p.m. repeated attacks and hand-to-hand fighting took place, hand grenades being used on both sides, and balls of magnesium wire being lit by the Russians and flung in front of the Japanese trenches to light them up. At 9 p.m. Okasaki suddenly ordered the "Cease fire," in an instant it was obeyed—a tribute to the perfect fire discipline of his troops—and he was able to estimate the strength of the Russian attackers. He received reinforcements, and the struggle became hotter than ever, and at 2 a.m. a final attack by 7 battalions was made. The Japanese 30th Regiment, however, this time did not wait to be attacked, but moved out and fell on the left of the Russian line, which was completely surprised and retired on Sha Ho Tun. The Japanese had thus been completely successful in retaining possession of the hill, but were far too exhausted to pursue.

At midnight Bilderling had reported that Manju Yama was retaken. Whether he was misled by some small local success, or whether the wish was father to the thought, is not known, but it is almost certain that the report was not at any instant true, and in any case it was a very premature moment for the commander to report a definite success.

Kuropatkin, receiving this report, had every reason to be satisfied with the trend of events. He could still make his great attack on the morrow, using the (supposed recaptured) Manju Yama as his pivot of manœuvre. But at 3 a.m. the situation changed. Zarubaiev, in command at the bridgehead at Liao-Yang, reported that his reserves were all in action and asked for reinforcements; Stakelberg,

Russia. The force he had met was, of course, the Japanese 12th Division, advancing towards Lan Ni Pu in accordance with Kuroki's orders. The battle which followed in the dense millet was short and sharp, infantry only being engaged. Orlov brought up his reserves, but a Japanese battalion got round his left flank, and his men were no match for the Japanese in this variety of fighting. He now heard of the loss of Manju Yama, and he reported that he was unable to effect a junction with the 1st Siberian or XVII. Corps and that he was retiring on Yentai station. This retirement rapidly became a rout, but near Hsiao Ta Lin Kou his troops ran into the head of the left column of Stakelberg's 1st Siberian Army Corps. Stakelberg managed to rally one battalion, which Orlov personally led in counter-attack against the Japanese near Fang Shen, a regiment of the 1st Siberian Corps assisting him. Orlov was wounded and his battalion fled again, the bulk of his command eventually arriving at Yentai station in utter rout. Stakelberg however continued his counter-attack on Fang Shen; two regiments of his command and one of Orlov's (rallied) were in the front line, and two more in reserve; but they could do no more than check the advance of the Japanese, even when, about 4.30 p.m., the right column of Stakelberg's command came up. This column had been delayed by cavalry blocking the roads—seemingly a strange method of employing the mounted arm.

Vague rumours of Japanese forces on the extreme east now began to be heard. These were of course Umezawa's detachment, which in reality was far from the scene of action. However, the rumours were sufficient to cause Samsonov, who with his cavalry was still near the mines, to withdraw to the north-west. This circumstance, and the fact that a Japanese battalion soon after occupied the mines, decided Stakelberg to retire, and at 6.30 he withdrew to Hsiao Ta Lien Kou, and during the night reached Liu Lin Kou, whence he had started in the morning.

To return now to the Manju Yama side. Kuropatkin, arriving at Fan Chia Tun at 10.30 a.m. on the 2nd, had three successive reports from Bilderling. The first told of the repulse of a Japanese attack on Manju Yama, the second told of its capture by the Japanese, and the third of Bilderling's intention to recapture it at once. These were confusing, and the situation was the more obscure owing to the fact that no Japanese could be seen on Manju Yama—they were on the reverse slope and therefore concealed. Kuropatkin issued no definite attack orders, merely directing his corps to get into touch with each other. At 8 a.m. Dobrshinski, acting under Bilderling's orders, commenced his counter-attack. He was reinforced by a brigade of the 5th Corps, under Ekk. A few companies of a Japanese battalion had been pushed forward to the spur south-west of Hsi Kwan Tun. When the Russians advanced these troops were ordered by Okasaki to retire. Their commander, however, begged to be allowed to

morning of the 2nd September, and the more so when the news arrived that Oku and Nodzu expected to be in Liao-Yang during the day. As a fact, they had advanced on the day before towards the Russian second position and anticipated little trouble there, but as it turned out they met with a stubborn resistance which delayed them for two days more. However, Kuroki read this message to mean that the Russians were in retreat on the east, and so for the second time he was deluded into a too optimistic view of the situation. He issued his orders on that assumption ; the 12th Division to pursue the enemy towards Lan Ni Pu, the 2nd to capture Hill 920 and pursue to Lo Ta Tai. Umezawa was to move on the Yentai coal mines.

To turn now to Kuropatkin. During the night 1st—2nd September, he prepared his orders for the great counter-stroke which was to overwhelm Kuroki's little force. This was before he heard of the loss of Manju Yama during the night, and he clearly intended to use this point as a pivot of manœuvre. His orders—the "Disposition No. 4"—were as follows:—The XVII. Corps was to hold the Hsi Kwan Tun position (which in reality it had lost), the 3rd Siberian Army Corps to move to Chan Hsi Tun and act as reserve, the 1st Siberian Army Corps (Stakelberg) in two columns, to Yang Chia Pu Tse and Liu Lin Kou, the X. Corps (Slutschevski) to march on Fan Chia Tun, and Orlov to advance southwards towards the Japanese right and rear, getting touch with Stakelberg before moving off. These movements all began and were carried out in substance, with the exception of Orlov's. That officer's troubles and defeat must now be dealt with.

On the night of the 1st—2nd Orlov received two messages from Bilderling, requesting him to co-operate with him in attacking the Japanese at dawn on the 2nd. He prepared to move at 4.30 a.m., but meanwhile received another order directing him to act "in the manner which has been indicated to you." This referred to the Disposition No. 4, which he had not yet received, and much perplexed he sent to ask Bilderling what it all meant. He had not heard the result of the fighting on Manju Yama. He could get no answer out of Bilderling, but soon after dawn he heard from Dobrshinski (commanding 35th Division) that there had been fighting on Manju Yama during the night, the result of which was not known. The Russian communications must have been in a bad state on this day, and dearly Kuropatkin paid for this. Orlov, rightly thinking that anything was better than inaction, prepared to advance against the Japanese position on Wu Ting Shan. His guns opened at 6 a.m. ; there was little reply, and at 8.30, leaving 2 battalions near the mines, he advanced with 5½ battalions in the front line and 4 in reserve. Near Ta Yao Pu he came suddenly into collision with Japanese infantry, and the head of his column was thrown into disorder. His troops, it should be noted, were mainly reservists and the latest arrivals from

help the 15th Brigade. These forces must have been Orbeliani's or Samsonov's cavalry, possibly both. Okasaki, the commander of the 15th Brigade, decided, however, to go on; he asked that all guns might be concentrated on Manju Yama, and this being done, succeeded in getting in daylight within a thousand yards of Manju Yama, in spite of the fact that the Russian guns, reinforced from the corps reserve, almost silenced those of the Japanese. Nearer however he could not get, the infantry garrison of Manju Yama having been reinforced by another regiment.

The turn events were taking was very disquieting to Kuroki. Instead of a mere rear guard, he had found a strongly entrenched force blocking his way to the west, while a force of unknown strength was reported advancing against his right flank. However, he was too far committed to retire, and he acted boldly and wisely in going on with his attack, merely sending for the rest of the 3rd Brigade and the 29th Kobi Regiment, and informing Umezawa of the unknown force on the right.

Okasaki was still burning to advance, and in the evening received permission to do so and carry Manju Yama by night attack. At 7.20, guns opened fire, and soon after the infantry advanced. The right section moved more quickly than the left, having easier ground; the Russian regiment on the north of the hill fell into temporary panic, but was rallied. However, the Japanese succeeded in establishing themselves on the north of the hill, while a fierce fight still went on further south. The extreme left section of the Japanese turned a large Russian force out of Hsi Kwan Tun with unexpected ease, and turned north, taking the hill in flank. At this moment—11 p.m.—a counter-attack with bayonet and hand grenade was made by three Russian companies, but unsuccessfully. Hand-to-hand fighting in the dark went on for some time, and a second counter-attack was launched, but the Japanese always had the upper hand, and soon after midnight were in possession of the hill.

During this day Orlov arrived near the coal mines, where he joined Samsonov about 2 p.m. He saw the fighting on Manju Yama, but made no attempt to interfere, simply entrenching a position between the coal mines and Fang Shen. Samsonov seems to have done nothing during the day. He and Orbeliani managed to check the Japanese advance beyond Wu Ting Shan, but only by presenting the appearance of a large force. This was probably the worst thing they could have done. They might either have moved round the Japanese flank and taken Inouye in rear, so inflicting much damage on him; or by remaining out of sight have drawn the Japanese on still further till Orlov and they could have effected a surprise and possibly cut off the 12th Brigade. Liubavin on the extreme east continued to retire before Umezawa.

Kuroki had every reason to be pleased with the situation on the

following out the Disposition No. 3, was in position as follows:—on the left, 2 battalions held the small hill called by the Japanese "Manju Yama," or "rice-cake hill"; near Hsi Kwan Tun 2 battalions with a few companies pushed forward beyond the village, and on the Hill 920, a regiment, 4 batteries in the fields between Sha Ho Tun and Hsi Kwan Tun; this composed the left section. The right section (3rd Division) on the Hill 1057 does not concern us, the general reserve, at Sha Ho Tun, consisted of a little over 2 battalions, 5½ squadrons and 8 batteries. The following additional Russian forces were on the same flank:—Orlov, with 3 regiments and 8 guns, and Samsonov, with 4 cavalry regiments and a battery, near the Yentai coal mines; Mischtchenko, with 4 cavalry regiments and 2 batteries, near Sai Chia Tun; Orbeliani, with 3 cavalry regiments, near Ta Yao Pu; and on the far eastern flank, Liubavin's detachment, of 2 cavalry regiments and 4 guns. The latter was opposed to the Japanese Guard Kobi Brigade, under Umezawa, which had crossed the Tai Tse Ho further east and was acting as an outer flank guard to Kuroki's army.

Against these forces Kuroki launched his three brigades. Crossing the river himself at Chiang Kwan Tun, he viewed the battlefield from a small hill. Manju Yama to the west, and the hill of Wu Ting Shan, 5 miles to the north-west, stood out from the millet which covered the low country and even reached near to the top of Manju Yama. Reports reached him that the Guards and 4th Army were in possession of the Ya Yu Chi position, and he resolved to advance boldly, still thinking the Russians in retreat. A message from Oyama directing him to act with caution he disregarded, thinking no doubt that his superior knowledge of the situation justified his doing so. Only luck, bad Russian leading, and his own splendid infantry, saved him from disaster.

At 7 a.m. the Japanese advanced, the 12th Brigade on the right occupied Wu Ting Shan, and the 23rd turned a weak Russian force out of Kung Ku Feng, but the 15th Brigade (its commander realizing that Manju Yama was strongly held) waited for the guns to prepare its attack. The artillery of the 2nd Division had crossed the river by this time, and at 8.30 the guns of both divisions, distributed along the ridge south of Wu Ting Shan, opened on Hsi Kwan Tun. They were replied to by Russian guns behind Hsi Kwan Tun. It will be noticed that Kuroki kept no general reserve—another indication that he expected little resistance—but he had sent for part of the 3rd Brigade, which had previously been with the Guard Division. These troops arrived in driblets during the day, and were posted behind the 15th Brigade.

The 15th Brigade advanced at 11.30 a.m.; at 1 p.m. Inouye, commanding the 12th Division, receiving reports of strong hostile forces on his right, sent word that he could no longer advance nor

34 pontoons and some trestles, about 180 yards long, the superstructure being covered with millet straw. "Chasseur's" comment on the whole action is as follows:—"We can only say that, as a strategical move, this decision (to cross) on the part of the Japanese staff was on a par with the incompetence of General Orlov, who allowed this solitary, unsupported, and detached division to make the passage of the Tai Tse unopposed, when he was in a position not only to have prevented the crossing, but to have overwhelmed the division while in the act of crossing." Orlov commanded a Russian flank detachment, near the Yentai coal mines, and while we may agree with this criticism of the Japanese grand tactics, it seems hardly fair to put the blame on Orlov: surely the officer at fault was Bilderling, who was charged with the duty of watching the Tai Tse Ho, and whose cavalry it was that first observed the Japanese crossing. Kuroki moved his headquarters from Anping to Hei Yu on this day.

Although the Japanese crossing had been seen at 6 a.m., the Russian cavalry commander who saw it did little to pass on the information, and nothing to stop the crossing. Bilderling did not act on his own initiative, but referred to Kuropatkin. A telephone breakdown delayed the message and Kuropatkin only got it at 11 a.m. He then put into operation the "Disposition No. 3," which he had prepared during the previous night; by this Bilderling was ordered to defend the Hsi Kwan Tun position, while part of the army in front of the 2nd and 4th Japanese Armies was to retire on the second line of defence. Of the rest the 1st and 3rd Siberian Army Corps and the Xth Army Corps were to cross the Tai Tse Ho near Liao-Yang and move east. Kuropatkin had thus committed himself to a slow and ponderous offensive against the three Japanese brigades north of the river, intending to overwhelm them while holding the 2nd and 4th Armies on his southern front. Comment is needless, rapid action on the 31st by Bilderling in co-operation with the flanking detachments of Orlov, Orbeliani and Samsonov (the two latter being cavalry) must have swept Kuroki back into the river, while there seems no good reason for abandoning the advanced position south of Liao-Yang, which had not been forced at any material point by Oku or Nodzu.

Kuroki, receiving reports as to the position of his brigades, and as to the enemy in front of them, issued his orders during the night 31st—1st September. The 15th Brigade was to capture Manju Yama, and the 12th Division prolonging the line to the north was ultimately to intercept the Russian line of retreat on Mukden. It is clear that he still thought that the Russians were evacuating Liao-Yang, and that he was only opposed north of the river by a strong rear-guard.

By the early morning of the 1st September, Bilderling's corps,

in the close vicinity of Liao-Yang, was a formidable obstacle to the attacker. His second line, forming a bridgehead round the city, extended from Hsia Wan Tsu to Mu Chang, protecting six bridges between those limits. On the night of the 28th—29th August he gave orders for the advanced position to be occupied. On the 29th Oku and Nodzu were in touch with him. There followed desperate encounters on the Russian right and centre, in which Oku and Nodzu lost heavily and made little progress. On the early morning of the 1st September however Kuropatkin retired from his advanced position, leaving the Japanese to carry empty trenches. The Russians occupied their second line. Oku and Nodzu rested a day in front of it, and we will leave them there while we examine more fully the adventures of Kuroki on the Japanese right.

Returning to the 29th August we find Marshal Oyama issuing his orders for the general attack. In these he gave directions for the advance of the 2nd and 4th Armies which have been referred to above, but was strangely silent as to the 1st Army, except that the Guard Division was ordered to co-operate with the 4th Army in an attack on the hills by Meng Chia Fang. We know, however, that on the 29th, Kuroki was expecting to cross the Tai Tse Ho and was making preparations to do so. The morning of the 30th found his forces as follows:—the Guards in front of Meng Chia Fang, the 2nd Division facing almost west between Ta Shi Men Ling and Shih Chu Tsu, and the 12th Division concentrated at Hei Yu. Opposing the 2nd and 12th Divisions north of the Tai Tse Ho was Bilderling's XVII. Army Corps on the hills between Hsi Kwan Tun and San Wa Tsu. Space is hardly available to describe the attack of the Guard Division on the 30th, and it will be enough therefore to say that although carried out with the greatest vigour, it failed, and by nightfall the Guards were back in the trenches they had left at dawn, having lost heavily, particularly from the Russian artillery fire. More interesting are the movements of the 2nd and 12th Divisions. At midday Kuroki received reports which inclined him to think that the Russians were evacuating Liao-Yang; at 1 p.m. therefore he gave the order to cross the Tai Tse Ho. The 12th Division and the 15th Brigade, 2nd Division, were to ford the river at Lien Tou Wan, while the bridging trains with an escort of infantry were to move on Chiang Kwan Tun and make a bridge for the field artillery and train. These movements were carried out; the 23rd Brigade, leading, reached Lien Tou Wan at 11.30 p.m., and all the infantry of the 12th Division were across by 6 a.m. After them, the 15th Brigade, 2nd Division, crossed. No opposition of any kind was met and the troops marched to the positions indicated to them by Kuroki's order, being all in position by 4 p.m. on the 31st, on the ridge facing due west between Kwan Tun and Shang Fen Kow. The bridge at Chiang Kwan Tun was built by the sappers between 3 and 8 p.m., and consisted of

2,000 ft. to the south and east, although nearer Liao-Yang few are even 1,000 ft. Most of the rivers are rapid but fordable. Roads are bad and unsuitable to any except the native carts. The Mandarin road, running along the railway from Port Arthur by Liao-Yang to Mukden, is the best, whilst fair roads connect Liao-Yang with Wiju and Takushan. The railway divides the hilly ground from the great Manchurian plain to the north-west, and has a branch north of Liao-Yang to the Yentai coal mines. The chief peculiarity of the country at the end of August was the giant millet, or kaoliang, which covered all the low country and much of the lower slopes of the hills to a height of 8 ft., and so formed a screen to hide advancing infantry, though hampering their movements to some extent.

The Manchurian climate in August is hot but healthy: some rain falls and roads are rendered difficult at times, but on the whole the season may be called good for campaigning. Daylight lasts from about 4.30 a.m. till 8 p.m.

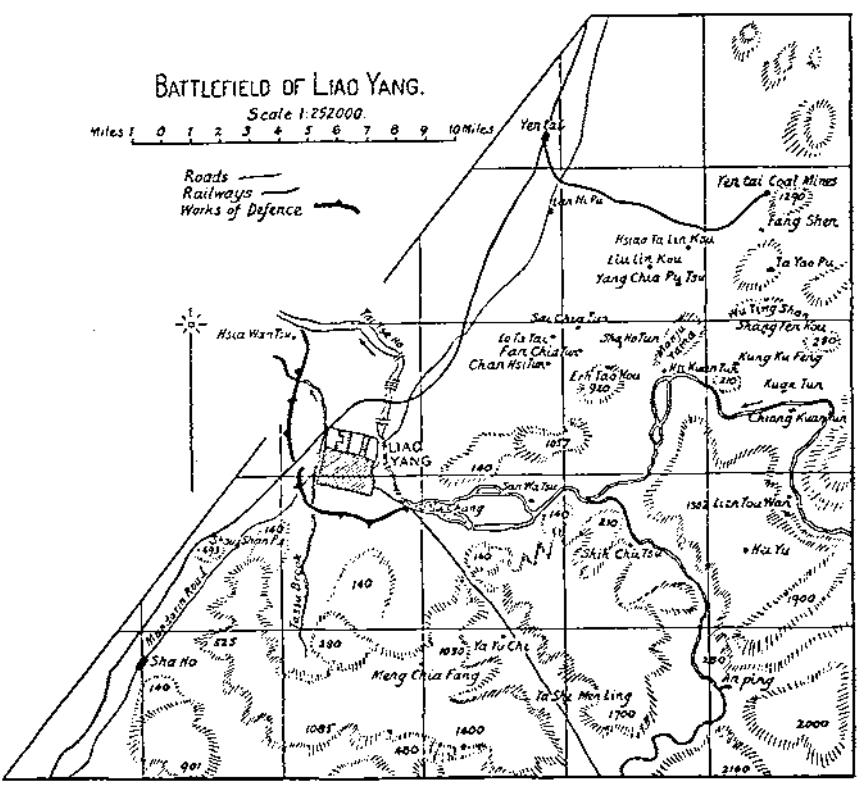
The Japanese First Army under General Kuroki consisted of three divisions; the Guards under General Hasegawa, the 2nd Division under General Nishi, the 12th under General Inouye, and the Guard Kobi Brigade under General Umezawa. Each division consisted of two brigades, with a cavalry regiment of three squadrons, six 6-gun batteries and a battalion of engineers 750 strong with bridging train and telegraph company: each brigade contained two infantry regiments of three battalions each, 950 rifles per battalion. General Kuroki therefore had about 40,000 rifles and 120 guns, while the total Japanese force is generally estimated at about 130,000 men and 600 guns, though some authorities give the total as considerably greater. General Kuropatkin had about 150,000 men and 500 guns.

Realizing that Liao-Yang marked the certain point of concentration of the three Japanese armies, Kuropatkin had previously prepared a fortified position there. He hoped to be able to delay the Japanese advance by rear-guard actions till the end of September, by which time he expected to have a force collected in Liao-Yang with which he could with safety launch his great counter-stroke. However, the Japanese advance could not be checked, and he found himself forced back on his advanced position of defence on the 28th of August. This line, consisting of field redoubts and works, extended from Shou Shan Pu by Ya Yu Chi to Hsi Kwan Tun, with a gap in the middle where the Tassu brook crossed. His right flank, consequently, resting on a small hill near Shou Shan Pu, was in the air; his left, where his communications with Mukden were specially vulnerable to Kuroki's army, was well thrown back behind the Tai Tse Ho. His works were chiefly on the forward slopes of the foothills, commanded by the higher hills to the east and south, but very strong, while the Tai Tse Ho, 200 yards wide, and fordable in places only, with no bridges save

on 5,000 miles of single-line railway. Obviously he must strike quickly, overcome the Russian forces in Manchuria before they could be largely reinforced, and so if possible secure a favourable peace before the resources of his own country were exhausted. Strategical victories were of little use to him. The capture of Port Arthur might well have been a secondary consideration, but there were sentimental reasons for its investment, and its capture might be expected to add enormously to Japanese prestige.

Kuropatkin had a far more difficult task. He had continually to fight delaying actions, putting off battle till the railway could give him the force with which he hoped to overwhelm the Japanese and march to Tokio. His attitude is best described by the words attributed to him before the war: "After one month they will call me inactive; after two, incapable; after three, a traitor; after six, we shall see!" Russian plans were further complicated by the fact that great unrest prevailed at home, and it was urgently necessary to be able to report successes in the field, in order to distract the attention of the discontented peasants.

As will be seen from the map, the south and east of the theatre of war is mountainous. The hills are rugged and rise to a height of over



SOME NOTES ON THE ACTION OF THE JAPANESE FIRST ARMY AT LIAO-YANG.

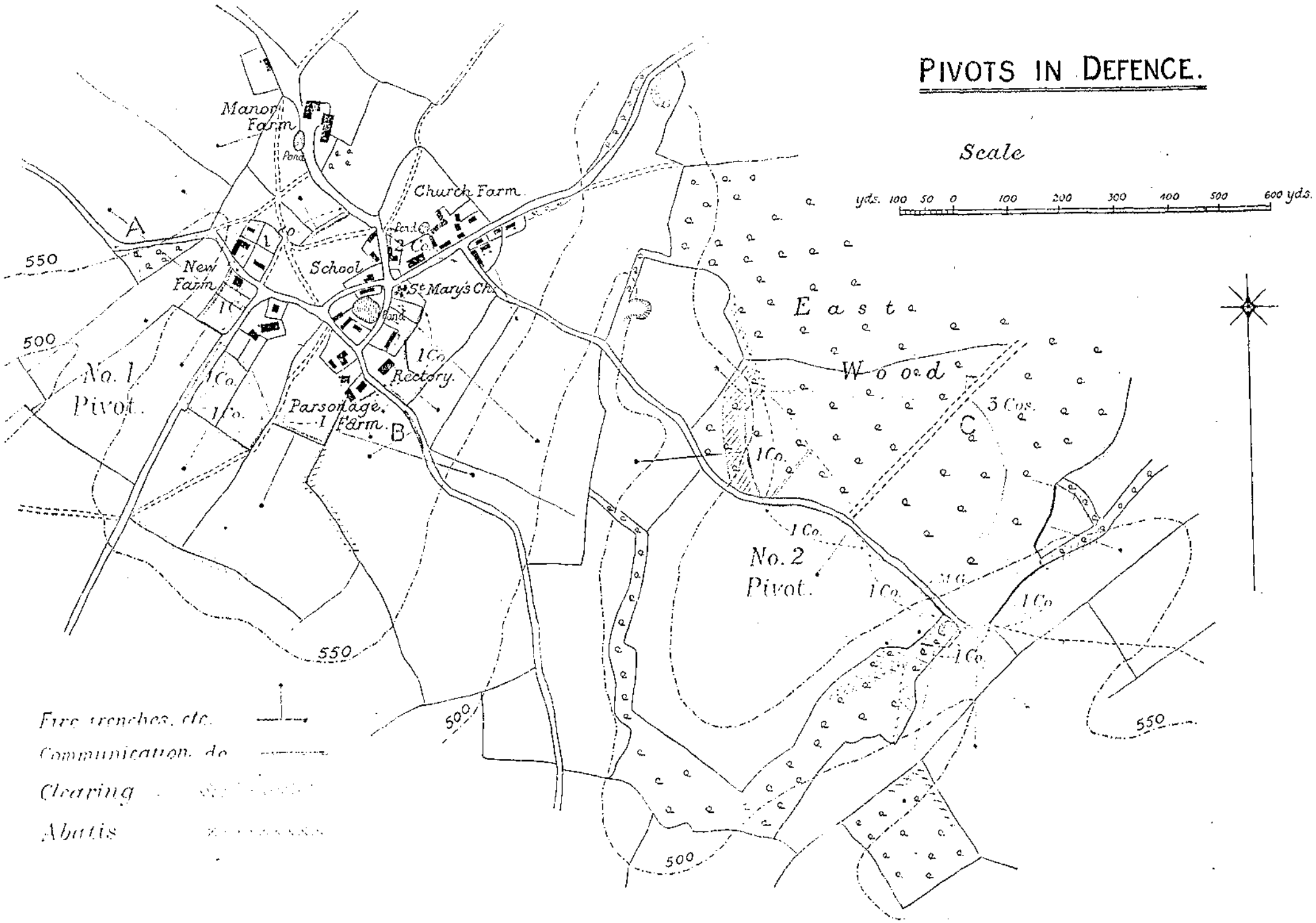
By Lieut. C. R. Satterthwaite, R.E.

The Battle of Liao-Yang was the first of the three great battles on land in the Russo-Japanese War, and though in many respects indecisive—as there was no rout or disorganization of the Russian forces, and the Japanese losses exceeded those of the Russians—it may be regarded in some ways as the most momentous of the campaign. It was the first pitched battle between evenly matched forces of the West and East, and it effectually silenced those critics who could not believe it possible that the forces of the great Russian Empire could be seriously checked or defeated by those of a small island which had only awakened from mediævalism forty years before.

Before going into details of the great turning movement of the Japanese First Army which really decided the battle, it will be as well to recapitulate shortly the events of the campaign up to the date of the battle. War broke out in February, 1904, and the Japanese, organized in four armies, began to land in Manchuria, naval successes having given them for some time at least the local command of the sea. By the end of April General Kuroki's First Army had landed at Chemulpo and Chinnampo, concentrated at Wiju, and forced the passage of the Yalu. During May General Oku's Second, and General Nodzu's Fourth Armies landed at Pitzewo and Takushan respectively. Oku turned south and drove in the outer line of defence of Port Arthur at Nan Shan ; then turned north again and defeated a Russian attempt to relieve Port Arthur at Telissu, leaving the investment of Port Arthur to General Nogi's Third Army, which had only just landed. Thus Kuroki, Nodzu, and Oku were advancing in converging lines towards Liao-Yang, the ancient capital of Manchuria, where it was known that fortifications had been prepared, and where consequently the first great battle was expected to take place. Kuroki had much stubborn fighting at the Motienling Pass and at Anping, but in the last days of August all three armies were in touch before Liao-Yang, with practically the whole of General Kuropatkin's available forces before them.

It will be as well to consider the different objects before the two opposing commanders, as the effect of these is often apparent in their conduct of the battle. Marshal Oyama, the commander-in-chief of the Japanese Army, had a task which was fairly clear. He was operating relatively close to his base, while his opponents depended

PIVOTS IN DEFENCE.



would have little connection tactically with the primary defence of the pivot.

As regards the occupation of such positions, the approximate sites of pivots would be given and the garrisons allotted by the brigade commander, working on results of reconnaissance carried out by or for him or by divisional or higher authority. The pivot commander would then be responsible for the detailed arrangements for which any report or sketch made by a reconnoitring officer would be most useful. To assist in the work some Sappers would no doubt be allotted if available. As we have only $\frac{2}{3}$rds of a Field Company to an Infantry Brigade, one section is all that can be expected for a pivot occupied by a battalion.

The R.E. officer should be the pivot commander's adviser as to the employment of the Sappers, and in all other technical points connected with the defence. These are outside the scope of this article which has dealt with purely tactical considerations; technical details are, however, so closely allied to what may be called tactics of ground, that there seems no doubt that all R.E. officers should be experts in the latter subject as well as in the former, especially as it is laid down in *Engineer Training* that the reconnaissance of the ground and proposals for its occupation may fall to the lot of Engineer officers.

instance, companies do not unnecessarily have to face both to front and flank, but can be given a definite tactical mission such as sweeping with fire the front of a neighbouring pivot.

A so-called "Keep" may be prepared to enable the garrison to continue to resist after they have become too weak to hold the original outer line, or so that, owing to changed tactical conditions, the pivot can be held with a reduced garrison. Each case must be considered on its merits; it will often be undesirable, and sometimes impossible, to make a "keep."

It is laid down in the *Manual of Field Engineering* (50. 3) that "pivots should be capable of all-round defence." It would seem that this should be interpreted to mean that the flanks should be brought well back, so that the defence would not be seriously affected by even the loss of a neighbouring pivot.

The inadvisability of doing anything which would assist the enemy to hold the pivot if he captured it, and the extra work which would be entailed by making defences actually facing to the rear, would as a rule counterbalance the advantage of being prepared for the somewhat unlikely contingency of an attack from that direction.

The *Plate* shows suggested organization for two such pivots in fairly typical country. It may serve to illustrate most of the points mentioned above. No. 1 is supposed to be the right flank pivot of a position occupied by a brigade. Both are liable to be exposed to artillery fire. Their extent is, however, such that they would not be greatly affected by it. No. 1 can develop plenty of fire to the exposed flank. It is perhaps a little weak in frontal fire; wing trenches A and B would be used to increase this if necessary.

The distance apart is in this case decided by the shape of the ground; the central interval works out at about 1,200 yards. A battalion would be a suitable garrison for each pivot, assuming of course that a stubborn defence is intended. This may appear excessive in the case of No. 2, but owing to the contour of the ground the defence of its left flank could not be assisted from the next pivot. In both cases "natural" cover is available; the hedges round the village are thick and high, and "East Wood" is a well-grown hazel copse with some large trees. Any clearings required would not be conspicuous as they are a common feature of such woods. There are good existing radial communications in No. 1, and the lane along the front of East Wood would serve for lateral communication in No. 2. Others would have to be made. The shape of No. 1 may be said to be suitable; No. 2 is somewhat broad for its depth, but this is dictated by the shape of the ground.

If desired, a "keep" could be arranged for in No. 1 Pivot in the area—"Parsonage Farm—St. Mary's Church School." It would be practically impossible to form one in No. 2. An entrenchment could of course be made in rear, say, in the neighbourhood of C, but it

Every defended locality is not likely to be a pivot in the original meaning of the word, but the term seems to be the official one for what the French call *points d'appui*, or what Major Swinton in his lecture at the R.A. Institution on February 16th, 1911, characterized aptly as "defensive blobs." The customary use of the word "post" implies something on a smaller scale, and it would perhaps be well if the distinction as to size were generally recognized. One could then say without fear of misunderstanding that, if the shape of the ground or tactical conditions demanded that a "pivot" should cover an area somewhat extended for its garrison, it could be occupied by holding "posts" at intervals connected by obstacles.

One of the advantages claimed for the pivot system was the improved facilities for the command and organization of the defence. This is due of course to the concentration of the defenders into well-defined localities, instead of their being distributed along the whole front. Communication (in both senses of the word) to the rear is much simplified.

The internal organization of the pivot must also be good, if full value is to be derived from the system.

The garrison of a pivot will usually consist of the firing line and supports, local reserves being kept outside for use in intervals, etc. No great measure of offensive action will therefore be expected from the pivot itself; and the proportion of the garrison in the firing line can for this reason be relatively high. Men so allotted to the front line beforehand will be of more use there than if hurried into position at the last moment; and, if suitable internal communications have been made, they can always be moved to reinforce a more threatened portion of the defences.

Screened communications are very important; these must be both lateral, along the front line, and radial, back to the centre, where headquarters, reserves, etc., will usually be located. The enemy should not be able to detect any movements in, or behind, the firing line. If time is available such communications should be made bullet proof.

The shape in plan of a pivot generally gives a fair indication of its suitability; if there is a great disproportion between its breadth and depth, there should at least be some good reason for it.

It is better, if tactical considerations permit, not to allot to a pivot a garrison which does not admit of a sound system of command and organization. A complete unit, a company or battalion, whose commander is known to all is obviously the best; two companies or two battalions are probably the worst, as the command of, say, a battalion by the colonel of another in addition to his own can never be a really satisfactory arrangement.

Within the pivot, the subdivision between units should correspond with tactical requirements; better results may be expected if, for

garrison of a pivot in the conditions described. If the ground is such that the field of fire to front and flanks is more limited, the interval between pivots may have to be reduced. On the other hand, the enemy will be under fire for a shorter time and more rifles may be necessary to produce the required effect. Within certain limits these factors would neutralize each other and a battalion would remain theoretically the most suitable garrison. It is obvious that, when the field of fire to the flanks is very limited, smaller garrisons will suffice.

It may be said that such theoretical discussion has little practical value and that each case can only be dealt with on its merits. It is certain that each case must be dealt with on its merits, but previous theoretical discussion should facilitate this being done quickly and correctly.

In the defence of a position on this system, therefore, an estimate should first be made of the average garrison for a pivot demanded by the type of country. For ordinary European country, a battalion to a pivot seems a good basis to work on, if the necessity for modifications imposed by abnormal conditions is kept in mind. This, of course, applies to operations of the type contemplated in Secs. 107 and 108, Ch. VII., *Field Service Regulations*, Part I., that is stubborn defence by a considerable force.

Other conditions, as in the case of a protective detachment, may require a smaller force to hold a more extended line; the average pivot garrison would then be proportionately reduced.

"Natural" localities, or possible sites for artificial pivots, must next be examined. If the former are unsuitable as regards size or in other respects, it is for decision whether the advantage of concealment from air craft should outweigh other considerations, such as undue concentration and consequent liability to suffer from artillery fire; whether, in fact, the locality should be occupied as it stands, enlarged "artificially," or a fresh artificial pivot constructed on a more suitable site.

It may happen for strategical, or even tactical reasons, that there is no objection to the enemy discovering the position and that there will be no advantage in concealment from aircraft.

Concealment from the view of hostile troops on the ground is a different matter and should always be arranged for as far as possible.

In applying this system of defence to the ground there is a tendency to hold minor features or localities. This should be guarded against as it leads to the formation of a line of small posts. Such a line has few advantages over the old linear method and many disadvantages, especially as regards organization, compared with the system of large pivots.

There seems to be a certain amount of vagueness about the terms "pivot" and "post." Neither is defined in any training manual, except the former in its cavalry signification.

(iii.). To economize the numbers required for defence by occupying only part of the front.

(iv.). To facilitate command and organization of the defence by the concentration of the defenders into nuclei.

(v.). To obtain full benefit from the power of modern firearms and the disconcerting effect on the enemy of flanking and cross fire.

Other advantages not included in the above may be said to be

(i.). The gain in *morale* due to an increased sense of security which results from the shape of the pivot, its internal organization, and the facilities for strengthening it.

(ii.). The mutual support of neighbouring pivots.

(iii.). The possibility of developing flanking fire from positions screened from the front.

(iv.). Ground can be used to the best advantage.

Almost the only disadvantage is the liability to concentrated hostile artillery fire. This can be lessened by avoiding overcrowding and making good cover.

To attain the objects and secure the advantages enumerated above, a pivot must be of sufficient size and suitable shape to give the necessary amount of fire to front and flanks; it should require for garrison a complete unit or an easily handled portion of one; it should be large enough to be comparatively invulnerable to artillery fire. These are not very definite data from which to fix the size of a pivot, but it is necessary to make the best of them.

The length of front required depends upon the amount of ground to be covered by fire. This is determined by the extent of field of fire to the front, and partially by the interval between neighbouring pivots; both these depend again on the nature of the ground both as regards shape and surface in so far as visibility is concerned. The amount of fire to a flank which is required, also depends upon the extent of field of fire in that direction. If the ground is open, it would seem desirable that the whole space intervening between two pivots should be under the "close" rifle fire of one or other; this would give 1,200 yards as a maximum interval; either pivot would then be able to sweep the front of the other with "effective" fire. Under these conditions each pivot would be responsible for 1,300 yards or so of front. The maximum garrison excluding local reserves for this frontage, calculated according to Sec. 108. 8, *Field Service Regulations*, I., would be 1,950 men, or two battalions.

The conditions assumed are, however, very favourable to defence; the ground is open and there are facilities for forming strong pivots; the method, as such, aims at holding certain portions of the line only, so that a larger proportion of the troops may be available for counter-attack. It seems therefore that a battalion would suffice for the

PIVOTS IN DEFENCE; THEIR SIZE AND ORGANIZATION.

By DOLF.

Field Service Regulations, Part I., lays down (Sec. 107. 9) that "defensive positions will normally include a number of localities of special tactical importance," and that "the efforts of the defender will be directed in the first instance to occupying and securing these points." Here then is a definite principle on which the defence of a position or zone should be conducted. According to the *Manual of Field Engineering* (Sec. 50. 3), these localities may be commanding features of the ground, groups of substantial buildings and enclosures, or wooded knolls. It has been pointed out (*vide* "Natural *Points d'Appui*," *R.E. Journal*, February, 1913) that localities such as woods and villages, which are so to speak ready to hand, are better than those which have to be constructed for the purpose, such as a group of trenches on a hill. The following reasons were given; woods and villages are easily adapted for defence; abundant material for obstacles, etc., is usually available; they afford cover from the view and fire of the enemy and serve to screen the movements of reserves; and, perhaps most important of all, they give almost complete concealment from hostile aerial reconnaissance.

It cannot be expected, however, that natural *points d'appui* or pivots (to use the official nomenclature) of suitable size and situation will always be forthcoming. It seems clear then, that if this system is to be followed "natural" pivots may have to be enlarged, or entirely "artificial" ones constructed.

Thus the question arises as to what is the suitable size for a pivot; for if one has to be made to order, some idea as to this point is certainly necessary. Before going into this it may be well to recapitulate the objects and advantages of this system of defence. The objects may be said to be

(i.). To regain to a certain extent initiative presumably lost owing to defensive attitude: this is accomplished by occupying localities that are certain to attract the enemy to attack them.

(ii.). To preserve an offensive spirit in the defence by giving opportunities for counter-attack.

It appears that the whole conduct of war will be a much more deliberate art than it is at present. By deliberate art I do not mean that it will be slower, as, on the contrary, I think that it will be quicker, but that events will be more calculable and will be more accurately foreseen; in fact war will be less of an art and more of a science. The element of surprise will be removed almost entirely from it and battles of encounter should be things of the past.

The character of the advanced guard will be modified as its duties will be confined almost entirely to those of protection, the aeroplanes relieving it of nearly all its reconnaissance duties. A commander may also decide to use his advanced guard to start his battle. The advanced guard action will not be a sort of reconnaissance in force, but the first phase of the actual big fight, *i.e.* seizing tactical points, villages, etc.

It has often been said that aircraft will supersede cavalry, but I think that this idea is fallacious and that they will prove to be the cavalryman's greatest friend, as by relieving him of his reconnoitring duties they will leave him free to carry out his still more important *rôle*, that of co-operation with the other arms on the battlefield. And also in the future we shall not have so many instances of a victorious army being robbed of the fruits of its victory owing to the horses of the cavalry being too tired to take up the pursuit and prevent the enemy rallying and re-forming.

troops, and they start settling down in their positions for the night; then the aeroplanes must go up and locate these positions, and again they must go up in the early morning and catch the enemy as he moves out and discover the directions in which he is moving.

For all these duties, which I have classified under the heading of Tactical Reconnaissance, the best type of aeroplanes would be two-seater biplanes, provided that there is a sufficient supply of well-trained observers. It has now, I think, been fairly conclusively proved that, except in very bad weather, a good pilot alone will bring back quite as good information as a partly trained observer.

These machines do not require to be very fast, but as they will have to do many short trips, they should be able to climb rapidly and to land at a slow speed. They will have to trust to special fighting aircraft of their own side for their protection from the hostile aircraft. Possibly they might carry some form of light armament, but as, I think, their *rôle* should be strictly confined to reconnaissance this would probably only hamper them.

Organization.

At present the idea is to keep the aeroplanes as Army Troops under the C.-in-C. who will allot them to divisions as required, but considering the purposes for which I have suggested they may be used I think that the eventual organization may be somewhat as follows :—

(*a*). *Army Troops.*

2 squadrons fast single-seater monoplanes.

(*b*). *Cavalry Divisional Troops.*

1 squadron two-seater monoplanes.

(*c*). *Divisional Troops.*

6 squadrons two-seater biplanes.
6 squadrons fighting machines.
(One squadron of each per division).
Total—15 squadrons with the Field Army.

These numbers are taken with the strength of squadrons as at present, viz. 12 machines per squadron.

The total number of squadrons required would be considerably greater than this as the wastage of war in this arm will be very great indeed, and it will probably be necessary to send out complete fresh squadrons during the progress of the war to replace those first sent out.

In conclusion, I will put forward a few suggestions as to the influence that aircraft will have on the conduct of warfare in the near future, beyond which it is impossible even to surmise what will happen owing to the rapidity with which aircraft are developing.

For this purpose a squadron of two-seater monoplanes would probably be the most suitable, as they must be of a type easily transported by road, so that in the event of the weather being too bad for them to fly they can keep up with the cavalry by road.

TACTICAL RECONNAISSANCE.

(1). *The Reconnaissance of a Position.*—Aeroplanes will be of considerable assistance in this, as they will be able to find out the extent of the position and also to locate the enemy's general reserve and cavalry; two things which it is difficult to locate by other means. But they are not suited to the actual reconnaissance of the ground, as it is very difficult to tell from up above what points on the ground are mutually visible; but even in this a highly trained observer might be of considerable assistance.

(2). *The Attack of a Position.*—During the actual attack the movements of troops in the firing line will be of a too detailed nature to lend themselves greatly to aerial observation, but the aeroplanes will be able to note the general trend of these movements and also to obtain early information as to any moves of the hostile general reserve and cavalry, early information on which points is of the greatest value to the G.O.C. as it enables him to know when and where to expect a counter-attack. They will also, owing to movements of transport to the rear, be able to tell him of any signs the enemy may show of weakening any part of his line or of retiring, and thus assist the G.O.C. in knowing when and where to throw in his own reserves. If the enemy is defeated they will be able to give invaluable information as to his lines of retreat, and so ensure the opposing cavalry being sent out in the right direction. There have been many instances in history where the want of this information has led to the cavalry being sent out in the wrong direction, and thus the fruits of the victory have been lost to the victors. At this time also the aeroplanes might be employed in dropping bombs. They would be able to fly quite low, and the moral effect of a few bombs dropped amongst the troops already partly demoralized by their defeat might conceivably greatly assist the cavalry in turning a retreat into a rout.

(3). *The Defence of a Position.*—In this the chief duty of the aeroplanes will be to locate the enemy's lines of advance, and to discover against which portions of the lines he is massing most troops, and thus prevent him delivering an unexpected decisive attack. They must also carefully watch the flanks of their side for any signs of an outflanking movement on the part of the enemy.

(4). *During a Contested Advance or Retreat.*—Here the times when the aeroplanes can be most usefully employed will be the evening and early morning. In the evening there usually comes a time when there is a lull in the fighting owing to the fatigue of the

A FEW NOTES ON THE EMPLOYMENT OF AEROPLANES IN WARFARE.

By Capt. A. G. Fox, R.F.C.

These notes do not profess to be in any way complete but are a few lessons learnt from last year's manœuvres and elsewhere.

Strategical Reconnaissance.

At the commencement of a campaign it is imperative that the G.O.C. be furnished with early information as to the position and size of the enemy's columns. At present the independent cavalry is pushed forward to obtain this, but before it can do so it must break through the enemy's protective troops, and will in all probability have to dispose of the hostile cavalry operating in the zone separating the two armies; and so, unless it is exceedingly strong and prepared to do a lot of fighting, all it can do is to discover the contour of his covering troops. This is the time when the employment of aeroplanes will be of the utmost value; they can go straight out and locate the main bodies of the enemy without being stopped by his protective troops and without troubling about his cavalry, except to locate it. This will leave the independent cavalry free to perform any special tasks assigned to it or it may even be dispensed with to a large extent leaving more free for protective duties. It will also be of great advantage to the strategical concentration as the preparation of ships to carry a large number of horses takes time. So aeroplanes will speed up the initial stages of warfare.

For this purpose a squadron of aeroplanes with a large radius of action will be required. This will be best furnished by a squadron of fast single-seater monoplanes, which will have to trust entirely to their speed to escape from the hostile aircraft.

If a force of independent cavalry is still employed, a squadron of aeroplanes will be of considerable assistance to it. Their chief duty will be to locate the hostile cavalry's bivouacs each evening. During the day it is doubtful whether they will be of much use, as they will probably not be able to get any information that they may obtain back into the hands of the commander before the situation has developed so much as to render the information of very little value to him.

forge, and hoisting gear beyond that carried by a field company is required for swinging.

The weight of bridge at swinging was 6 tons, whilst the weight completed was 6 tons 16 cwt.

The bridge took a test load of 90 cwt. in a truck and showed a deflection of only 2½ in.

The advantages and disadvantages of this kind of bridge appear to be as follows :—

ADVANTAGES.

(*a*). It is very light and stiff for the span and load.

(*b*). The timber used is of ordinary scantlings.

(*c*). It can be built and swung without crossing gap to be bridged.

(*d*). Being a complete girder no anchorages are required after construction.

DISADVANTAGES.

(*a*). Special ironwork has to be carried or made.

(*b*). The stresses may be indeterminate.

(*c*). The extra stiffening required for swinging involves extra labour and materials.

(*d*). The frames require very accurate construction.

(*e*). The cross-bracing cannot satisfactorily be calculated, for deforming forces sideways would depend chiefly on any inaccuracy of construction and would not merely depend on wind.

(*f*). A very heavy spar is required for the derrick for swinging.

(*g*). The bracing of end frames cannot be completely satisfactory as headroom must be allowed.

(*h*). For a large bridge the frames are too heavy to be readily portable.

(*i*). Stiffness is not necessarily an advantage in field bridges, for no warning is given before failure.

In practice I should never construct a bridge of this kind unless the gap were very deep. Where 3-in. steel rope is available a tension bridge would usually be preferable. I should only construct this type if anchorages were impracticable, and the gap very troublesome to cross. I have to thank Capt. Grove for much help with this bridge.

Field Girder Bridges

Exactly what cross-bracing was put in was not clear in the July article; if wires were used they were so fine as not to be visible in the photographs. In any case the shore frames cannot have been braced as the braces would have interfered with the headroom. The lateral stiffness appears to have depended on the pin joints. I cross-braced the frames BC, CD in an ordinary way with light planks whilst the shore frames AB and DE were cross-braced at the top and stiffened below by using rather a heavy shore transom prolonged to form an outrigger as in *Fig.* 3.

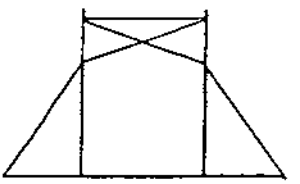


FIG. 3.—*Shore Frames.*

It should be noticed that when using very light cross-bracing, it is most important to have the frames accurately squared so that the compression members may be in vertical planes.

I found after building the bridge that the roadway swung to and fro when infantry crossed it, so I afterwards added light cross-bracing under the roadway, which made the bridge laterally very stiff.

In McClintock's bridge the thrust of the joints was taken by iron pins in wooden holes. With my heavier load the compression members would have crushed and split, so I shod each compression member with thin iron plate to take shear off my pins.

In order to save weight I found it advisable to make all the compression members double. The narrower ones were stiffened with cover boards whilst the wider ones had cross-bracing of light boarding. Incidentally this had the advantage of permitting the main ties to be fastened symmetrically to the centre part of the pins.

I had anticipated considerable difficulty in correctly adjusting the numerous ties, but in practice I found that, by making each tie with two parts and adjusting by Spanish windlass, no difficulty resulted.

In erecting the girder my procedure was somewhat different. Each frame was cross-braced separately, each pin joint as soon as connected was hoisted by a pair of derricks and adjusted by them. These derricks then became suitable struts for stiffening the bridge whilst swinging. An extra spar was required to give the sling of the outer end a fair lead without bringing pressure on the light cross-bracing.

This bridge actually took 1,090 man-hours to erect, but I do not think that a field company at war strength could construct it in less than 20 hours of work. The pins are too heavy to forge on a field

FIELD GIRDER BRIDGES.

By MAJOR G. E. SMITH, C.M.G., R.E.

IN an article in the *R.E. Journal* of July, 1912, Major McClintock, D.S.O., describes an adaptation of the "Tarron" girder which he calls the "Bangalore" girder. The Commandant, S.M.E., directed me to experiment with such a bridge, which I now propose to describe.

Careful readers of the *Journal* will have noticed that Major McClintock has further developed his design and published his results in the January number, and it will be noticed that the design is considerably improved. My solution differs in various respects, having been arrived at previous to the publication of the second article. My problem was to design a girder of 64 ft. span to take infantry crowded in fours, and I found that by putting in a few extra road-bearers I could also deal with concentrated loads up to 75 cwt.

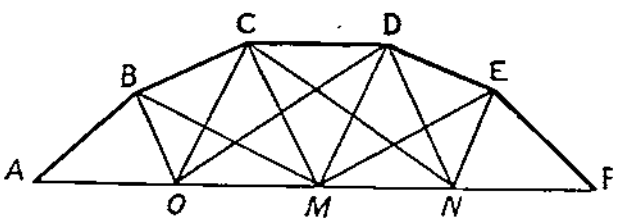


FIG. 1.—"*Bangalore Girder.*"

In the Bangalore girder it will be noticed that if loaded at O only, the girder, which is hinged at BCDEF, is unstable unless the weight of the roadway is sufficient to prevent E from rising with the thrust. Accordingly, whilst retaining three suspended transoms I used a four-sided funicular polygon and suspended each transom from all the angles of it.

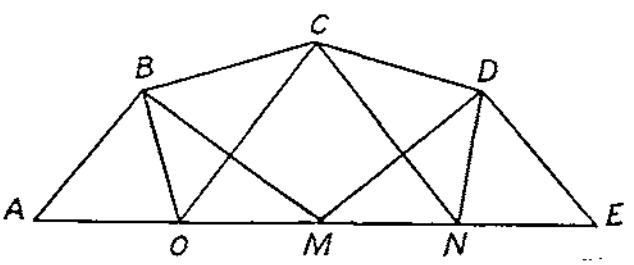


FIG. 2.—*Tarron Girder as constructed at S.M.E.*

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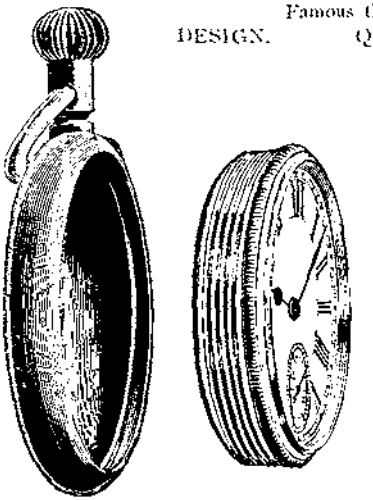

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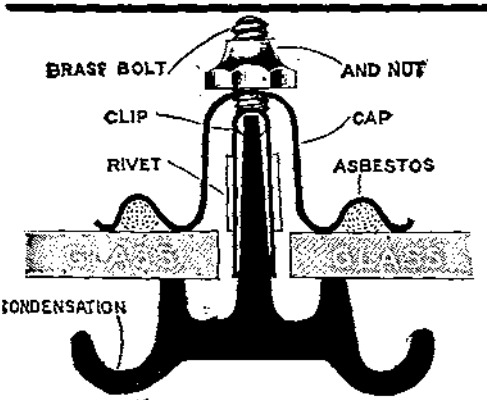

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