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# CONTENTS.

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Chinese wall at Yatung before demolition.

Chinese wall at Yatung after demolition.

THE 3rd COMPANY 1st (BENGAL) SAPPERS & MINERS

ON THE THIBET MISSION, 1903 04.

Cantilever and lenticon bridge, 45 ft. span.

Bridge over nullah, 60 ft. span (total).

Gallery round a cliff.

"Ubique" cottage.

**Bengal Sappers & Miners**

# *TRAINING AND ORGANISATION OF MILITARY ENGINEERS.*

*By* Capt. J. E. E. Craster, R.E.

In writing this article, I have throughout been oppressed by the knowledge that the majority of my readers must know far more about the subject than I. Moreover, the work has not been rendered easier by the absence of any books on the subject; at least, if any exist, I have so far failed to discover them. It will be obvious, therefore, that I have had to rely solely on my own limited experience, and that I have no other authority to support the views I have put forward.

I will begin by stating an axiom :—

*Military Engineers must be organised and trained for war.*

It is necessary to commence in this way, because the fact that war is the end and aim of a sapper's training is sometimes lost sight of in the details and ramifications of engineer organisation. Difficulties occur not in the recognition of the principle but in its application.

The obvious deduction from the foregoing axiom is that a military engineer should in peace time be employed, as far as possible, on the same work that he will be required to do in war. What that work will be cannot be accurately foreseen. This is the unknown quantity in the problem. In order to lend an air of mathematical precision to our deliberations, let us call it X.

Unfortunately, the most difficult part of the solution is still before us.

Statistics of previous operations would, undoubtedly, help us to arrive at a rough approximation of the value of X, for any particular case. Or to put it more explicitly,—it would be very useful, at the end of a campaign, to have a rough record compiled, shewing the way in which the sappers spent their time, and the percentage of the whole that was devoted to each class of work. In order to facilitate comparisons, diagrams might be prepared for each campaign as illustrated below :—

| Group I. | | | | | | Group II. | | | | Group III. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Purely Military Engineering. | | | | | | Common to Civil and Military Engineering. | | | | Non-effective. | |
| Field Fortification. | Siege Works. | Field Bridging. | Hutting. | Camp Water Supply. | Balloons. | Roads. | Railways. | Telegraphs and Telephones. | Reconnaissance, Survey and Reproduction of Maps. | Sick. | Prisoners of War. |

The space which I have devoted to each heading is purely arbitrary, and I do not pretend that I have included all the various duties which the sappers are expected to perform.

The list, though incomplete, is a long one, and shews that a sapper's duties in war are many and various; therefore his occupations in peace time must be many and various also.

It happens that sometimes the cheapest and most remunerative way of employing him in peace is also the best way of training him for his duties in war. This is merely a fortunate coincidence. Fortunate in one way, yet extremely unfortunate in another, for it has at times brought about a confusion of ideas among the British public, who are the ultimate controllers of the engineers' destinies. They have, in fact, not infrequently mistaken the earning of by-profits as the main object of an engineer's existence, and have therefore concluded that a sapper should always be employed during peace in the most remunerative way. They have forgotten that they must train him for war.

The military training of an engineer officer should be equal to, if not better than, that received by officers in other branches of the Army. By military training I mean training in strategy, tactics, and the art of war generally. In field fortification he should of course be an expert. It is far more important that he should fully understand the tactical uses of fortification than that he should have at his fingers' ends all the types of works shewn in the text books. The site of the work to be executed is of infinitely more importance than the details of its construction; the latter do not, as a rule, call for the exercise of any great talent.

The necessity for impressing engineer officers with the tactical uses and abuses of fortifications cannot be too strongly insisted on. Too much fortification is as bad a fault as too little. The fatal attraction that earthworks have for troops may be great enough to cause them to voluntarily give up their mobility, and with it all chance of winning a victory. Fortifications are at best only a prop that enables the weaker force to keep the field. The engineer should therefore regard his handiwork with no exaggerated esteem. I do not mean that he should despise or neglect his own special work; it is on his merits as an engineer that he is valued by the other branches of the service. This is well illustrated by the following extract from Napier's *Peninsular War*:—"The engineer officers were exceedingly zealous, and notwithstanding some defects in the constitution and customs of their corps, tending rather to make them regimental than practical scientific officers, many of them were very well versed in the theory of their business."

Though a few engineer officers are fortunate enough to obtain staff appointments, the great majority must look to their own particular line for their advancement. There may be a Napoleon among them;

but if he does not in the first instance distinguish himself as an engineer, it is likely that his secret will be buried with him.

I find I have strayed from the line marked out by the heading of this article, so I will hark back to the diagram. The various duties that it includes may be divided into two classes; those which are purely military, and those which are common to both civil and military engineering. The former includes field fortifications, siege works, bridging, hutting, water supply and balloons; the latter roads, railways, telegraphs and telephones, survey and the reproduction of maps.

Of the duties included in the first category, two are so technical that special units are set apart for their performance. In order that the bridging and balloon companies may maintain a sufficiently high standard of efficiency, they must be employed for the whole, or nearly the whole year, at their own special duties; they cannot, with advantage, be employed in any civil or semi-civil occupation. The remainder of the duties in the first group do not demand such constant practice, and it should be sufficient if both officers and men were put through an annual course of instruction. This leaves them free, for the greater part of the year, to practise the duties enumerated in the second group, which I propose to discuss at greater length.

Few opportunities occur for road-making in civilised countries. In India sapper companies are still often employed on road-making during peace; but on the whole the demand for roads has decreased, and we may anticipate that, as the world's railway system develops, it will shrink still more.

The construction, maintenance and working of railways will in the future monopolise a great deal of the time and labour of military engineers. For this work some special units are required. Railway companies, composed of railway specialists, are necessary to form a nucleus for a railway corps; but the expense of maintaining a sufficient number of railway companies to work unaided any but the smallest railway system is prohibitive. The railway companies must therefore look to the field and fortress companies, to auxiliary railway troops and to civilians for assistance in repairing and working the railways committed to their charge. For this reason, it is desirable that both officers and men of the field and fortress companies should obtain practical experience of railway work during peace. The survey, design and construction of new railways, besides affording valuable technical experience, gives more opportunities than any other form of employment of learning and practising useful engineering. I trust I may be permitted to suggest that we have not enough officers or men employed on railways at home. Few opportunities for employing military engineers are forthcoming, because English railways are all in private hands. It might, perhaps, be possible, when Parliament sanctioned a bill for a new railway, to have a clause inserted

guaranteeing that certain portions of the work should be performed by military engineers.

Railways exist primarily for the benefit of the public. This fundamental principle is daily receiving wider recognition, and, consequently, it is probable that the State will in future exercise more control over their administration than it has done in the past. There are grounds for hoping, therefore, that the opportunities for employing military engineers on railways will increase.

The huge area occupied by a modern battle has necessitated the use of telegraphs and telephones to maintain communication between the various parts of the field. A telephone system will probably form part of the equipment of every outpost line; no defensive position will be considered complete without one. The erection of lines, and of simple telegraph and telephone installations, should form a part of every sapper's training. The construction and working of the main telegraph lines connecting the forces with their base would be, as hitherto, the special duty of the telegraph companies, of whom a considerable proportion (if not the majority) of both officers and men may be usefully and economically employed during peace on the civil postal telegraph and telephone systems.

The Ordnance Survey and various colonial surveys afford good training for officers and men in survey work. This training is supplemented by instruction in field sketching and reconnaissance. The men employed on the outdoor duties of the Ordnance Survey develop a facility for map reading, a keenness of vision and a sense of direction that should render them extremely useful as guides or scouts or for any reconnaissance duties. The reproduction of maps in the field is a matter of the greatest importance, and must not be overlooked during peace.

I have now come to the end of the duties shewn on the diagram. I have attempted to shew that, to keep pace with modern developments, increased attention must be paid to railways, telegraphs and telephones, and that a large proportion of officers and men may advantageously be employed on the former during peace time.

Engineer organisation in the field I propose to deal with in the briefest and most general terms. I have no desire to flounder into a morass of detail, or to amuse my readers and weary myself by the construction of a formidable diagram to shew through what tortuous channels the C.R.E. of an Army Corps should communicate his orders to the last-joined subaltern,—a diagram which, when finished, might be mistaken at a short distance for an aristocratic pedigree.

In brief, the whole of the engineer organisation in the field must be under one central authority, a C.R.E. or (as I should prefer to call him, to distinguish him from other and lesser C.R.Es.) the Chief Engineer. He must, of course, be on the staff of the Commander-in-Chief. His most important duty will be to adjudicate between the

rival claims of the various engineer branches. It must be remembered that railways, telegraphs, survey, balloons, field companies, and in fact every engineer unit, will be clamouring for engineer officers and men. In addition the commander of every small post, who at manœuvres does not know what on earth to do with a section of sappers, finds on service that he does not know what on earth to do without them; and he, accordingly, adds his voice to the general clamour. The chief engineer, therefore, must control the distribution of *personnel* and must concentrate his officers and men on the most urgent work; this is essential to economy and efficiency. In other respects the various branches must be as decentralised as possible. In nine cases out of ten, the man on the spot knows best what to do, and he should be encouraged to do it without delay and on his own authority.

Let us turn aside for a moment to examine a rival system, organised on utterly different lines,—a system which has often been held up to us as the ideal at which we should aim. The German engineers are organised on the water-tight compartment basis; for each engineer duty there exists a separate corps. The pioneers, who correspond roughly to our field companies, confine their efforts to field works, demolitions and bridging. The railway battalions, being a totally distinct branch of the service, do not expect, or certainly do not receive, any help from the pioneers. Telegraphs are in the charge of a third branch. These various corps have nothing in common, and to still further widen the gulf between them the rates of pay are different. They are not, apparently, under any central authority; consequently there can be no concentration of *personnel* on the most urgent business; one branch sits idle while another is worked to death.

For any expedition of moderate size, the German system cannot compare with ours for efficiency or economy, though no doubt on paper it is vastly superior to ours. Possibly in very large wars the disadvantages of the water-tight compartment system may not be so clearly marked. With such wars, however, we have no concern; for the size of the British army precludes them. For any war of a size that the British army can tackle, the water-tight compartment system of engineer organisation is bad, utterly bad.

To blindly model our forces on the lines of the German army is equivalent to building a small motor car to the design of a steam roller.

In conclusion, I would urge that the subject of engineer organisation stands in need of study and discussion. We cannot hope to make the most of the existing arrangements, or to improve upon them, if we do not appreciate the principles upon which they are based. The iconoclast is abroad, and hardly a day passes that is not marked by the disappearance of some long-established organisation.

Yet every system which has survived the South African war has not necessarily outlived its usefulness; neither is the obliteration of the existing system always essential to the introduction of improvements. Reforms which have their origin within the organisation are likely to be more beneficial and less irksome than those which come from without.

I feel that I owe an apology to my readers—if any have borne with me thus far—for attempting to deal with a subject of which my lack of knowledge and experience has, I fear, been patent in every line. I have thrown a sprat to catch a whale. If I succeed in inducing those whose experience renders them masters of the subject to give us the benefit of their views, I shall have attained my object.

# *ORGANIZATION OF ROYAL ENGINEERS FOR WAR.*

*By* Bt.-Colonel E. R. Kenyon, R.E.

The present period of Army organization seems to be a fitting occasion for considering whether a radical change is not required in the organization of the Royal Engineers for war.

What then are the engineer duties which must be provided for in any serious war; and can our existing organization be improved without increased expense?

It is now most happily an accepted axiom that infantry and artillery must entrench themselves, not merely as working parties under engineer supervision, but as tactical units selecting and preparing their own lines of defence. Entrenching is not a duty which needs an engineer for its proper execution. The actual work is for the most part that of a labourer, not of an artisan, or, when carried to the greatest perfection, that of a navvy and not of an engineer. The planning and laying out of entrenchments requires tactical, not engineering, knowledge. Any officer who has properly studied his profession should therefore be able to do the work; and the most appropriate officer would seem to be the one who is to hold the line at the risk of the lives and honour of himself and his men. For the preparation of special posts such as villages, for the construction of redoubts, etc., the aid of engineer supervision and of a few skilled artisans may be useful. Saps, mines and obstacles will be needed, not only in siege warfare, but also in the attack and defence of field positions; but for these also the requirements are a large supply of labour under highly skilled supervision with a small percentage of trained workmen.

The preparation of camps is, as a general rule, work which can be well done by unskilled labour under the direction of a sanitary officer, and does not call for engineering knowledge or mechanical skill. Sometimes, of course, especially where large standing camps are concerned, there are important questions of water supply which need the direction of an engineer and the work of artisans and mechanics. It is therefore necessary that there shall be a small body of such men at the service of large bodies of troops when required.

It has been conclusively proved in South Africa and in Manchuria that facilities for collecting and transmitting information from one part of a fighting force to another during action, as well as during the

preliminary movements, must be enormously increased beyond what at present exist in the British army. It is also perfectly clear that the organization, working, repair and construction of railways must play an extremely important part in all large operations of war, and that the improvement of communications of all kinds is of vital importance. For coast defence and for the attack and defence of fortresses railways will have to be utilized to a very much greater extent than hitherto.

A consideration of these points seems to lead to the conclusion that the chief strength of the Engineer force should be devoted to our *Lines of Communication* and to what we may well describe as our *Lines of Information*, with a smaller proportion for general duties.

Field and Fortress Companies should therefore either be supplemented by a large increase to the Telegraph, Railway and Bridging Companies, or should have their composition so altered as to enable them to provide Sections to deal with these special branches of our work. In fact, I think we shall find that these special duties will be of such predominant influence in future that the companies might well be re-named so as to indicate the particular branch of engineering for which each is most fully equipped. Thus one Field company might contain three sections of trained telegraph men and might therefore be called a Telegraph company; another might have three sections of railway men and be called a Railway company; and so on; each company being capable of doing general work, and yet having its own speciality which would be denoted by its designation.

As regards the Survey companies the exceedingly good work done by them both in peace and war should not blind us to the fact that to the General rapid and clear reconnaissance, and not accurate survey, is of prime importance, and we cannot have too many officers or men trained for such duty.

Submarine-mining companies are not needed now that submarine-mining has been abolished or transferred to the Navy; and they have therefore been transferred to the category of Fortress companies, so far as the Regulars are concerned. Whether submarine-mining will not have to be resuscitated as part of our land service is at least doubtful; but if it is, it will be, I hope, as part of the duties of a Coast Defence Corps, which will include garrison artillery, submarine mines and search lights under one command.

We therefore require :—

(1). Field troops to accompany detached forces of cavalry or mounted infantry, capable of constructing bridges, tapping telegraph lines, and giving any general engineering assistance that may be needed,

(2). Balloon and Telegraph companies for the Lines of Information,

(3). Bridging and Railway companies for the Lines of Communication.

To the Bridging companies should be allotted the communications at the head of the army, *i.e.*, pontoon and comparatively light and hasty bridges. The Railway companies would have charge of all communications—roads, railways, bridges—from the base to the main body of the army.

Each engineer unit should contain officers and men capable of giving the skilled engineering and mechanical assistance which might be needed by the other arms, as stated above, at special defensive posts, for difficult water supplies, etc.

The Telegraph companies would work both telegraph and telephone lines; and by means of these would keep every part of an attacking force in close touch with the supporting troops and the commander. The telegraph lines would be run as far forward as cable carts can go; but beyond this point light telephone lines would be carried forward on drums by men, so that each battalion would be kept in touch with its neighbours, the reserves and the artillery. No one can have read the account of Spion Kop and other South African fights or of the Manchurian battles without seeing the enormous advantage that will be secured to any army which is thus bound together by a flexible chain of telephone and telegraph lines. In this way alone can the commander recover something of the personal control of the fight which at present he has lost; and by these means alone can the co-operation of infantry and artillery be perfectly secured and directed.

At present the Corps of Royal Engineers (excluding the Indian garrison) is composed as follows:—

3 Field troops.
3 Bridging companies.
3 Telegraph companies.
1 „ cadre.
1 Search Light company.
5 Balloon companies.
1 „ cadre.
1 Field depôt.
4 „ parks.
17 „ companies.
37 Fortress companies (including 17 ex-submarine-mining companies, of which 5 are local, and 1 other local company).
3 Railway companies.
4 Survey companies.
7 Depôt companies (of which 6 are double companies).
2 Militia battalions.
10 „ Submarine-Mining divisions.
31 Volunteer corps (including 7 Submarine-Mining divisions).

In place of this distribution I would, for the Regular units, propose the following :—

4 Field troops.
12 Bridging companies.
34 Telegraph companies.
18 Balloon companies.
1 „ cadre.
1 Railway and Search Light depôt.
12 Railway companies.
7 Depôt companies.

The Militia and Volunteer companies should be maintained with a similar proportion of duties.

Thus, if we had to send abroad a force of 8 Divisions (which Mr. Balfour, as President of the Imperial Defence Committee, seems to consider the largest expeditionary force we are likely to have to despatch in the first year of the most serious war that need be contemplated), we should be able to equip it with the following proportion of engineers, which I venture to think is not extravagant in view of modern requirements :—

| | | |
|---|---|---|
| 1 Field troop per Cavalry Brigade : | Total, | 3 Field troops. |
| 1 Bridging company per Division : | „ | 8 Bridging companies. |
| 1 Telegraph company per Brigade :* 1 „ „ „ Division (as Corps troops for connecting with Divisional headquarters, with cavalry, with other Divisions, and for general use) : 1 Telegraph section per Brigade of Artillery : | „ | 30 Telegraph companies. |
| 2 Balloon companies per Division :† | „ | 16 Balloon companies. |
| 1 Railway company per Division : | „ | 8 Railway companies. |

The proportion of Telegraph companies seems large, but it must be remembered that this branch is the only one which cannot be supplemented, when necessary, by labour from the other arms.

If instead of 8 Divisions we had to send 13 or more, as in the South African war, we should have (besides the Indian corps and the

* This has by actual test on Field days been found not at all excessive.

† At Nan-Shan, where the Russians had 15 battalions engaged, they had 10 balloons in use. A British balloon company can work one balloon.

contingents which the Colonies might supply) the following reserves to draw from :—

15 Service and 9 Depôt units or cadres.
2 Militia battalions.
10 „ Submarine-Mining divisions (which may perhaps be converted to some other branch of engineering duties).
31 Volunteer corps.

I do not touch on the question how this re-organized Corps could best be employed in peace ; many obvious suggestions will present themselves to the mind. But it is the war organization which needs to be first determined, and then the peace utilization will follow. The simultaneous discussion of peace and war arrangements only leads to a consideration of side issues and the consequent postponement of the important decisions affecting war efficiency.

## *No. 3 COMPANY 1st (BENGAL) SAPPERS & MINERS ON THE THIBET MISSION, 1903—1904.*

*By* Bt.-Major S. H. Sheppard, d.s.o., R.E.

Leaving Roorkee on November 15th, 1903, the Company arrived at Siliguri three days later, and was at once sent on to work on the new cart-road below Guntok.

About December 20th it moved to Guntok itself, and commenced work on the Guntok-Lagyap road over the Nathu La into Chumbi. The rest of December and the first part of January were spent on the first mile out of Guntok; this was ordinary heavy road work, with big cuttings and a great deal of blasting. In January, 1904, the 12th Coy., 2nd Q.O. (Madras) S. & M., moved on to Chumbi, and the 3rd Coy., 1st S. & M., took over charge of the whole road from Guntok to the Nathu La, being assisted by 1,100 local coolies.

The work went on quietly and well, in the finest of weather, until the middle af February, when the Company moved to Lagyap Pass, 10,000 ft., leaving the coolies at the third mile under supervision of Lieut. A. D. Walker, R.E., and a dozen N.C.Os. and Sappers. On February 16th the first heavy snow fell, and from that time until the middle of May the men worked in the greatest discomfort, often in two feet of snow or in freezing slush over their boots. At one time it was so cold that every party had to keep a huge fire burning near them, and break off for a few minutes in every hour to thaw themselves.

However, between February 15th and the latter end of April, the following work was accomplished :—

Two miles of entirely new 6 feet trace cut from thirteenth to fifteenth miles, and paved in the Sikkim fashion; four miles of new trace cut out roughly from 15th mile to Changu; the difficult and dangerous bit from 10th mile to 13th kept open and improved; meanwhile the coolies below had completed the cart road to the fifth mile, and improved the existing mule-track up to the tenth mile.

The system of paving referred to above is, apparently, peculiar to Sikkim and Assam, and is practically a continuous Irish Bridge; large stones or logs (the latter are best for hasty work) are placed on the outside and inside of the track, and the centre filled up with stones *on edge*, very firmly wedged and hammered in; the sharp points are then beaten smooth with a big hammer, and the whole covered with sand or gravel. This remains passable in any kind of weather, and lasts for years. A certain amount of maintenance is necessary to

keep earth spread over the stones, as otherwise mules and ponies are apt to lame themselves. On crossing to Champethang, 13,000 feet, ten miles on the Sikkim side of Chumbi, stones were difficult to find, so parts of the road were corduroyed with trunks of pine trees. Those of 9″ to 13″ diameter were chosen, as far as possible, and these were cut into 6′ lengths and laid parallel to and touching one another; such a corduroy, on a slope, has to be very firmly battened down by stout ribands at each side, or the logs will "creep," leaving awkward spaces between. This also requires to be covered with sand or gravel; otherwise the mules' feet wear off the bark of the logs and the stripped wood is very slippery in rain. I do not know of any kind of road, except Sikkim paving and corduroy, that would have been even passable during the torrential rains experienced in June and July.

On May 15th, the Company was split up; half remained with Lieuts. E. F. J. Hill and C. H. Haswell, R.E., in the Chumbi Valley; and a composite half-company under Capt. Sheppard, consisting of 60 rank and file from the 3rd Coy., 1st S. & M., and 20 rank and file (under Lieut. J. A. Garstin, R.E.), 12th Coy., 2nd S. & M., proceeded to Gyantse.

Lieut. Hill's party, for the next five months, were continuously employed on road-work on both sides of Chumbi; they also built some log huts at Champethang, as well as a log hospital, 100′ × 14′. The latter was made of logs laid horizontally, one on another, between uprights fixed at 10′ intervals; the walls were plastered with mud, and the roof made of weather boarding; this hut stood the rains excellently. This party also had an exceedingly difficult bit of road, about a mile in length and some 8 miles from Chumbi towards Gyantse, practically the whole of which had to be blasted out of granite cliffs.

Meanwhile the other half coy., under Capt. Sheppard, marched from Chumbi to Gyantse, with a small relief column commanded by Major Peterson, D.S.O., 32nd Pioneers, arriving at the latter place on May 24th, after having exchanged a few shots with the enemy *en route* at the village of Naini.

The garrison of Gyantse (*Plate* I., *Fig.* 1) were, at that time, subjected to daily bombardment from rifles, jingals, and small cannon mounted in the Jong, which dominated the Mission Post from a distance of about 1,000 yards. The effect produced by this bombardment was small, owing to the defences and traverses constructed by Capts. C. H. D. Ryder and H. McC. Cowie, R.E., who were on survey duty with the Mission. A strong house (known as Gurkha Post) had been taken by our troops a short time previously and converted into an excellent outpost; but on all other sides the Thibetans had occupied and fortified houses and villages, whence they harassed the *dák* patrols and foraging parties.

## CAPTURE OF PALLA VILLAGE.

The most serious menace was the fortified village of Palla, which was situated about 1,000 yards to the N.E. of the Mission Post; this village had been strongly loopholed and sangared; and with our glasses we could see its garrison preparing to mount jingals and small cannon, which would have enfiladed many of the defences of the Mission Post. It was therefore determined to storm Palla in the early morning of May 26th.

The attacking column was composed of:—

Two 1st line storming (explosive) parties, of one officer and four sappers each; two 2nd line ditto, some 30 yards behind; two assaulting columns, each of an officer and sixty men of the 32nd Pioneers; with a general reserve on Gun Hill, consisting of the rest of the half-coy. Sappers, two 7-pr. guns, a company of 8th Gurkhas, and a company of 32nd Pioneers.

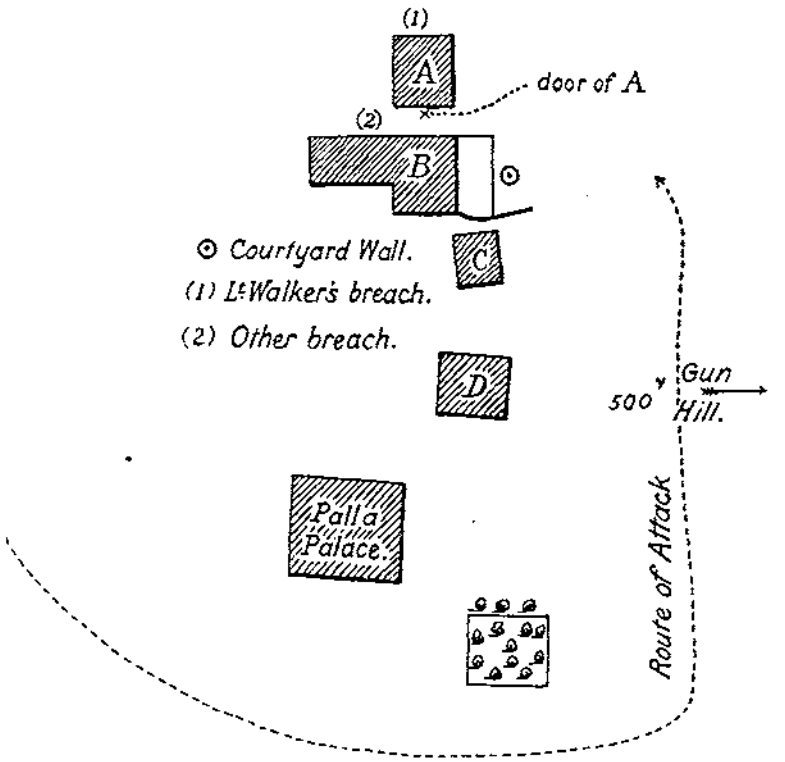
It was decided that the attack should be delivered on the side furthest from the Mission Post, as it was hoped that the defences might be weaker on that side. The orders were that houses **A** and **B** were to be tackled first, and that, when breaches had been made by the explosive parties, the assaulting columns should at once enter them and storm the houses.

The night march was commenced at 2.30 a.m., a long circuit being taken to the south; it was carried out very successfully, and the column arrived within 300 yards of their objective before the garrison had any inkling of attack. The storming parties then approached the village, and arrived safely at the courtyard wall shown in sketch; they then separated, No. 1 going round **A** and blowing in a breach at **1**, whilst No. 2 made an opening at **2** in house **B**; No. 2 party was also fortunately able to secure the door of house **A** on their way.

The storming parties then went back to collect and direct the assaulting columns; but it was found that the latter, owing to the darkness and the heavy fire, had gone astray, and only about twenty men in all (Sappers and Pioneers) could be found. With these it was impossible to assault both houses, so it was determined to take **A** only at first. On reconnoitering this, it was found that the defenders (some 50 or 60 Thibetans) had taken post on the upper floors and roof, carrying the ladders up with them. A box of guncotton was therefore exploded in the centre of the ground floor; this killed or buried half the garrison, and the rest were either bayoneted in the house or shot as they fled.

A good many casualties occurred doing this fight, and shortly after the capture of the house **A** our force holding it consisted only of two British officers (Capt. Sheppard, R.E., and Lieut. Gurdon, 32nd Pioneers), eight Sappers, and eleven Pioneers unwounded; Lieut. Garstin, R.E., had been mortally, Capt. O'Connor, R.A., and Lieut.

Mitchell, 32nd Pioneers, severely, and Lieut. Walker, R.E., slightly wounded, also one Sapper and four Pioneers wounded; and nearly every man of the storming parties had been hit with stones and heavy bricks, and was more or less knocked about. Under these circumstances, it was only possible to hold house A, and look out for counter-attacks from the Jong.




Meanwhile Major Peterson, 32nd Pioneers, commenced an attack on Palla Palace and house D; and with the aid of the guns from Gun Hill, took both with small loss. Houses B and C then surrendered. Some sappers did good service in carrying down boxes of guncotton, under fire, from Gun Hill to Major Peterson's party.

The first thing required after the Palla fight was a bridge over the river, as the Thibetan bridge was rendered unsafe by the guns from the Jong. The width of the river at that time was about 150′, with numerous subsidiary streams; the only timber available was that obtained from houses in the vicinity, none of which exceeded 15′ in length. So a bridge of crib piers, with numerous short spans was decided upon, and was constructed in three days with the aid of working parties from the troops (*Plate* I., *Fig.* 2). It lasted until after the Jong was taken, when there was no further need for it as the Thibetan bridge was available.

Having completed the bridge, a covered way to Palla (now converted into an outpost held by the 32nd Pioneers) was taken in hand. As this had to be made through perfectly open ground, with no cover of any sort and only 600 yards from the outlying houses and gardens at the foot of the Jong, it was impossible to construct it entirely by daylight. At dusk tracing tapes were stretched along the ground in the required direction, and just before dark working parties were extended, the men being at 6′ intervals; each man then dug a hole 3′ × 3′ × 3′. Next morning, just before light, these holes were occupied by working parties, who joined them up to one another, thereby making a continuous trench 3′ × 3′; another working party in rear widened and deepened the work of the day before. In this manner the covered way was completed in about four days, with only one casualty, though the Jong kept up a continuous fire on the working parties. The covered way **B** was easy, as it was fairly well protected by trees, and so could be got out in daylight; both **A** and **B** were eventually made 6′ wide and 4′ deep, with numerous crossing places 8′ wide.

The 8th Gurkhas had already constructed a brick and sod wall as a covered way (**C**) to their Post; but on the Thibetans occupying a house some 400 yards beyond the Post, this wall was enfiladed, and had to be re-built in zigzags. This work was done in one day, under a very heavy though erratic fire from the Jong, during which one sapper was killed by a dropping bullet.

Besides the above, many other operations were carried out. Palla was fortified, and all outlying houses demolished; many villages and fortified houses in the neighbourhood were dismantled; a machicouli gallery was built, under heavy fire, in the Gurkha Post; the defences of the Mission Post were improved and strengthened; portions of the enemy's water supply were cut at night; and many trees between the Mission and Gurkha Posts were cleared away. The latter work had to be done after dark, as the trees in question were only half a mile from the Jong; and once the cutting party were in considerable danger, as they only returned to the Post half an hour before a night attack was made by the Thibetans over the ground where the trees stood. The enemy several times attempted to fill in the Palla covered way, and once managed to flood a portion of it, but communication was always quickly restored.

On June 26th Brig.-General J. R. L. Macdonald, R.E., in chief military command, arrived with a relieving column, having stormed Naini Monastery *en route*, and the next event of importance was the taking of Tzechen Monastery. The 8th Gurkhas attacked this from a ridge to the south, while the 40th Pathans and Sappers made a frontal attack across the plain. The fire was very heavy, though wild; the monastery and fort on the top of the hill were reached with the loss of one officer only (Capt. Craster, 40th Pathans) by the

frontal attack, though the Gurkhas had several casualties on the ridge.

The large charges of guncotton (whole boxes) used at the Palla fight had apparently inspired the Thibetans with a wholesome terror of the explosive, and it was found that they never again stood in a house after an entrance had been effected by the help of guncotton. In this case they retreated from the monastery into the fort as soon as the doors of the former were blown in, and from the fort into the open as soon as an entrance was made into the latter; they were then immediately shot down by the maxims and mounted infantry, who were in readiness on that flank.

Between this fight and the capture of the Jong a new bridge was built across the river, about two miles below the Mission Post. The volume of water had increased considerably, and the river had now a somewhat formidable current; so a place was chosen where there were two subsidiary streams and the main one was narrow and deep. The latter had a span of 45′, and the longest timbers available were only 22′; the current was too swift for a crib pier to stand in it; so both sides had to be cantilevered out until only a 20′ span was left. This was a matter of some difficulty as only 12′ timbers were available for the cantilevers, and only about 2½′ was gained by each layer. However, by continual anchoring and the use of very large stones, the structures were made very solid; and, as a precaution, tension ties were added, passing over a frame 8′ high in the clear, the ties being made of 6 strands of 14 B.W.G. tripping wire (see *Photo*).

## CAPTURE OF GYANTSE JONG, 6TH JULY, 1904.

Three columns were told off for an assault on the Jong on the night of the 5th—6th July, all under command of Lieut.-Colonel Campbell, D.S.O., 40th Pathans.

The plan was that the three columns, with objectives as shewn in *Plate* I., *Fig.* 3, should emerge from behind Palla Post about 3 a.m., surprise the enemy, and obtain a lodgment in the town at the foot of the Jong by dawn. In order to do this it was necessary to take the Chinese house—a very strongly fortified double-storied building with a high courtyard wall in front, barred by a very strong entrance gate.

With each column as explosive party was a detachment of 12 Sappers under an R.E. Officer, explosives being also carried by the infantry. Each column was composed of two companies. The centre column in addition had one 7-pr. gun.

The left column gained its objective with slight opposition; but the centre and right ones were discovered by the enemy when 200 yards or more away from the Town, and a heavy direct and cross fire was opened on them. Seeing that the Chinese house could not now be

taken by surprise, the centre and right columns effected a lodgment in garden (3), where they had an uncomfortable time, as there was no back wall and therefore very little cover from the close fire of the enemy. However, just as dawn was breaking, the 7-pr. got a couple of double shell on to the roof of the Chinese house, and, while the garrison were temporarily demoralized by this, the Sappers took the opportunity to blow in the courtyard gate; the house was then stormed, and the enemy quickly vacated the rest of the town. A heavy fire was kept up from the Jong while these operations were in progress, but after the Town was taken the greater part of the enemy left the Jong also. The Sappers were employed till noon in making a covered way (by breaking through the walls of houses) through the town, to connect the various pickets which had been posted. After this, the 10-pr. guns shelled the curtain wall, making the breach marked X; and this was most gallantly stormed by the 8th Gurkhas at 3 p.m. All further resistance ceased soon afterwards.

## CROSSING THE BRAHMAPUTRA.

### CHAKSAM FERRY.

On the way to Lhasa the Brahmaputra was crossed at Chaksam. The stores available were :—Four Berthon boats with superstructure for two rafts; two Thibetan ferry boats, shaped like large oblong boxes and capable of carrying 50 armed men or 22 mules at a time; a few Thibetan skin boats, capable of carrying 1,600 lbs. of stores or 10 armed men; also 200 yds. of 1″ steel cable and one traveller, and about 640 lbs. of 2″ and 1½″ manilla rope besides the ordinary equipment ropes (*Plate* II., *Figs.* 1 and 2).

Round Rock A, owing to the confluence of the two streams, the force of the current was terrific, and large whirlpools suddenly formed. These latter were a source of great danger to the Berthon boats, in one of which Major Bretherton (Chief Transport Officer) was drowned.

The crossing was commenced at mid-day on the 25th July, by rowing only, the Berthon boats being made up into rafts. This method was very slow, as the big ferry boats were occasionally unable to make the opposite shore; when this occurred they were carried beyond the island, and had to be towed up for nearly 1½ miles along the north bank.

On the 26th several efforts were made to get a line across, but all failed owing to the tremendous force of the current; the boats were therefore rowed over as before. The river having risen during the night, many boats were carried down stream, and by the end of the day only 14 boatloads had been put over in twelve hours of unremitting work. After the accident in which Major Bretherton lost his life, the Berthon rafts were given up and single boats used;

these were found to be much more economical in time than the rafts, and also less dangerous.

In the early morning of the 27th a line was got across in the following manner at the third attempt:—Two of the Berthon boats were anchored out as far as possible from either bank, and connected by a line; the two other boats then came out from opposite shores, bringing lines; on approaching the anchored boats, they threw the ends of the shore lines to their occupants, who joined up with their own connecting line.

Having got the line across, the 1″ cable was hauled over and made fast to the top of rock A, which was about 20′ above the water; the other end was passed over a trestle 10′ high at B and fixed to an anchorage. For the passage of every big boat, one end of a 2″ manilla rope was sent across from B to A, the other end being held on the shore at B by 60 coolies; the end at A was then fixed to the boat, which was then swung and pulled across with the aid of the traveller on the cable. The rate of crossing by this contrivance was at once increased to 40 boatloads a day; and the passage of the whole force—3,500 men, 3,500 animals, and 800,000 lbs. of stores—was completed in 5½ days.

## PARTE FERRY.

On the return march of the Mission after the treaty had been signed in Lhasa, the half-coy. was allowed to go ahead to the Brahmaputra with one company of Gurkhas and 300 of Capt. Ross's coolie corps in order to prepare for the re-crossing of the force.

On arrival at Chaksam, it was found that some wire rope and other stores, which had been urgently indented for from India, had just arrived; this was very fortunate, as, except the wire rope and traveller, none of the stores used on the outward journey were trustworthy after continual use at the ferry for six weeks.

The stores now available were therefore:—One 1½″ steel cable, 250 yards long, with traveller (this latter was, however, too heavy to be of any use, as it weighed over 80 lbs.); one 1″ steel cable, 170 yards long (30 yards had been broken off), with traveller; 320 lbs. each of 2″ and 1½″ manilla rope; 320 lbs. spikes and nails; 320 lbs. plain wire; remainder of rope, blocks, etc., in equipment; boats as before.

A new and better ferry than Chaksam had been discovered at Parte, 11 miles up the river, so it was decided to move there by river with all boats, stores, etc., towing the big ferry boats. This proved a difficult and at times dangerous business, as the river ran very swiftly round the points, and the big boats leaked badly; the latter defect was remedied by cutting up a couple of Thibetan skin boats and nailing the leather over and around the bows of the others; and,

after many minor accidents, the boats arrived at Parte safely on the third day.

It was at once decided to make *two* ferries; one at **AB**, span 105 yards; the other at **EF**, distance from bank to bank 140 yards and 170 yards between points of support of wire rope (*Plate* II., *Figs.* 3 to 7).

The $1\frac{1}{2}''$ wire rope was stretched across the lower ferry, and the $1''$ rope at the upper crossing; with such a big span as the latter, it would have been difficult to stretch the heavier rope taut enough to keep it out of the water. The light traveller was used at the lower ferry, and an ordinary single block at the upper.

Very large piers had to be made. They were constructed of gabions 5′ high, sunk so far out that their tops were level with the water; the gabions were filled with stones, and anchored back with wire, the space between them and the shore being filled up with stones.

In addition to the two swinging ferries, a service of Thibetan skin boats was arranged, working from **C** to **D**. These rendered excellent service, as each could take 10 armed men or 1,600 lbs. of stores at each trip.

Attempts were made to swim the mules over; but it was finally found quicker to take them across in the two ferry boats, which took 22 mules and kits (not loads) at a time. Three Thibetan skin boats, tied behind each ferry boat, took stores, kits, etc.; and a few mules were swum behind the rear skin boat at each trip.

The lower ferry, **AB**, was easily worked, the boats being pulled across by parties of 40 men. The distance was only 105 yards, and the stream was sluggish and deep. One end of a 150-yard $2''$ manilla rope was made fast permanently to the bow of the ferry boat, and the free, or towing end, was attached to the traveller and pulled across the river by the traveller wire; the towing party detached the $2''$ rope and pulled it taut, and the boat was then partly swung, partly hauled, across. The instant the boat arrived at pier **B**, the free end was again attached to the traveller and hauled over to **A**, and so on. We found that the rope parties never had to keep the boats waiting, the rope was always ready to pull before the boat had finished loading or unloading.

One difficulty was experienced (*Fig.* 6). Owing to the force of the current, it was impossible to undo the free end of the towing rope from the traveller on arrival, so a stopper rope was employed; on arrival, the end of the stopper rope was undone, and pulled taut until the towing rope was loose enough to be unfastened.

Five boatloads could be passed every hour, if the boats could be loaded and unloaded quickly enough; but generally the rate worked out at about $3\frac{1}{2}$ boatloads per hour.

The arrangements at the upper ferry were rather more complicated,

and were far more difficult to work owing to the great span and also to the fact that there was a very fierce current at the spot. Here *two* towing ropes had to be employed, and the free ends, when sent across, were attached to the bows of the boat, one rope for each side of the river. When the boat was at rest at pier "*d*," being loaded, the free end of one towing rope was attached to the block at **F**, hauled across and tied to the bow of the boat, its other end being held by 50 coolies on the bank at **F**. As the boat left pier "*d*" to be swung across, the free end of the second towing rope was attached to the block at **E**, and hauled across to **F** so as to be ready to be tied to the bow of the boat when unloaded at pier "*c*"; its other end was held by 50 coolies on the bank at **E**. The same procedure was followed when the boat was swung back. So a boat was always being swung across by one towing rope, while at the same time the free end of the other rope was being sent over on the block to swing the boat back.

Wire ropes, of eight strands of 14 B.W.G. each, were used as towing ropes, as it was found that the force of the water was so great that 2″ manilla ropes could not be hauled across at all. Stopper ropes were employed as at the lower ferry.

The working parties were as follows :—

At **A.**—Swinging party, 40 coolies, also worked stopper rope; traveller wire, an equipment mule. At **B.**—Swinging party, 40 sepoys, also worked stopper rope; traveller wire, 12 sepoys. At **E.**—Swinging party, 5 coolies; stopper rope, 20 coolies; traveller wire, 15 sappers. At **F.**—Swinging rope, 50 coolies; traveller wire, 20 coolies or sepoys; stopper rope, 20 coolies or sepoys. All these parties were supervised by a Sapper N.C.O. There were also numerous small parties to place gangways, secure and loose boats, etc.

A regular average of 3½ boatloads an hour was sent across the upper ferry.

The force began its passage at 11 a.m. on the 27th September; and, working till late on 27th and 28th, the whole were across in a little over 48 hours with no serious accident or hitch of any kind.

The march back to India was devoid of any engineering work of importance. The Chinese wall at Yatung had to be destroyed. The wall was 20′ high and 24′ thick. Thirty yards of it, and a very large and massive gateway, were destroyed with 180 lbs. of guncotton, fired electrically (see *Photos*).

Gyantse was reached on October 6th, and Chumbi on the 18th. Here the other half-company rejoined the Lhasa party, and the whole marched for Siliguri on the 25th, reaching that place on November 3rd and Roorkee on the 7th, after an absence of a year all but one week. The health of the Company was extraordinarily good throughout the campaign.

# *ARMY RAILWAY ORGANIZATION.*

*By* Capt. L. E. Hopkins, R.E.

The following is written without any idea, beyond what I know by hearsay and observation, of what may or may not be the official policy in England or India. It is merely a study of the question, made to fill up many days of inaction during the frequent blizzards in Baluchistan of January and February. Many points are no doubt not new, but the analysis of the conditions of the problem, and the scheme as a whole, especially the non-military nature and the organisation of the Railway Corps for India, and many other minor points have perhaps new features. If any of those who took part in the stupendous railway operations undertaken by the Corps in South Africa disagree with my conclusions, I think it will be because they wrongly apply the special conditions of that war on considering what peace railway organisation is required in furtherance of the essential objects for which the Home and Indian armies are maintained.

The increase in the size of modern armies in civilised warfare has made it impossible to provide for their requirements over a long line of communications without a railway. It is not a question of money: it is simply that it cannot be done with animal transport. Our former expeditions, into Afghanistan for instance, were on a very small scale; and the troops were able to live to a great extent on the country, where an army of 150,000 men would be able to find nothing. In less ambitious wars, the advance to Khartoum in 1898 has provided an illustration of how much cheaper it is to advance with a railway and, in the case of pacification of a new country, how much more conducive to success. In South Africa, and again in China, it became necessary to take over and work long lengths of existing railway in a hurry, and attention was thus drawn to the question of providing previously organised railway labour for such emergencies.

The problems with which we have to deal are the repair of railways captured or recaptured from an enemy and partially destroyed by him, and the working of them; the construction and working of new lines for the use of an army in the field; and the construction and maintenance of fortress railways in peace, and of siege railways, field railways and railways in prepared defensive positions during war.

To take the last of these problems first, we are at once confronted with the question of narrow gauge lines, which have somehow become earmarked for railways in fortress and field. The adoption of the

narrow gauge is usually justified by its adaptability to steep grades and sharp curves. The permanent way and rolling stock are no doubt suitable for very sharp curves, but the light locomotives suited to light military permanent way are quite useless on any grade steeper than $\frac{1}{100}$ and not much use at that. We have here (at Nishpa, Kelat) an ordinary four-coupled military light 2′ 6″ gauge locomotive, which was intended for use in pushing small skips of spoil in or out of the tunnel headings; and though the steepest grade was only $\frac{1}{85}$, and the road very good and laid with 41¼-lb. rails, it was found much easier to push the skips in and out by hand. I think we had the engine in steam twice only, and she is now locally known as the "coffee pot." Broad gauge locomotives and rolling stock with 14 ft. wheel base will work over 400-foot curves without any difficulty, as I know from experience; and they can of course negotiate heavy grades up to $\frac{1}{25}$ far better than light locomotives.

It is also supposed that a narrow gauge line is quicker to platelay. But as speed in platelaying depends on supply of permanent-way material, not on weight of rail, and as the supply of that material must depend on "coffee pot" locomotives working on heavy grades, it may be admitted at once that there is not likely to be much advantage in the long run for the narrow gauge. It would tax the resources of a broad gauge single line, with grades not steeper than $\frac{1}{50}$, to supply the wants of an army of 150,000 men in the field, which would probably amount to from 2,000 to 3,000 tons a day. Now it is said that a light 2′ 6″ locomotive can draw 30 tons net over $\frac{1}{40}$ grades; I doubt it, but for the sake of argument, 30 tons at an average speed of 8 miles an hour including stops, and with crossings four miles apart, gives one train per hour each way, or say 16 trains a day each way; and the total freight delivered at railhead will be 16 × 30 or 480 tons for single-engine trains and 1,440 tons for treble-engine trains, which, though a very sanguine estimate, is a long way short of 3,000 tons. A light narrow gauge locomotive on a line laid on ordinary country roads, with possible grades of $\frac{1}{15}$, over light rails hastily chucked down anyhow, would certainly not pull more than 10 tons.

The Germans think that they will be able to use their light narrow gauge material on such level highways as are to be found in the plains of Germany. In my opinion they are, as usual, backing theory too heavily; and they take no account of the utter unreliability of light rails and locomotives and stock, the narrow margin of power, the fact that a hastily made line has very inferior carrying capacity, that couplings smash and axles break, and that the light trucks and engines derail very easily. Narrow gauge railways are meant for such jobs as running about Woolwich Arsenal and big engineering works, where grades are easy and sharp curves are essential; but under ordinary circumstances they cannot compete with equally well-run

broad gauge lines, and when it is a question of using native oriental labour, the difficulty of maintaining narrow gauge lines and locomotives in the high state of efficiency necessary to make the most of them is a very great disadvantage.

Permanent fortress lines should always be broad gauge. Field railways on the narrow gauge are no better than animal transport and are only justifiable where grades are known to be dead flat. The Germans have sunk money in the purchase of narrow gauge material for war purposes; but they are not infallible, and I think the money would be better employed elsewhere, if for no other reason than that the multiplication of types of permanent-way material, locomotives and rolling stock is undesirable and prohibitive. The only thing one can say in favour of light narrow gauge locomotives is that they do not get sore backs; but then a mule generally "gets there" somehow, and a "coffee pot" as often as not will not arrive for some days.

The speed of trains on narrow gauge lines is another very serious consideration. Although on heavy grades there would not be much difference, on easy grades narrow gauge light lines would not ordinarily stand a speed of over 10 miles an hour, where a broad gauge line under similar conditions of track might bear a speed of 25 to 30 miles an hour.

Commercially speaking narrow gauge railways have sometimes been made a moderate success, but only with heavy 40-lb. rails and heavy 25 to 30-ton locomotives, which of course alters the case entirely. As a matter of fact the only successful lines have been those with easy grades and curves. In nearly all cases rates charged are double and treble those in force on broad gauge lines. Working expenses are high, and the cost of hauling a ton one mile is about treble the cost on broad gauge lines. Of Indian lines the Barsi 2′ 6″ gauge railway has $\frac{1}{100}$ grades and not much of that and 600-foot curves, and its working expenses are 60 per cent. of gross receipts. The Darjeeling-Himalayan, with 20 miles of mountain line on $\frac{1}{28}$ grades and 60-foot curves on a 2′ 0″ foot gauge, pays its dividends largely out of a heavy rice traffic on the 12 miles of line in the plains and by charging rates ten times as high as those in force on broad gauge lines in the plains; by these means it is able to pay 8 or 9 per cent. on its capital, having been very economically constructed along an existing cart road. The Kalka-Simla railway was no doubt made possible by the adoption of the 2′ 6″ gauge with its sharp curves, but a simple arithmetical calculation will show that it can never possibly pay half the guaranteed interest. The Morvi line is successful on account of its easy grades and curves. In fact it is practically certain that, in most of the situations where narrow gauge lines have been successful, lines on the same gauge as, and worked and constructed by, the parent line, with old rails and engines and at slow speed, would have been at least equally successful.

Narrow gauge railways for siege and field fortification purposes may perhaps be justified on the ground that they can be readily run in trenches in connection with hand-pushed trucks and that they generally require less cover for concealment and protection; but from every other point of view the broad gauge is first and the rest nowhere.

Having attempted to deal with the question of gauge, let us consider how Continental Powers meet the railway problem, and what are the conditions which have led up to the organisation of their railway troops. Continental armies possess numerous railway troops. Their position is this;—they expect to capture railways in foreign territory, where, on account of the whole population being actively or passively hostile, they would be compelled to provide every single man of the staff of the lines which they wished to work.

In the German army, railway troops form in peace time a brigade of three regiments, with an aggregate of nearly 4,000 men, under the command of a Major-General. These form a nucleus which is quadrupled for war by taking in men from the reserves who in peace time are civil employés on the State Railways. They include traffic and construction companies; and it is even considered necessary, for the reasons above stated, to provide large gangs of labourers for loading and unloading and work of a similar nature. In peace time the railway regiments work the Berlin-Juteborg Railway, 27 miles long, which in war time would be worked by their depôt companies. In war it is their duty to put in order railways captured from the enemy, and to work them until they can be handed over to the above-mentioned traffic detachments called out from among the State Railway employés.

France by contrast has only one regiment of railway troops, of eight companies. Volunteer railway detachments, enrolled from among the employés of the principal railway companies, are relied upon; these are civilians, and are exempt from military service. There are six of these detachments, each totalling about 1,300 men, and they are capable on mobilisation of taking over the entire working and maintenance of 1,600 miles of double-line railway.

The Russian army has four regular railway battalions, two employed in working the Trans-Caspian lines and one on the Central Asian Railways. They are sub-divided into 17 engineer and 27 traffic companies.

Of these three systems the German seems to be the best organisation on paper (assuming the figures in the paper on "Engineers and their Duties" in Vol. XXV., 1899, of the *R.E. Professional Papers* to be still correct). But the 4,000 men on the peace establishment cannot possibly get much training on the 27 miles of the Berlin-Juteborg line; and to an Englishman it would seem unnecessary to

militarise the men they take in from the staff of the State Railways. It would probably be better to follow the French idea of a small number of regular railway troops for service at the front, and to rely on previously organised but unmilitarised civilian labour to take over the working of captured railways.

The Russians have the largest number of regular railway troops; but those in Russia proper seem to have no training, and those in Trans-Caspia and Central Asia must be practically civilians, and it is not quite clear how they can be relieved of the duty of running the Trans-Caspian railways and put on military duty at the front. The Russians have not, or had not in 1899 (see *R.E. Professional Papers*, Vol. XXV., 1899), any organised civil railway detachments.

The Germans and French seem to know what they want, and the latter seem most likely to be able to meet their wants in war time. They both recognise that for working railways in a hostile European country they must have a complete staff ready. Their scheme does not provide for the rapid construction of long lengths of communication railways, and they do not require to provide for the construction of anything more than siege lines and temporary diversions of, at most, a dozen miles or so. The Russians on the other hand seem to be muddling along somehow in much the same way as the journalists seem to think that we do in England.

The question of what we in England want in the matter of military railway organisation depends on conditions very different from those sketched above. Our Army may be divided roughly into the Home* and the Indian armies. The duty of the Home Army is primarily the defence of England; and, to a certain extent, the defence of the Colonies and naval bases, which are however more under the charge of the Navy. In a secondary position there are such unforeseen affairs as the Boer Wars, the recovery of the Soudan, and the settlement of such countries as Egypt, the strategical position of which forces them upon our notice. The essential duty of the Home Army is however the defence of England. There is no question of invasion of European countries and capture of railways in hostile territory; there is a remote contingency of invasion of countries adjacent to our Colonies, and of "Striking Force" expeditions on the continent of Europe; but there is no call to provide railway organization for these affairs.

All that we require then in the way of railway troops is a sufficiency of companies for running fortress railways in England and at the Colonial military and naval bases. Railway troops may also be required for such work as was necessary in South Africa, in China, and in Egypt in 1882. These are however really unimportant affairs;

* The term Home Army is intended to mean the force charged with the defence of England and the Colonies.

they do not call for expenditure on elaborate preparations. They are not essential. It is quite sufficient for the above-mentioned duties to provide 3 or 4 railway companies of the existing type, each capable of repairing and working 25 miles of line and of undertaking siege and fortress railways.

For the defence of England itself, however, there are some other railway preparations which are essential. The civilian management of the great English railways should in case of invasion come under the orders of the Commander-in-Chief. The existing management can best carry on the railway work after an invasion, whether it is a question of repairing lines destroyed by invaders or of working military traffic. The Managers should however be in touch with the War Office in peace time, and they should be informed what is expected of their railways in the way of troop trains on mobilisation. Details of defence of lines, and of the co-operation of railway and military officials in war time through the medium of Railway Staff Officers, should be worked out and settled in such a way that there will be no hitch at the critical moment. If it is considered necessary to have military control over a large amount of labour for construction and maintenance, the Railway Volunteer Staff Corps provides an organisation ready to hand and requiring little elaboration.

The question remains whether military railway troops should be kept up for such chance occasions as a Suakim-Berber Railway or Soudan Military Railway. I do not think anyone would recommend such a proposal, taking into account the following considerations, together with the above-mentioned fact that such things are outside the real object for which the Home army exists. Military labour, being in the nature of forced labour, can never compare in efficiency with voluntary civil labour. Civil labour can always be obtained by paying for it, and it is cheaper to pay a high price for a special work and have it well done than to keep up continual expenditure on military railway troops and perhaps get the work not so well done in the end. For really large railway enterprises it would be out of the question to keep up sufficient railway troops to be anything more than a mere drop in the ocean of labour required. The Suakim-Berber Railway did not fail for lack of military railway troops, but on account of the difficulty of the undertaking and the hostility of the natives. It is better to let the military work be done by soldiers and the civil work by civilians; if the first is done properly, there will be no difficulty about the other.

In short for the Home army there is no justification for keeping up more railway troops than 3 or 4 railway companies of the present type. Their *personnel* should be soldiers first and railway men afterwards. They should largely confine their duties to the maintenance and construction of siege and fortress railways, and should work out the details of such affairs in conjunction with the fortification and

artillery branches. They should all be skilled men ; it is waste of money to keep more labourers than is absolutely necessary. The officers of railway companies might divide the duties of Management, Traffic, Engineering and Locomotive Work, and specialize themselves in one or other of these subjects as far as possible with the means at their disposal. The non-commissioned officers should divide the duties of Loco. Foremen, Station Masters, Permanent Way Inspectors, Carriage Examiners, Vacuum Brake Inspectors, Engineer Overseers, and Storekeepers. The men would be enlisted as Drivers, Shunters, Foremen, Platelayers, Signallers, Clerks, Masons, Smiths, Carpenters, Fitters and Gangers. The railway worked in peace time should have some definite purpose, should run from somewhere to somewhere instead of having both ends in the air ; there should be a regular service of trains over it and public traffic attracted. A depôt should run the line when the companies are mobilised.

The organisation should be on the idea that the companies, on arrival at their siege or other work, should make use of local labour as platelayers, porters, shunters, cleaners, coal heavers, and all the unskilled jobs. In nearly all countries in which our army is likely to operate such local labour will be procurable ; in Egypt, South Africa, China, anywhere almost outside of Europe and the United States, there will be no difficulty about it. With this idea there will be no occasion to train men to lay rails quickly. Laying permanent way can be very quickly learnt by intelligent men ; and its speed depends mostly on the state of the rolling stock, the supply of material, the number of labourers employed, and the organisation for feeding them and giving them sleep.

The Loco. men must be carefully trained in driving, cleaning and repairing engines and rolling stock under all conditions of bad water, bad fuel, heat, cold, snow, defective valves and defective brake power on heavy grades. There is as much difference between driving an engine and being a first-class driver, as between riding a horse and being a good horse master. Then there are such things as derailments ; and re-railing a 60-ton engine cannot be done off hand by anyone. Foremen Platelayers require some slight experience to keep a line in good order. Traffic work is mainly a question of common sense and discipline ; but, even so, Station Masters and Signallers require practice and especially a knowledge of principles as laid down in any Railway General Rules. Though engineering is, as an old platelayer said, largely a matter of brute force and stupidity, still there are such things as laying points and crossings, handling high explosives and riveting girders, which cannot be properly carried out without some practical experience.

I have no information on the subject of the existing railway companies except such as is given in *War Establishments* and the *Equipment Tables*. The omission from the latter of "Safety

Fuze" (unless I am mistaken) and the provision of 100 yards of "Instantaneous Fuze," which is not a widely-used article and not a necessity, seems curious. Electric exploders and all their paraphernalia might well be omitted as unnecessary and too cumbersome for war service. To the equipment might perhaps be added re-railing ramps, suitable for rails of from 60 to 80 lbs. per yard, and drivers should be taught how to use them ; I have seen a first-class European driver trying to re-rail his engine with his ramps upside down and wrong way round. The three-inch (?) hemp hawsers, which appear to be the largest provided, would not be of much use for re-erection of damaged girders.

We can now consider the requirements of India. The duties of the Indian army are the defence of the North-West Frontier—the North-East Frontier need not be considered—and ultimately perhaps the maintenance of British Power in India itself. It is however more usual to consider British power maintained by law and police, and the army retained for external defence. This at least is the view of the "British Public" as laid down in the *Spectator*, founded no doubt on the recent redistribution of the Army in India.

The whole of the railways in India are worked by native labour, and in the event of serious internal disturbances the movement of troops might be at the mercy of the natives. If then we are to apprehend any serious, widely-diffused and well-organised revolution in the country, we are bound to make arrangements for the supply from England of a large number of military railway troops ; for it would be out of the question to expect civil labour, scattered over the country at the mercy of every rebel and unorganised for resistance, to carry out the work required. But conjecture fails to say what would happen if we were reduced to such a state of affairs in India. The fact is that though we hold India to a certain extent by force of arms, we mainly hold it by force of good government ; when that government shall have become so distasteful to the people as to bring about a general rising, which it has also been unable to foresee and check, it will be time we cleared out of India and that quickly. We may therefore dismiss the possibility of having to work the Indian railways by military forces in time of internal disturbance.

Then there is the question of sending railway troops out of India to work railways captured in foreign territory, as happened in China. Such work is entirely outside of the legitimate purpose of the Indian army. It was no doubt inconvenient that no railway troops were available in China, and this appeared much more so from the fact that the other Powers all had railway technical troops in their pockets so to speak. But it is probable that, if they had been pressed, the Railway Department of the Government of India could have supplied *personnel* and *matériel* without the least difficulty.

The main purpose for which the Indian army has to be maintained

is the defence of the North-West Frontier. In the event of war it may be necessary to advance the defensive frontier some 400 miles more or less beyond the present political frontier, and it is therefore essential to provide for the very rapid construction of railways in support of that advance. As a maximum to be aimed at, it should be possible to push forward 200 miles of line simultaneously into both Northern and Southern Afghanistan within twelve months. It is useless to conjecture what might or might not be the relative positions of the Indian and Russian armies at the moment of declaration of war and soon afterwards, what might be the position of Sistan, or which would be able to seize Herat first. But it may be assumed that, in the event of war and an advance into Afghanistan, we should either go there as allies or would, at least at first, only have to contend against Afghans. For this reason it seems unlikely that a force of more than 50,000 men would leave the Indian railhead at the commencement, such a force in fact as could be maintained in the field at a distance of 100 miles from railhead by means of animal transport alone and by relying largely on local supplies of grain, fodder and forage. That 100 miles across the frontier should be practically as quiet as the 100 miles on the Indian side; if not it is the business of the advance force to make it so; and until that is done there will be the greatest difficulty in making a railway. If the conditions make it necessary for convoys to have larger escorts than is required for mere watch and ward, it will be a difficult matter to construct a railway. I do not think it will make the smallest difference whether we use military labour or civilian labour with military escort; the work will not get done.

The conditions of the advance will remain the same until the main armies are within striking distance of each other, that is to say there will be an advance force of about 50,000 men on either side while the main armies advance with railheads. For of course the Russian advance will have to be made on a similar plan; and for this very reason it has come to be recognised that the fantastic ideas expressed by some Russian Generals, that India might be attacked by a vast horde of Cossacks working independently in imitation of the old days, are quite insupportable. Even if such an invasion were successful at first, it could never do any good in the long run, and without the support of a large army and railway the force would be simply annihilated. By the old methods of attack on India the attacking force annihilated in one decisive battle the feeble resistance they met, and then proceeded to settle down and make themselves comfortable; and there was no question of reinforcements for the defenders from their base on the sea, as would now be the case. Their case was always like that of the first invaders of India, the Saracens, who, on their arrival in Sind, received orders from the Khalifah Suliman at Bagdad to "sow and sweat wherever you may find yourselves on

receipt of this mandate, for there will be no more Syria for you"; and in Sind their descendants have been ever since, and still form part of the nondescript population of that country and Baluchistan.

Provided that the enormous quantity of necessary stores have been prepared beforehand, some 20,000 labourers and a large administrative staff will be required to construct these lines-of-communication railways as rapidly as possible. To work them a further provision of labour will be necessary. It is a question whether all this labour can and should be military or civilian.

The sole advantage of military labour for construction is that it is amenable to military discipline, that it is always ready, and has to go anywhere and do anything it is told. Another point put forward as an advantage is that it can defend itself and does not require escorts. This latter seems to be a misconception. In the first place the labour constructing the railway should, as pointed out above, be free from anything worse than the attacks of robbers or raiders, capable of repulse by small guards and local levies; if it is not, the railway will inevitably not progress. In the second place it means compromise, which though often expedient is usually unsatisfactory, and which in the present case is bound to fail. Whatever may be done in the way of soldiering and engineering compromise with English officers and men, it is certain that the native of India must be either wholly a civilian or wholly a soldier. There is a hard and fast line between the classes who enlist as soldiers and those who are labourers; and even if you enlist a labourer as a soldier, he will very soon suffer badly from swelled head and be quite useless as a workman. Of course there are exceptions, which, however, it would be invidious to specify, but as a general rule the soldier in Hindustan will not condescend to dirty his hands.

The disadvantages of the use of military labour are numerous. In the first place, there must be a large technical administrative constructional staff, either civil or Royal Engineers from civil employ, as well as subordinate civilians and artisans. At the same time the military labour regiments have their own officers, who are not necessarily technically trained and who, however excellent they may be as officers, are inevitably rather in the position of the fifth wheel to the coach; while the rank and file often would not co-operate with the subordinate technical staff, and would not coalesce with the civil labour of which a certain amount (mainly skilled) would be absolutely necessary. It is a matter of fact needing no apology that military labour does not do as much work as civil. The men are under military law, their work is done by order and they get their pay in any case. They must spend much of their time on military duties, and a proportion is wholly required for military duty, such as guards; and, generalising, where the coolie gets along somehow, the soldier, as someone has expressed it, requires "hot and cold water laid on."

Technical railway troops, as distinct from regiments of labourers, must also be maintained if only military labour is to be employed; and I believe that to keep up a sufficient quantity of such troops to construct 400 miles of railway would be quite impossible. Moreover skilled labour cannot be enlisted in railway corps for the simple reason that the pay is not sufficient, and railway trades cannot be taught from a text book any more than tactics can be learnt without war experience. Supposing the pay to be raised sufficiently to attract skilled labour, there will be the greatest difficulty in keeping that labour supplied with work, as is the case now with sappers and miners, and the men will rapidly fall off in value.

Granted then that skilled labour cannot be militarised, what sort of organisation can be expected to work properly, in which regiments of military labourers are sandwiched among civilian artisans and a wholly civilian loco. and traffic staff? What sort of a maintenance gang is it that goes to work with a rifle in one hand and a pick or shovel in the other? Neither fish nor fowl. While using their rifles they are under the Officer Commanding Lines-of-Communications, and while shovelling they take orders from the Railway Officer; unless the Railway Officer and Officer Commanding Lines-of-Communications are combined in one. By arming maintenance gangs you make them liable to the duties and penalties of combatants, while the amount of protection you afford to the line is infinitesimal.

All these facts are pretty generally admitted as regards locomotive and traffic labour; but there seems to be an impression, on what grounds it is difficult to say, that engineering trades must be militarised.

The objections raised against civil labour for railway construction in war are that it is not amenable to military discipline and that it may not be forthcoming when required. To take the latter point first, I think it is merely a question of money so far as skilled labour is concerned; and if double rates have to be paid, there will still be a saving in actual cash compared with the expense of keeping up military labour doing nothing for years; and what is far more important the labour obtained will be efficient and the work will be well done. I will endeavour to show further on that the first objection can also be overcome. As regards unskilled coolie labour there is no question that thousands of Ghilzais, Hazaras and Pathans, many of whom have been on railway construction works in India and Burma, will flock to the works in Afghanistan. There is little question of patriotism among the most loyal of such races; they cannot afford it. The feeling of antagonism to white men is largely confined to the ruling classes and is a matter of self-interest; they are well off and do not wish to be interfered with and see their absolute independence turned into the semi-independence of our ruling princes in India. The highest bidder, and the bidding need not be very high, will get all the labour wanted in Afghanistan. The spending of large sums of money on

local labour must moreover have the effect of improving local feeling towards the army and putting a stop to all petty hostility.

A civil organisation has a great advantage in being more elastic; it provides for men going away when they have had enough and being replaced by others, whereas military men have to work to order; and everyone knows the difference between working to order and working on one's own initiative.

There is one other argument put forward for military labour. It is thought that platelaying is a highly technical matter, requiring trained men if the work is to progress quickly, and that therefore troops trained to the work must be kept ready. This again is a misconception. The art of platelaying can be picked up in a week by any given gang of men, provided the supervising staff know their business; and although no doubt speed of platelaying ultimately depends on the rate of linking up the joints, the utmost possible limit is never approached in practice. Progress of platelaying really depends on the rate at which material can be supplied and the capacity for organisation of the engineer in charge.

The above remarks apply mainly to construction. For maintenance it can be shown that India has no need of railway technical troops. In European armies the *rôle* of railway companies is to patch up lines, immediately behind an advancing army, captured or re-captured from the enemy, and possibly to run a few trains at the front. Also they may be required to lay diversions round fortresses; and in no case can they expect to get labour locally, except by force. Now there is no analogy between these conditions and the conditions in India, and because European nations have railway troops there is no reason why we should in India. It is a far cry from Quetta to Russian-Central Asian Railways, and by the time we arrived there (supposing there were any motive for going) we should have had time enough if necessary to organise railway troops. But as a fact railway troops would not be required. We should make use of local labour, which there need be no question would be readily obtainable. The Central Asian people have no strong tie or loyalty to their present rulers, and in any case Oriental nations have not that strong sense of patriotism which makes it so difficult for invaders in Europe to obtain local labour. For this fact we have a proof in the Russian advance on Constantinople in 1878, when they captured the Turkish Railway (Chemins de Fer Orientaux) and practically took over the existing staff to work it.

The question of the repair of lines re-captured from an enemy who may have penetrated into India is too remote a contingency to call for organisation in anticipation. The lines we construct in Afghanistan might be captured by and re-captured from an enemy; but by that time a railway repair corps, on the model of the Railway Pioneer Regiment in the South African War, will have been readily

organised on a semi-military basis out of the seasoned construction staff.

From the above consideration I am led to the conclusion that we require in India a Railway Corps on the lines of the French civilian detachments. We must have some organisation which will ensure the supply of the necessary civilian labour when the time arrives. The corps should not be military, but on mobilisation it should become subject to military law. By enrolling only the best men, and by granting certain civil advantages, a member should obtain "*izzat*" or honour by joining the corps. The head of the corps would be the Manager of the North-Western Railway (Lahore), who would in peace time have a Royal Engineer officer as staff officer in charge of the corps organisation, in correspondence with the Quartermaster-General and the local heads of detachments. Government servants of the Railway Department, who are civilians and not bound to serve beyond the frontier, might be expected to join the corps without hesitation if they were assured that on mobilisation they would become entitled to an allowance equal to 33 per cent. of their salary and to double travelling allowances. Military Engineer officers would be detailed for duty with the corps, and on mobilisation would be entitled to whatever allowances are sanctioned under existing rules.

Subordinate (civilian) members of the corps might be induced to join by means of a nominal retaining fee, for administrative purposes, of about 10 per cent. of the average wage of their trade or profession, not exceeding Rs.30 per mensem; by certain civil privileges, such as exemption from the provisions of the Army Act, reduced fares when travelling by rail, exemption from service on juries; by commissions or certificates of membership of the corps, carrying titles; by deferred pay and liberal pay on mobilisation; by wound and disease pensions and life insurance; and by a scale of pensions for one, two or three years approved active service or permanent employment on a State Railway. There might also be a gratuity payable after five, ten, fifteen or twenty years enrolment in the corps. The agreement would be annual, terminable by either side annually; and the local heads of detachments would be required to certify to the efficiency, suitability and fitness for active service, morally and physically, at each annual renewal of the contract. The staff officer at headquarters would inspect some of the local corps every year, and further certify to their efficiency. The penalty for not joining on mobilisation would be the penalty for desertion under the Army Act. The deferred pay on joining would be an inducement to join when called out on service; the civil rights, etc., are an inducement to enrol; and pension, pay, etc., an insurance against desertion and discontent while on service.

The corps might be graded:—Officers as 1st, 2nd and 3rd class; overseers, supervisors, foremen, etc. as Conductors or *Jemadars*; and the workmen as Pioneers. The money paid to members in peace

time should be merely a nominal sum, or the men would live on it and the existing railway staff to which many of them would belong would be disorganised. The advantages of belonging to the corps in peace should be mainly honorary, or should at least have no cash value. There should be no medical examination before enrolment; but nomination to the corps should be made solely by responsible officers of State or other Railways, themselves officers of the corps, who on active service would have to make use of the services of the men they nominate. The officers might be distributed all over India on various railways; if all were on the North-Western Railway, that line would be denuded of staff on mobilisation. Still a large proportion might be taken from the North-Western without disturbing its organisation.

There should be no drill or any suggestion of militarisation, which civilians as a rule I believe strongly dislike and mistrust. The strength of the corps might be about 3,500, possibly less.

The organisation would be on the following lines. The ranks of the officers would be filled up with Managers, Engineers, Traffic Officers, Loco. Officers, Storekeepers and Account Officers of varying degrees of seniority, and big contractors. The Conductor or *Jemadar* rank would comprise Loco. Foremen, Station Masters, Senior Drivers, Clerks of all branches, Overseers, Sub-Engineers, Permanent Way Inspectors, Traffic Inspectors, etc., and contractors. The Pioneer ranks would be filled up with Sub-Overseers, Guards, Drivers, a few Firemen, Gangers, Shunters, Fitters, Masons, Carpenters, Bricklayers, Smiths, and possibly some others. Contractors have been included because they are the men who have command of labour and also experience with the petty details of engineering. Although an engineer is perfectly able to carry out work by daily labour, it is not usually considered an economical use of his services; one would as soon expect him to habitually do his own cooking instead of employing servants for the purpose. We do not want to enrol labourers for earthwork or platelaying or maintenance. Pathan labour will be available locally, as pointed out above; and if necessary Contractors, Engineers and Overseers and Permanent Way Inspectors, who are invariably able to put their hands on any quantity of labour, will be able to arrange for it when ordered on duty. Only mates or maintenance gangers need be enrolled, and these might bring men with them if necessary; but the latter need not be enrolled. Maintenance of way depends on the mate or ganger; provided the ganger is skilled there is no difficulty. There is no skill required in tamping with a pick or using a lever or tightening bolts; and in fact all new lines are at first maintained by inexperienced coolies in charge of more or less experienced mates. In the same way Survey *khelassies* are manufactured in a week out of the most stupid and thick-headed Pathans.

The headquarters of the corps would be at Lahore where the Manager and his Staff Officer and the Chief Engineer reside. The detachments might be distributed as in the following table :—

| (1). *North-Western Railway.* | (2). *Oudh and Rohilkhand Railway.* |
|---|---|
| Manager.<br>Staff Officer.<br>Engineer-in-Chief. | Traffic Superintendent.<br>Engineer-in-Chief. |
| Two Engineering Detachments as in column 5. | Two Engineering Detachments as in column 5. |
| One Store Section (Permanent), viz. :—<br>1 Chief Storekeeper.<br>2 Sub-Storekeepers.<br>10 Clerks.<br>20 Watchmen and Messengers, etc. | One Accounts Section, viz. :—<br>3 Examiners of Accounts.<br>8 Accountants.<br>40 Clerks. |

| (3). *Great Indian Peninsular and East Indian Railways.* | (4). *Madras Railway and Bombay, Baroda and Central Indian Railway.* |
|---|---|
| One Traffic Detachment each. | One Locomotive Detachment each. |
| 1 Dist. Traffic Supt.<br>1 Traffic Inspector.<br>10 Station Masters.<br>10 Shunting Jemadars.<br>10 Signallers.<br>20 Guards.<br>3 Clerks. | 1 Dist. Loco. Supt.<br>2 Foremen.<br>25 Drivers.<br>25 Firemen and Cleaners.<br>1 Carriage Examiner.<br>1 Vacuum Brake Inspector.<br>10 Fitters.<br>5 Carpenters.<br>10 Smiths.<br>3 Clerks. |

(5).
*State Railways under Construction and Survey.*

Four Engineering Detachments.

1 Executive Engineer.
3 Assistant Engineers.
10 Clerks
10 Sub-Engineers and Overseers.
10 Sub-Overseers and Timekeepers.
30 Carpenters and Smiths.
10 Masons and Bricklayers.
30 Permanent Way Inspectors and Assistant Do.
20 Gangers.
10 Contractors.
100 Contractors' Men.

The cost of the corps in peace time would be about Rs.140,000 a year as against Rs.240,000, the cost of a native Pioneer Regiment. Rs.140,000 represents a charge of $\frac{7}{8}$ per cent. per annum on the cost of constructing economically the 400 miles of line for which purpose the corps is to be maintained. So that, if it should not become necessary to construct the lines until the lapse of half a century, the cost of maintaining the corps would add only about 17 per cent. to the cost of the lines; while it may be supposed that to construct them without some such organised corps would mean an expenditure of at least 50 per cent. above their ordinary economical cost. The 17 per cent. would be paid out of revenue, whereas the 50 per cent. would come out of capital; so one might prove that, with interest at 4 per cent., the corps would be actually making about Rs.660,000, instead of costing Rs.140,000, per annum. At any rate if there is real need for the corps there can be no objection on the score of cost.

I have attempted to deal with the railway requirements of the Home army, to settle the narrow gauge question, and to make it clear that for India there is only one *raison d'être* for a railway organisation for active service, viz.:—The construction of railways across the North-West Frontier to follow an advancing army. The conditions of this advance and construction can be laid down with almost mathematical accuracy, and I have tried to sketch an organisation, which will serve those conditions, in an Indian Railway Corps.

# *THE SIBERIAN RAILWAY IN WAR.**

*By* CAPT. C. E. VICKERS, R.E.

CAPT. VON TOEPFER'S paper is the first connected account, of any use for military purposes, which the present writer has seen of the working of this great military railway system, the main connecting link between the Russian armies engaged in the present conflict and their sources of supply. It is unnecessary to dwell upon its vital importance to the Russian armies engaged; but it seems certainly worth while to endeavour to summarise the principal features of the methods upon which it is being worked. Technical information in English bearing on the subject is not very easy to obtain, and is apt to be rather vague, but I have endeavoured to gather additional particulars from various sources and to set them down in some sort of order.

The whole question of the working of railways under war conditions is full of interest, more particularly to an army like ours which may be concerned with operations in so many different parts of the world, and discussion on the subject is not lacking; but it must be confessed that people unacquainted with the practical management and working of Railways are apt to underrate the magnitude of the problems which arise in the direction of railway affairs under war conditions, and which would arise in England itself, should by any unhappy chance war ever penetrate to our shores.

It is of interest to perceive that almost from the inception of this Trans-Asian project military considerations have been practically paramount, though, as has been well pointed out, a Railway across an uncivilised country always has another and more pacific influence, as constituting a channel of trade, a rapid way of communication, and a means of quelling disturbances by the transport of troops to threatened places.

The Siberian railway has not worked perfectly; nothing does under conditions of extreme pressure. But, having in view the difficulties which have been overcome, it is but due to acknowledge the foresight and grasp of those who conceived the plan, and the ability of those

(* With acknowledgments to the paper, by Capt. von Toepfer, Instructor at the Dantzig Military College, in the *Kriegstechnische Zeitschrift*, August 8th, 1904, and to sundry other publications. A translation of Capt. von Toepfer's paper was communicated by the Chief of the General Staff, W.O.).

who organised such a vast system, which, all said and done, has shewn wonderfully few breakdowns, and has successfully performed its task so far in a way which must extort admiration. For the Russian armies, at least, have been kept going.

It will perhaps be convenient to allude first to physical features and equipment, then to consider the system of working, and finally to look at the results accomplished during the present war. Information on many points is lacking, but we must hope to learn more as time goes on.

## THE LINE.

The ruling grades and curves do not appear to be really severe, although at places in Mid-Siberia six-coupled goods engines could only draw 24 loaded trucks owing to the sharp curves, which run up to 250 mètres radius. This is about 12½ chains, so that either the engine wheel base must be very long, or there must be other reasons. Certainly much of the line was at first not properly ballasted. On the Manchurian Railway the location seems to have been more advantageous; the minimum curve radius is generally not less than 425 mètres, with exceptional curves of 236 mètres. The ruling grade is 1½ per cent. in hilly country, while on the plains the ruling grade is 0·8 per cent., compensated to 0·6 per cent. on curves of 640 mètres.

Loco. depôts are naturally enough sited as far as possible at the foot of steep sections, so as to facilitate banking. Permanent way on the Manchurian line is laid with 67-lb. rails, and is well ballasted,* the formation being 18 ft. wide and the side slopes kept flat. The Siberian railway proper was originally "laid in a very careless and inefficient manner"; the original rails were 42 to 47 lbs. per yard, and too weak, for buckling and spreading used to be not uncommon occurrences. In the year 1898 £15,000,000 had to be provided for improving and re-laying up to Lake Baikal. The bridges are throughout substantially constructed, though on the Ussurian line, *i.e.*, towards Vladivostock, where for hundreds of miles no stone is to be found, timber was necessarily employed.

In constructing the Manchurian line the first necessity was to get the line joined up after some fashion, so that workmen, materials and provisions might be got through to carry on the permanent construction. All obstacles offered by the ground were therefore turned, temporary bridges and deviations used, and heavy gradients allowed so as to reduce earthwork. The Chingan tunnel, which is 2½ miles long, was avoided during construction by a 12½-mile deviation with three switchback reversing stations.

There are a number of large bridges on the Manchurian line, 14 of over 220 yards length, among them those over the Nonni,

* 18″ of top ballast appears to be allowed.

Sungari (two), and Hung-Ho. The Sungari bridge, near Harbin, is 1,040 yards long. All these large bridges* have stone piers and girderwork superstructure. The culverts, etc., for water passage (flood openings, etc.) average 10 yards per kilomètre. Reinforced concrete has been used a good deal on the Manchurian Railway for decking culverts; the normal span used is 7 ft., the thickness 8¼ inches with rail reinforcement; and similar construction is employed up to 21 ft. span.

At the commencement of the war the break at Lake Baikal was undoubtedly the most serious obstacle to the working of through traffic. Even in summer time (and the lake is much subject to storms) each of the two transfer steamers could make but three crossings in 48 hours, each time conveying 27 trucks, *i.e.*, an average of 40 trucks per steamer per day; and although the vessels are constructed as icebreakers, traffic used to be entirely suspended (except what went over by sledge) for three months of the year, and absolutely stopped for about six weeks when the ice was not firm enough to carry sledge traffic.

It is evident, moreover, that at the beginning of the war the amount of rolling stock available on the Trans-Baikal section was quite inadequate to forward the traffic which could be got up to the lake, however perfect might be the arrangements organised for its transfer. There was therefore the greater urgency to get some sort of line through, in order that engines might be got to the other side. Up to 1903 the project of laying a line round the lake appears to have remained in abeyance, owing doubtless to the great cost involved; but as the political horizon darkened, and it became evident that however much the capacity of the Siberian line might be increased the net effect would be to pile up more traffic at the west side of the lake, it was forced upon the Russian ministry that the undertaking must be faced.

The Circum-Baikal line, Irkutsk to Myssowaja, some 162 miles, includes no less than 34 tunnels,† some as much as a kilomètre long; in all 6¼ miles of boring, 200 bridges and large culverts, while at other points it is largely built up by retaining walls. The cost was about £52,000 per mile, and the difficulties of rapid construction were very great. Irregularities on the part of the contractors in feeding their workmen caused strikes in several places. Carelessness, possibly culpable, caused a fire in one of the tunnels, so delaying boring; and positively wilful neglect in storing explosives endangered the lives of the workmen and progress of the work. The special train carrying

* Some of these big bridges were destroyed during the retirement and the Japanese are now taking traffic over by deviations.

† The tunnels are constructed for double line, but only one road was laid.

the inspection committee, which was to take over a section was derailed between Tanchoi and Kultuk. In this we can feel some sympathy with the engineers, for newly laid lines are extraordinarily apt to derail a train or two before they settle down!

It was essential to get a line across the ice as soon as it would bear. On January 27th, 1904, the ferry steamers had made their last journey; and after a thickness of 1½ mètres of ice had been registered and experiments had been made with goods engines under steam, the laying of rails from Baikal to Tanchoi across the ice was begun on February 9th. There were special difficulties, however, apart from the extreme cold and storms, in the ice movements and cracks. Earthquake shocks occurred from time to time, causing an undulating movement of the whole of the ice, with such sudden violence as to break rails and fishbolts and to entirely destroy several lengths of line in places. But all these difficulties were overcome, and, by spreading the weight with extra long sleepers and, in some places, a second gridiron of beams, a sufficiently secure road was eventually obtained. Traffic was commenced on March 1st, *i.e.*, a laying rate of about 1⅓ miles per day was maintained. Engine power was not used, as one engine had gone through the ice at a trial. 600 men and 1,000 horses supplied the motive power, and between 1st and 26th March 65 engines, 25 carriages and 2,313 covered and open goods wagons were worked across.

To compare with a smaller undertaking of the same kind, one may recall the transfer of traffic across Bethulie Road bridge during the South African war (March—April, 1900). In this case trucks were separately pushed across by hand while the low-level deviation was under construction, the road bridge being not strong enough to carry engines and only able to bear loaded trucks singly.

It is seemingly on the Trans-Baikal section (between Tanchoi and Harbin) that the principal difficulties as regards fuel and water supply are experienced, and the latter question is very serious. Most of the rivers which have to provide water freeze down to the very bottom. A few feet below the ground surface almost along the whole line, but particularly in the Jablonowy Mountains, there is encountered a permanently frozen layer up to 44 ft. in thickness; and consequently, except in a few places such as Tachita, where artesian wells are satisfactory, the boring has to be sunk deep.

At first it was only possible to work six trains a day on this section; but after adding 11 new stations and additional lines at twelve others (so as to simplify crossing trains and avoid the tedious process of see-sawing), it was expected to increase the capacity of the line to about 9 trains a day by May, 1904, and more later on. The average train load appears to be about 35 vehicles, each of which will convey 40 men or 8 horses.

## MILITARY CONTROL.

The total length of the line of railway communication from the Russian frontier to Mukden is 3,882 miles, viz., the Siberian Section (west of Lake Baikal) 2,050 miles; the Circum-Baikal line, 162 miles; the Trans-Baikal railway (Myssowaja to Kaidalowo, and thence to the Chinese frontier, Mandshuria), 750 miles; the Manchurian Railway (to Mukden), 920 miles. There is also the Ussurian section, about 450 miles.*

Under peace conditions the Ministry of Communications, the Finance, and the State Departments are all interested in the control of the Railways; the Finance Department controls the Manchurian Railway through the Russo-Chinese Bank—but the Ministry of Communications is mainly concerned, and practically the traffic is directed by the Committee for Siberian Railways, which was formed about ten years since and sits under the presidency of the Emperor. The *Working* of each section is under the direction of its own *Line Manager*.

Of the Headquarter Staff at St. Petersburg the 1st department of the Administration of Military Communications deals with study of all means of communication, organisation of troop moves in peace time, etc., while the 2nd department deals with transport on mobilization and the working of the railways in connection therewith, line of communication organization, postal and telegraph services. In the various military districts also officers are specially appointed for dealing with the transport of troops under the department: these appear to be the intermediaries between the Commanders of Districts and the working staff of the railway.

Additional to this, however, on February 23rd, 1904, an "Executive Committee for the organization of Railway Transport to the Far East" was organised under the Chief of Military Communications at the Ministry of War. This Committee controls all railway transport on the Line of Communications and regulates war railway traffic. Again, on the staff of the Commander-in-Chief and under the Chief of Military Communications of the Army there has been constituted a Railway Department, which superintends and supplements as may be necessary all railways and waterways beyond Lake Baikal. This, in fact, is what we should know as the Director of Railways' department—or what, under the French system, is the department of Railways and Communications. The work of increasing the capacity for traffic of the whole of the Siberian Railway (up to the Chinese frontier) is placed under the Minister of Communications.

* The Ussurian section appears to include a branch line to the coal mines at Soutchen (138 kilom.). The junction is about 30 kilomètres from Vladivostock, and the earthwork was completed towards the close of 1904. The last 61 kilomètres was to be narrow gauge (2' 6").

The exact arrangements made for local control of traffic (by what we should call Railway Staff Officers, etc.) are not very clear; but it is evident that the need for a separate staff to control the railway traffic,—as distinct from the staffs which arrange operations, distribute supplies and munitions, and so on,—has been recognised, just as it was on the German side in the war of 1870–71, and in the South African war.

The arrangements for guarding the line appear to be quite independent of the control of working and to be organised under the District Commands.

## THE TRANSFER ACROSS LAKE BAIKAL.

The distance across the lake is 28 miles. While the lake was frozen over last year the troops crossed by marching and by sledge conveyance, the sledges which had been used in previous winters being supplemented by 3,000 more. The carriage and foot road was kept in order by gangs of workmen, being swept clear and provided with small bridges over cracks in the ice. It was marked out by posts and lanterns, which latter were lighted by night, and the Half-Way station was further lighted by petroleum flares. Shelters were built at four-mile intervals, and it may well be imagined how necessary they were when it is stated that the temperature would fall to 22 degrees Fahr. below zero. When snow fell or fogs came on bells were tolled at all shelters, between which also telephones were provided to give warning of cracks, etc.

Three or four troop trainloads a day were sent across, the troops having previously been given a day's rest at the Barracks near Irkutsk. The trains were sent down to a temporary lakeside platform, so as to arrive within the four hours after midnight, in order that the march across the lake might be completed in one day. All arrangements for despatch came under the orders of the Post Commandant. Baggage (and sometimes troops) was sent over by sledge; the batteries crossed with their own horses. One sledge would accommodate four men. The train loads were despatched at one-hour intervals, the intervening time being required for loading baggage, etc.

At intermediate halts food would be prepared by the regimental field kitchens (travelling); but the principal meal was taken at the half-way house, which had large waiting rooms for the different classes, and was properly warmed and fitted with cooking arrangements.

The march across was usually completed by 9 p.m.

## ROLLING STOCK.

The gauge of the line, as in European Russia, is 5′. The engines are mostly American or Russian built. The clearance is large, allowing

a continuous platform all round the engine; and the cab is closed in behind, so as to give some protection against the severe weather.

The standard engine is of the 4—6—0 type, both for passenger and goods traffic, and the principal particulars are as follows:—

Cylinders, 24″ × 26″.
Driving wheels, 72″ diameter.
Fixed wheel base, 14′.
Total weight, 62 tons.
Adhesion weight, 92,000 lb.
Diameter of boiler, 60″.
Firebox, 80½″ long, 36″ wide.
Heating surface—
Firebox, 119 sq. ft.
Tubes, 1,650 sq. ft.
Total, 1,769 sq. ft.
Tender capacity, water, about 4,000 gals.

The tractive force is not stated.

At least two powerful engines of the Mallet type have been supplied to the Siberian Railways recently. These are doubtless for working some of the more severe grades.

Some engines of the American type are also in use on the Siberian section (4—4—0, leading bogie). These are apparently the same as in use on the Russian State Railways, and of these the principal features are:—

Wheel base, 9′ 10″.
Compounded on the Worsdell system, outside cylinders 18½″ and 26½″ diameter respectively, stroke 26″.
Joy valve gear.
Weight of engine, 51 tons.
Adhesion weight, 26·2 tons.
Tender about 30 tons.

In passenger service this engine is calculated to haul trains of 200 tons at an average speed of 55 kilomètres (about 33 miles) per hour.

Some of the six-coupled engines, of similar type to the above mentioned, are constructed to burn petroleum, but this arrangement is probably not in use in Siberia. The passenger coaches are mostly six-wheelers, except the corridor coaches which are on bogies. The covered goods wagons, which are four-wheeled, will carry 40 men or eight horses, and are mostly equipped with some means of heating.

The normal load capacity per wagon is reckoned as eight tons.

According to information dated about June, 1905, the Russian Railways, including the Siberian line, need an additional 32,000 trucks. The various locomotive works in Russia are stated to be capable of turning out 1,100 new engines per year with a prospective further increase to 1,600.

## TRAFFIC CAPACITY.

On the Siberian line (west of Lake Baikal) the train load varies from 20 to 39 trucks, but on certain sections the maximum is 24 trucks, thus of course involving a break of trains. At first the average

distance between stations was about 20 miles, but additional stations have been opened and the average distance reduced to 15 miles or less; and it is stated that 13 trains a day can now be worked.

On the portion between Lake Baikal and the Chinese frontier the difficulties in obtaining fuel and water are great, and the normal capacity before the war was only six trains, four military, one passenger, and one supply train. The maximum load appears to be about 40 trucks. By adding additional stations and passing lines and improving water supply 9 trains a day could be worked, and this increase has apparently been effected. Of this number during last summer two were required for railway material.

The Manchurian Railway was well constructed, and trains of 44 trucks could be worked. Its capacity at the commencement of the war was at least as great as that of the Trans-Baikal line, but rolling stock and engines were deficient. Since then a large amount of rolling stock and particularly of engines has gradually been transferred from European Russia, of course at the expense of civil traffic in that part of the Empire until additional stock could be built. The average speed throughout seems to be something like 10 miles an hour.

## TRAFFIC CARRIED.

In peace time the railway was carrying a considerable amount of traffic. For the year 1900, 758,000 tons of traffic were conveyed; but as the average haul is not stated this information is not of much value, though we may assume the mean distance to be considerable.

Under peace conditions the time-table of the Siberian line provided for four passenger and six goods trains in each direction; that is, the time-table contained these timings, but, as commonly the case on single lines, only so many of these trains were run as the traffic warranted. At the beginning of 1904 four military trains each way were to be provided as far as Krasnojarsk and three thence to Irkutsk. Actually from January 10th to February 1st (old style) five military trains each way were worked, and on February 1st (14th) the change to the military time-table was carried out. This provides two passenger trains and eight military trains for troops, stores and railway material. The change was effected without a hitch, 46 troop trains being actually *en route* to the East at this date. Civil traffic was suspended, but was in fact resumed again at the end of April, as was indeed practically essential, for the country districts alongside the line are now very largely dependent on it for supplies.

It would be of great interest to know the system adopted for the control of civil supplies, but particulars are lacking. As, however, traffic is only accepted without guarantee as to time of delivery, it may be assumed that simply surplus truckage is assigned to the merchants.

The reports we have seen of the large numbers of trucks standing under load, both in European Russia and Siberia, seem to indicate imperfect arrangements for the release of rolling stock. There must further be great difficulties in rapidly clearing rolling stock and arranging its distribution, for at the outset collecting stations were very imperfectly equipped with sorting and marshalling sidings.

The average time between Moscow and railhead for troop trains may be taken as 30* days, including halts on the road; and an average inclusive running speed of 17 miles per hour on the Siberian section, and 10 miles per hour beyond Lake Baikal.

It appears that even during the War the Russians attempted to keep up a fast train service over the Siberian Line as well as that of military trains. This of course rendered the attainment of the maximum output more difficult. According to newspaper reports, however, 17 trains a day (12 military, 3 passenger and 2 railway stores) were being worked in the early part of this year. Deducting halts, the journey was being accomplished by troops in 21 days, or an average of 400 kilomètres per diem.

According to the Minister of War, between 8th February, 1904, and 25th March, 1905, the railway conveyed to Harbin 774,554 officers and men, 146,408 horses, 1,521 guns, and 351,000 tons of stores. Really, however, it appears probable that these figures include transport in both directions, and that it would be nearer a correct estimate to take 510,000 men, 93,000 horses and 100 guns as delivered at the front between February and December, 1904. In April, 1905, there were actually in Manchuria 411 battalions, 181 squadrons, and 168 batteries.

* But apparently at the outset of the war the troops reckoned about fifty days as the time of the journey from home to the front.

# *THE BATTLE OF TELISSU OR VAFANGU.*

FROM THE 13TH JUNE, 1904, TO THE 15TH JUNE, 1904.

*By* Bt.-Colonel J. D. Fullerton, R.E.

I. Description of the Battlefield.
II. The Opposing Forces and their Dispositions.
III. Narrative of Events.
IV. Comments.

## I. Description of the Battlefield.

*Extent.*—The battlefield area is bounded on the north by a line running east and west through Vafangu Station on the Manchuria railway; on the east by high hills east of Va-fan-vopen; on the south by the hilly ground about Chu-chia-tun and Tapinkou; and on the west by a low range of hills running from Tapinkou to west of Lunkoo.

*Hills.*—The general character of the area is hilly, the principal heights being those to the east of Lunkoo (right of the Russian position), and immediately to the south of the line Va-fan-vopen—Yud-sia-tun (the left of the Russian position). These hills commanded the country to the south fairly well, but the generally undulating character of the ground was on the whole rather favourable to the Japanese, as it allowed them to conceal the movements of their troops.

*Rivers.*—The Fuchau river runs through the area in a direction generally speaking north-east to south-west; it was not of sufficient importance to act as a serious obstacle, and was crossed by the Japanese without difficulty.

*Railway.*—The Manchuria Railway runs north and south through the area, and was in good order; it was freely used by the Russians to bring up troops during the action on the 15th June, 1904.

*Villages.*—There are no villages of any importance in the area.

*Woods.*—The country to the west of the line Lunkoo—Tapinkou is woody, and difficult to observe from the heights forming the right of the Russian position.

*Roads.*—The main road runs from Pulantien to Telissu, parallel to the railway. There is another main road from Pulantien to Fuchau, followed for part of its length by the Japanese Left Column. But

most of the roads in the area are mere tracks and unsuitable for heavy wheeled traffic.

*Weather.*—The weather during the operations was fine, but there was a very thick fog early on the morning of the 15th June, which delayed the opening of artillery fire for about an hour and at about 4 p.m. it began to rain heavily.

## II. THE OPPOSING FORCES AND THEIR DISPOSITIONS.

### A. THE RUSSIAN FORCES.

On the morning of the 15th June, 1904, the Russian Force was distributed as follows:—

In command—Lt.-Gen. Baron Stackelberg, Commanding the I. East Siberian Rifle Division.

| | | |
|---|---|---|
| Covering Right Flank. | Ussuri Cavalry Brigade (Maj.-Gen. Samsonov). | 1st Dragoon Maritime Regt.<br>4th Siberian Cossacks.<br>8th Siberian Cossacks.<br>1st and 2nd batteries, Transbaikal Cossacks. |
| RIGHT. North of *Ta-fang-chen.* | VIII. E. Siberian Rifle Division.<br>IX. E. Siberian Rifle Division. | 31st Regt. (3 battalions).<br>1, 2, 3, 4 batteries of Artillery. |
| CENTRE. North of *Yud-sia-tun.* | I. E. Siberian Rifle Division. | 4th Regt. (3 battalions).<br>1, 2, 3, 4 batteries of Artillery. |
| LEFT. South of *Va-fan-vopen.* | I. E. Siberian Rifle Division. | 1st Regt. (3 battalions)<br>2nd Regt. (3 battalions)<br>3rd Regt. 3 (battalions) |
| RESERVE. *Sisan.* | IX. E. Siberian Rifle Division. | 33rd Regt. (3 battalions)<br>34th Regt. (3 battalions)<br>35th Regt. (3 battalions)<br>36th Regt. (3 battalions) |
| | 35th Brigade, 31st Infantry Division, XVII. A.C. | 139th Regt. (4 battalions)<br>140th Regt. (4 battalions)<br>1, 2, 3 batteries of Artillery. |
| | VIII. E. Siberian Rifle Division. | 32nd Regt. (3 battalions) |
| Arrived during progress of the action on 15th June, 1904. | III. E. Siberian (Res.) Rifle Division. | 9th Regt. (3 battalions). |

The total strength was 41 battalions of infantry, 3 regiments (15 squadrons) of cavalry, 2 horse artillery batteries (12 guns), 11 field batteries (88 guns); *i.e.*, about 36,000 men and 100 guns.

The Russian plan of operations was:—

1st. To hold defensively the line Lunkoo—Va-fan-vopen.

2nd. To make a flank attack on the Japanese right *viâ* the hills east of Va-fan-vopen, force them back on the line of railway, and thus cut their communications with Pulantien.

### B. THE JAPANESE FORCES.

On the morning of the 15th June, 1904, the Japanese Forces were distributed in four columns, the exact composition of which has not been published. The cavalry on the extreme right were about 12 miles south-east of Va-fan-vopen; the Right Column was south of Chu-chia-tun; the Centre about Tapinkou; and the Left was advancing on Lunkoo from a point about 6 miles west of that village.

The composition of the force was as follows:—

In command—Lt.-Gen. Oku, Commanding II. Imperial Japanese Army.

| | | | |
|---|---|---|---|
| III. Division. Lt.-Gen. Oshima. | No. 5 Brigade | 6th Regt. | |
| | | 33rd Regt. | |
| | No. 17 Brigade | 18th Regt. | |
| | | 34th Regt. | |
| IV. Division. Lt.-Gen. Ogawa. | No. 7 Brigade | 8th Regt. | |
| | | 37th Regt. | |
| | No. 19 Brigade | 9th Regt. | |
| | | 38th Regt. | |
| V. Division. Lt.-Gen. Uyeda. | No. 9 Brigade | 11th Regt. | |
| | | 41st Regt. | |
| | No. 21 Brigade | 21st Regt. | |
| | | 42nd Regt. | |

Also a Cavalry Brigade (no details known).

The total strength is very difficult to ascertain, as Reserve Brigades are said to have joined their Divisions; if this were the case the infantry would have amounted to 54 battalions, which, with the cavalry brigade and other troops, would bring the total up to about 70,000 men and at least 144 field guns.

The Japanese plan of operations was:—

1st. To hold the right, opposite Va-fan-vopen, with the Right Column.

2nd. To make a vigorous attack on the Russian centre, with the Centre Column.

3rd. To make a flank attack with the Left Column against the line Ta-fang-cheng—Lunkoo and the country north of Lunkoo.

4th. To demonstrate against the Russian left flank with the cavalry brigade.

## III. NARRATIVE OF EVENTS.

*June 13th.*—The Japanese Force was assembled at Pulantien (Port Adams), while the Russians were at Telissu and to the south near Va-fang-tien. The Japanese Commander decided to attack, and issued the following orders :—

1st. The cavalry to advance by the Pitsewo—Hsiung-yo-cheng road and threaten the Russian left flank.

2nd. The Right Column to move east of the railway on Chu-chia-tun.

3rd. The Centre Column to advance along the railway direct on Telissu.

4th. The Left Column to move along the Fuchau road, and roads east of it, on Wu-chia-tun and the right flank of the Russian position.

After a 12-mile march, opposed by small Russian detachments, the Japanese halted on the line Weng-chia-tun—La-Tzu-Shan—Yan-chia-kou.

During the day considerable reinforcements, brought up by rail, reached the Russians.

*June 14th.*—The Japanese continued their advance, and there was some sharp fighting between the Centre Columns and the Russian advanced troops about Va-fang-tien. The Japanese scouts discovered the Russian position to be along the line Lunkoo—Ta-fang-cheng—Va-fan-vopen.

At 3 p.m. the Japanese Right Column was at Chu-chia-tun, while the Left Column was in the neighbourhood of Tapinkon. The artillery bombarded the Russian position for about two hours without much effect ; and by sunset the Japanese were disposed thus :—

Cavalry : Shao-pao-tzu.

Right Column : Su-chia-tun—Pang-chia-tun (1½ miles west of Pang-chia-tun).

Centre Column : Pang-chia-tun—Weng-chia-tun.

Left Column (acting independently) : Towards Fuchau and Na-chia-ling.

The Japanese orders for the attack were :—

Cavalry to outflank the Russian left.

Right Column to hold fast on the line Su-chia-tun—Pang-chia-tun, and not to make any strong offensive movement until the attack of the Left Column from Fuchan had developed.

Centre Column to move to hills west of Ta-fang-cheng and attack the Russian centre.

Left Column to carry out an extended flank attack on Russian right from Na-chia-ling and neighbourhood.

Further orders directed the Centre Column to make its advance during the night; the rest of the troops to act at 4.30 a.m. on 15th June.

*June 15th.*—1 *a.m.*—The Russian Commander decided to attack, and issued orders for the carrying out of the plan above mentioned. The flank attack was to be made by the 35th Brigade, 31st Infantry Division, XVII. A.C.; the column was intended to march at daybreak, but owing to a misunderstanding the troops did not leave their camp till 8 a.m.

2 *a.m.*—Desultory firing occurred along the Russian right front.

5.30 *a.m.*—The artillery duel between the guns of the Russian left and the Japanese guns south of Ta-fang-cheng and Va-fan-vopen commenced, after having been delayed by fog for about an hour.

The Japanese Centre Column advanced with difficulty and occupied the hills south of the line Lunkoo—Ta-fang-cheng.

6 *a.m.*—The Russian cavalry discovered the advance of the Japanese Centre Column.

6.30 *a.m.*—The Japanese Centre Column continued to advance, but its progress was slow.

8 *a.m.*—The Russian Flanking Column (35th Brigade, 31st Infantry Division, XVII. A.C.) started from camp.

9 *a.m.*—The Russian Commander discovered the Flanking Column had not advanced as directed and sent orders to its Commander to push on. There was some misunderstanding about these instructions, and a considerable delay in the advance took place.

9.30 *a.m.*—The Japanese Centre Column, assisted by a part of the Left Column which had come up from Fuchan, now began to press back the right of the Russian line, viz., the Lunkoo—Ta-fang-cheng position.

The Japanese artillery inflicted considerable damage to the Russian guns, no less than five batteries being practically speaking destroyed.

10 *a.m.*—The Russian cavalry to the north of Lunkoo had to retire.

10.30 *a.m.*—The Russian detachment from the Reserve at Sisan (consisting of the 34th and 35th Regiments and one battery, of the IXth E.S. Rifle Division) was ordered to the assistance of the troops on the Lunkoo—Ta-fang-cheng position and soon became heavily engaged with the Japanese Left and Centre Columns.

11 *a.m.*—The Russian 35th Brigade XVII. A.C. now came into action against the Japanese right flank, and heavy fighting took place, the Japanese being twice reinforced from the General Reserve.

A Russian regiment arrived by train and was sent to occupy the hills west of Vafangu Station.

11.30 *a.m.*—The Japanese attacks began to tell, and the Russian right from Ta-fang-chen to Lunkoo was gradually forced back.

12 *noon.*—The Japanese cavalry, which had been delayed by the difficult country, came up and threatened the Russian left. Several rigorous counter-attacks were made by the Russians, but they were unsuccessful and a retreat was ordered.

1 *p.m.*—The Japanese ambushed a Russian column retiring west of the line Ta-fang-cheng—Lunkoo, and inflicted considerable loss.

3 *p.m.*—The Russians were now in full retreat. The 35th Brigade XVII. A.C., which withdrew rather late, suffered very severely, as did also the IX. E.S. Rifle Division in carrying out the retirement along the hills to the north-east of the Lunkoo—Ta-fang-chen position.

4 *p.m.*—The Japanese occupied the Russian main positions and the action ended. Heavy rain began to fall, and no attempt to follow up the Russians was made.

The Russian losses were :—

| | Officers. | Men. |
|---|---|---|
| Killed ... ... ... ... | 42 | 848 |
| Wounded ... ... ... ... | 81 | 2,442 |
| | 123 | 3,290 |

and 16 Q.F. guns.

The Japanese losses were :—

| | Officers. | Men. |
|---|---|---|
| Killed ... ... ... ... | 9 | 210 |
| Wounded ... ... ... ... | 58 | 903 |
| | 67 | 1,113 |

## IV. COMMENTS.

### 1. *The Russian Plan of Operations.*

The objects General Kuropatkin had in view, when he detached Lieut.-General Baron Stackelberg's force to the south, were :—

1st. To relieve Port Arthur.

2nd. To defeat the II. Japanese Army before it could make a junction with the I. Japanese Army at Feng-whang-chang.

The scheme failed because the II. Japanese Army with its 70,000 men was quite strong enough to deal with Lieut.-General Baron Stackelberg's force without any outside assistance. As a matter of fact, the Russians, far from making an offensive advance to relieve Port Arthur, were compelled, on reaching Vafangu, to take up a defensive *rôle*, in order to save themselves from being completely cut off from Liao-yang. General Kuropatkin does not seem to have been aware of the real strength of the II. Japanese Army, and apparently imagined that the force sent to cover the Port Arthur

Siege Force was merely a covering detachment unlikely to make a serious advance.

As regards Lieut.-General Baron Stackelberg's plan of action, it was clear, on the morning of the 13th June, that, owing to the great numerical superiority of the Japanese, a defensive *rôle* was the most suitable one; for if he had continued his advance southwards he would, in all probability, have been cut off from the Liao-yang Forces.

The Telissu position was a fairly good one; but, as is so often the case in undulating country, the hilly ground to the south and west of the position concealed the attackers' movements, while the woods to the west of the line Lunkoo—Ta-fang-cheng rendered observation difficult. The idea of an offensive movement east of Va-fan-vopen was a good one, but the misunderstanding regarding the action of the flanking force effectually prevented its attack from being brought to a successful conclusion.

### 2. *The Japanese Plan of Operations.*

The object of the Japanese was to cut off the Russian force, and the two flanking attacks, by the Left and Cavalry Columns, were arranged for this purpose. For some reason not at present quite understood (but said to be due to the difficult country) the cavalry failed to reach the ground east of Telissu in time, and the Russians were therefore able to retire with (comparatively speaking) little loss.

The general arrangements for the attack were most skilfully made; and the movements of the Left Column, which arrived on the scene at the exact moment when it was required, were extremely well carried out.

### 3. *Artillery.*

The Russians attribute their defeat, very largely, to the skilful handling of the Japanese artillery. The plan adopted by the Japanese gunners was to concentrate all their fire on one battery at a time, and in this way five Russian batteries were almost entirely destroyed in little more than an hour.

The Russian guns seem to have been much exposed, and this no doubt materially assisted their opponents.

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NOTE.—The plan is reproduced from the *Voennyi Sbornik* by the kind permission of the Imperial Russian Authorities. As most of the places have different names in Russian, Chinese and Japanese, the names which appear to be most commonly used in the different accounts of the battle have been inserted in the plan.

## *THE DESIGN OF TALL CHIMNEYS.*

*By* Bt.-Colonel G. K. Scott-Moncrieff, c.i.e., R.E.

In the June number of the *R.E. Journal* Major Ainslie has called in question the method of investigation of the stability of tall chimneys as given in Part I. of *The Principles of Structural Design*, pp. 319–20. In this paper, as I understand, he has not objected to the actual steps taken in the investigation; but he has pointed out that, if the limitations of such investigation are applied in the case of many existing chimneys, these would be found to be theoretically unsafe.

I may perhaps state that my practical knowledge of the subject is very small; I never designed a tall chimney in my life and never built one worthy of the name; so my opinion is of little value.

The example which is given in the book, and which Major Ainslie thinks is unnecessarily heavy, was one that was built at Woolwich about 10 years ago, designed under the orders of the Superintendent of Building Works at the Arsenal (Colonel M. T. Sale, c.m.g., late R.E.). I saw the work in progress on the occasion of one of many visits to the Arsenal with a class of officers under instruction; and, if I remember rightly, some of the latter asked me how the stability would be investigated. So I got the plan of the chimney from the office of the Superintendent of Works and worked it out. As will be seen from p. 319 of my book, the problem was, not the design of a chimney with certain data, but the investigation, in an actual case, of the maximum wind pressure necessary to reduce the tension and compression to zero at the windward edge, as well as the maxima pressures on the brickwork and the foundations.

In selecting this example I did so because it was one designed and built under the superintendence of R.E. officers, on the principle that such designs, whether of bridges, roofs, chimneys or any other structures, were more likely to appeal to R.E. officers under instruction than those prepared in civil life. But in so doing I do not wish to imply that they are the best that can be designed, or that they are free from faults. Certainly some of the bridges shown in the Second Part of the book quoted cannot claim to be above criticism.

However, in this particular instance, I do not think the chimney is an extravagant one, if it is held that every such chimney should be calculated so as to allow for 50—60 lbs. of wind pressure and that no reliance should be placed on the tenacity of the mortar. These two

points are questioned by Major Ainslie, and I think very reasonably questioned. I trust, however, that he will allow me to point out that neither of these points are part of my method of investigation. I shall deal with them both presently, but meantime let me turn to the only other point in which that method is questioned, viz.:—the position of the neutral axis. Major Ainslie says that this surely cannot lie up the centre of the shaft. Now, admitting that the investigations for the neutral axes of beams have been made mainly on those of fibrous material, such as wood or steel, and that the molecular conditions of such are probably very different from structures of stone or brick, I cannot see how, with our present state of knowledge, we can say that the position of the neutral axis in a beam of the latter will materially differ from one of the former material. That stone, brickwork and concrete have definitely measurable moduli of elasticity we know. We also know that in a tube of metal the neutral axis is at the centre, or "up the middle of the shaft." I can see no reason for supposing that, within elastic limits, the neutral layer of a symmetrically-built chimney will be other than a vertical plane in the centre of the shaft. If this be so the formulæ, on which my calculations for maxima and minima pressures are based, are applicable. This is the only point on which I can claim to have any method of investigation.

I think it is quite possible that many tall chimneys are built of a very much lighter section than would be involved in the rules quoted by Major Ainslie. In the footnote of p. 320 of my book I quote one which was destroyed at St. Louis in May, 1896, where the thickness was only 13 inches at 110 feet from the top. I can only suppose that the designer of this chimney either relied on his mortar to stand a definite amount of tensile stress or never expected a high wind pressure.

As regards the former point there can be no doubt that in nearly every brick arch there is a certain amount of reliance placed on the tenacity of the mortar. (I can speak with some confidence on this point, as I made a series of careful experiments on arches a few years ago in India. Besides, there is the distinguished authority of Sir Benjamin Baker, to the effect that at least 90 per cent. of the arches in the kingdom are in the condition of being partly in tension). If then mortar is trusted in the construction of arches, there seems to be no reason why it should not be trusted in chimneys. How far it is safe to trust the mortar must be a matter for local consideration; but I think the crucial point is not so much the tensile strength of the mortar, but its adhesive strength, a table of which is given on p. 39 of Part I., *Structural Design*. It is a subject on which one can obtain little general information. In every large masonry work which I have built of recent years I have always made adhesion experiments with the mortar I have intended to use.

Again I quite admit that to take 50–60 lbs. as the wind pressure is usually extravagant, and that the overturning moment is much less than that arrived at in the investigation given in the example quoted from my book. I have indeed stated that "so great a wind pressure would seldom, if ever, be experienced in any part of the British Isles, and certainly not in the low-lying district of Woolwich." How much mean wind pressure would have been safe in that instance is a difficult question to answer. Possibly the records at Greenwich Observatory would be a safe guide. At my present station (the Curragh) I have calculated the stability of high enclosure walls on an assumed wind pressure of 20 lbs., but even that reduced amount gives heavier results than are usually adopted in practice.

It is all very well to say that theory is of no use and that what has been done safely before can be done again, but every now and then a big storm comes and causes disaster. I remember a case a few years ago, on the N.W. Frontier of India, when a wall was added to an existing wall on a frontier post. It was built according to custom as regards thickness, etc. One night, in a violent storm, it was blown over and killed several men. I should not like to have been the engineer who built it.

As regards the formula of Messrs. Babcox and Wilcox, I think it is one to be used with caution, because it evidently takes moments about the leeward edge, and I do not think this is sound. My reason for thinking so is that unless the brickwork is of exceptional hardness it will crack. Major Ainslie calculates a chimney where 7·14 tons per square foot is the compressive stress. From Table VIII., p. 33, of my book it will be seen that brickwork of London Stocks laid in lime mortar begins to fail at 5 tons per square foot.

The data in connection with the chimneys mentioned in Sir G. Molesworth's *Pocket Book* are insufficient for any general deduction to be made. They seem to me, however, to be lighter than those which would be designed under the London County Council rules.

After all common sense must guide one as to when such rules can be safely relaxed. If I were building a chimney on the top of an isolated mountain like Shekh Budin, I should design it very much more stable than one in a low-lying valley surrounded by other buildings.

# *TRANSCRIPTS.*

## PROTECTION FROM LIGHTNING.*

FORTUNATELY, in this country thunderstorms of excessive violence are rare, or the inadequacy of the usual arrangement of lightning-rods would have long since been brought home to the public. In America, where severe storms are much more frequent, the inefficiency of the ordinary lightning-conductor has in this way been well established for some time, and, as a consequence, it has of recent years been quite common there to omit all provision of this kind even in the largest public and private buildings. In the latter case the risk is covered by insurance, but this is, of course, not entirely satisfactory, as none but material injuries can thus be made good. The need for further light on the efficient protection of buildings from lightning was evident over twenty years ago, when in 1882, a series of regulations for the instalment of conductors was published. Since then many buildings have been protected on the lines then laid down; but it was not long before it was recognised that the matter would have to be re-opened.

In their annual report for 1900 His Majesty's inspectors of explosives expressed this view strongly, in consequence of disasters due to lightning strokes at the Nobel factories at Krummel and Harum, Germany. In this position of affairs the Royal Institute of British Architects and the Surveyors' Institution, acting on the initiative of Mr. Killingworth Hedges, appointed a "Lightning Research Committee," being assisted to meet the expenses by grants from the Royal Society and the Royal Meteorological Society. Amongst the members of this Committee were Sir Oliver Lodge and Mr. G. Gavey, of the Post Office, whilst Mr. Killingworth Hedges acted as honorary secretary. The first step taken was to collect and collate accurate details concerning buildings struck by lightning. In the first instance information was sought both as to unprotected and protected buildings, but the mass of data became so voluminous that in the end only those cases in which the buildings were fitted with lightning-rods were investigated. One conclusion arrived at was that in Great Britain, during the years 1901 to 1904, over 500 buildings were struck by lightning, and of these the committee have details as to 115, of which 75 were unprotected, the remainder being fitted with rods supposed to be adequate by those responsible.

In a preface to the report, Sir Oliver Lodge points out that in protecting a building from lightning, two cases have to be provided for, which

* Extracts from an article in *Engineering*, 26th May, 1905.

he calls repectively the "A" flash and the "B" flash. In the former the cloud discharges direct to earth, and ordinary lightning-rods may be considered as providing good protection against this form of discharge. In fact, they may by means of a "brush" discharge from the points prevent an actual flash passing, the electric energy involved passing quietly and harmlessly to earth, just as an overfilled reservoir may be quietly discharged through the ordinary water conduit or over the spill-way.

In the case of the "B" flash, points are, however, quite inoperative. Here the primary flash takes place between one cloud and another over the conductor. Owing to electric inertia the second cloud is instantaneously overcharged, and there is not time to quietly pass off this overcharge by the brush discharge, and as a consequence a flash passes from this cloud to the building below. Against this kind of flash the only safe protection would consist in enclosing the building in a complete metal cage—a process too expensive to be practicable in ordinary cases, and objected to also on the score of appearances. The condition of affairs in a "B" discharge may be likened to a valley having in it several reservoirs, one above the other. If one of the upper dams give way, those lower down are certain to be washed out, however adequate the spill-way provided may be to take care of an ordinary flood discharge. Further, the flood from the broken reservoir will not follow any defined channel. Obstructions and training walls, which will safely control an ordinary flood, will fail to restrain such an avalanche of water as follows the bursting of a dam. Similarly, in the case of the "B" flash, the discharge will not be confined to the lightning-conductor, but may take quite unexpected paths.

In the case of a "B" flash the heated air from a chimney forms a path which is often preferred by the lightning. A case of this kind is quoted in an appendix to the report of the Committee—viz., that of the Alexandra Hotel, Darwen, a building protected at the time of the accident by conductors on three chimneys out of seven. The lightning came down one of the chimneys 41 ft. away from the nearest conductor. The chimney was broken, the grate displaced in the room below, and the marble mantlepiece broken down. At the same time a horse was killed in a field outside.

This additional fact illustrates another peculiarity of the "B" flash—viz., the tendency to side flashes and oscillations. These are also well illustrated by the damage done in another storm to St. Pancras Church, Euston Road. Here lightning apparently struck the rod and set up violent electrical oscillations on a lead roof with which it was in contact at one end, but this roof was not otherwise earthed. The consequence was that the electricity made its escape through the gas and steam heating pipes. The former were fused and the gas ignited.

Generally speaking the damage done in protected buildings has not been excessive, so that the rods have provided partial protection at any rate, and have, therefore, a considerable value even in the case of "B" flashes. To increase this the Committee recommend some important modifications in the specifications drawn up by the Lightning-Rod Conference in 1882, and also propose certain simplifications by omitting provisions which are now found to be of no advantage. Thus it is no

longer considered necessary to gild or platinise the points of conductors; iron rods are, moreover, preferred to copper as offering a greater resistance and thus reducing the surging of the current. Copper has, however, the advantage of being less easily oxidised, but where used on this account it is quite unnecessary for it to be of high conductivity. The necessity of avoiding bends and sharp angles in the conductor is emphasised. Conductors are best made as vertical rods fixed so far out from the wall of the building that it is not necessary to bend them round projections.

As matters stand, architects have commonly preferred copper to iron, as, a smaller section being used, the conductor was less conspicuous, and if in the form of a stranded cable could be bent round any projections or led into any corner and kept well out of sight. This practice is most reprehensible, since in an impulsive discharge of this character the current has a strong objection to being diverted from a straight-line path. Where iron has been used in the shape of a $\frac{3}{4}$-in. rod, better results have been obtained, since it is easier to keep such a conductor straight and direct than it is to bend it.

In the case of factory chimneys it is advised that arched metal rods connected to the conductors should span the opening. Two main rods are advised, fixed on opposite sides of the chimney. Electric testing of the conductors when fixed is considered unnecessary, though the quality of the "earth" should continue to be tested. For this earth the use of coke or cinders is now considered questionable, charcoal or pulverised carbon being considered better. As a practical guide to architects and others responsible for the protection of buildings from lightning the Committee make the following suggestions:—

1. Two main lightning-rods, one on each side, should be provided, extending from the top of each tower, spire, or high chimney-stack by the most direct course to earth.

2. Horizontal conductors should connect all the vertical rods:—(*a*) along the ridge, or any other suitable position on the roof, (*b*) at or near the ground line.

3. The upper horizontal conductor should be fitted with aigrettes or points at intervals of 20 ft. or 30 ft.

4. Short vertical rods should be erected along minor pinnacles and connected with the upper horizontal conductor.

5. All roof metals, such as finials, ridging, rain-water and ventilating pipes, metal cowls, lead flashing, gutters, etc., should be connected to the horizontal conductors.

6. All large masses of metal in the building should be connected to earth, either directly or by means of the lower horizontal conductor.

7. Where roofs are partially or wholly metal-lined, they should be connected to earth by means of vertical rods at several points.

8. Gas-pipes should be kept as far away as possible from the positions occupied by lightning conductors; and as an additional protection, the service mains to the gas-meter should be metallically connected with house services leading from the meter.

# EMPLOYMENT OF TROOPS IN THE ATTACK AND DEFENCE OF FORTRESSES.*

*Extracts from a Study by* EMIL RITTER v. DEBNO-GOLOGORSKI, *Royal and Imperial Major of Engineer Staff, in the* MITTEILUNGEN ÜBER GEGENSTÄNDE DES ARTILLERIE UND GENIEWESENS, 1904, *p.* 981, *of a similarly named book by the Russian Lieutenant-General* KASBECK.

A book with the above title, published in 1902, was the 2nd edition of similar "Instructions" written in 1900 by G. N. Kasbeck, then Major-General and Fortress Commander in Iwangorod and now Fortress Commander in Warsaw. The "Instructions" were brought into force by General Kasbeck at Iwangorod and later at Warsaw, pending the publication of the 2nd and 3rd parts of the *Regulations for Duties in the Field*. They expressed the Russian views of measures to be taken in Fortress Warfare. The 2nd Edition has received more or less official sanction by being published in Russian Headquarter Circular No. 4 dated 5th January of this year (1904).

This study therefore concerns the 2nd edition, and more immediately the first part of it dealing with "Attack"; but is limited to a few questions of Fortress warfare in which the most important alterations appear in the 2nd edition.

It may be stated that the 800 numbers of the 1st edition were sold in a very short time; this fact elicits an answer in an affirmative sense to the recently much-debated question as to whether the framing of regulations for the attack and defence of fortresses was necessary or not.† This is further proved by the fact that Germany in her *Belagerungs-und Verteidigungs anleitung*‡ and France in her *Instruction Générale sur la guerre de siége* possess similar regulations.

The new edition of the Russian "Instructions" also gave its writer the opportunity to lay more stress than formerly on the influence of the heavy artillery of an army in the field in the progress of an attack on a fortress. For instance Kasbeck opines that the introduction of heavy artillery with an army in the field will revive the assault, and that this heavy artillery will play the same relative decisive *rôle* in the assault as the siege artillery in prolonged siege operations. This latter opinion is also held by Lieut.-Colonel von Gerwien. But in v. Lobell's *Jahresberichten*, 1901,

* Communicated by the Chief of the General Staff.

† With reference to the discussion of the Austro-Hungarian *Field Pocket Book for Officers of the Engineer Staff and Pioneer Troops* it is stated in v. Lobell's *Jahresberichten*, 1902, "Not only Sappers and Gunners but officers of all arms and of every rank must educate themselves for siege warfare as well as field warfare; this must not however be left to private study; the official instructions must be brought to general notice the same as the regulations for training in field warfare and orders for duties in the field."

‡ See *Kriegstechnische Zeitschrift*, 1904, p. 98, 3rd pamphlet.

Lieut.-Colonel Frobenius states in opposition that, thanks to the growing interest taken by the army in siege warfare, the views are rapidly disappearing that siege warfare is the domain of siege and fortress artillery and that the corresponding battle between the two artillery forces, to which the other arms only play a subsidiary *rôle*, is the decisive factor. Lieut.-Colonel Frobenius further states: "There are some indications that the old idea, that questions of fortress warfare should necessarily be considered from a purely technical standpoint, is obsolete; one is beginning to realise that infantry and cavalry have a more important task to fulfil than merely to act as auxiliaries to gunners and sappers, and armies are ridding themselves of the bond caused by the temporary overestimation of the capabilities of the artillery arm." This view adopted by Frobenius can however only be treated as a side issue; it follows, as a natural corollary consequent to the disappearance of the last traces of Vauban's stereotyped attack, that fortress warfare partakes more and more of the nature of operations in which infantry plays the decisive *rôle* throughout; but the continuous and vigorous co-operation of the artillery is still indispensable.

The first six paragraphs of the Russian "Instructions" define the possible operations against a fortress (observation, blockade, investment). The attacker is warned against binding himself down to a definite method of attack during the whole period of operations; all measures he takes must be suited to the conditions of the defence. If the conditions of the defender have altered, a corresponding more expeditious method of attack must at once be adopted; the attacker must abandon his previous plan of operations, even if already in execution, directed against a fortress originally well-organised with a suitably strong garrison. Scarcity of over-head cover in the works of the defence (insufficient bombproofs and armoured cupolas) and want of flank defence of the intervals by the defending force, with a strong mobile force of field and heavy artillery of the field army on his side, are signs which justify an attacker in adopting more expeditious methods.

Regarding the further grouping of the subject and the representation of the various phases of fortress warfare, the "Instructions" follow the usual method of introducing the most important operations of the attacking force during a siege, pointing out their object step by step and giving short rules to be followed.

The attack is represented as a battle round a number of tactically important positions which the defence has strengthened by fortifications and has occupied at the right time. In these positions the so-called "advanced positions" (to be discussed later) are the first in which the defence offers a stubborn resistance. In order to give way step by step the defence will occupy various "intermediate positions" between the "advanced positions" and the main defensive belt (called the "main position") until eventually driven into the belt. If the attacker also gains the ascendency here, the defender continues his resistance in a "retrenched line" and finally in the enceinte. According to the "Instructions" the loss of the latter even constitutes no grounds for surrendering the fortress, the defence of which is still to be continued in

a *reduit*, in order to facilitate the re-taking of the fortress by a relieving force which may appear at the last moment.

From the above one sees that Kasbeck bases his attack on a definite configuration of the fortress and well-defined conditions of defence. Allowing that the defence of a fortress, dependent as it is on various circumstances and combinations of circumstances, will take a different course in each particular case, and that therefore a previously assumed course can hardly be accepted,—yet one must recognize that the course assumed in the "Instructions" is the only possible one for the elucidation of a theoretical development of the various questions. From the regulation that the measures to be adopted by the attack must be adapted to those of the defence it will be seen that Kasbeck in no way lays down a hard and fast scheme for the belligerents.

The paragraph "General course of the siege" receives quite a new interpretation in the 2nd edition. The methodical, *i.e.*, formal (step by step) attack is subdivided as follows:—

1. The first course consists of the surrounding (isolation), the object of which is the complete isolation of the fortress from the outside in order to prevent relief and replacement of men and *matériel*. To gain this object a line of defence is arranged about 2½ miles from the works of the fortress; this line forms, so to speak, a screen behind which the necessary preparations are carried out, *i.e.*, movement of troops, construction of roads from the detraining station, establishment of parks; it is also the means of getting into touch with the enemy, with the object of determining the extent of front for attack. This phase of the siege is called the *preparatory period* and the position taken up the *preparatory position*.

2. Under cover of this position the attacker pushes up his forces against the front to be attacked, working concealed; with the assistance of covering troops he constructs, at a distance of 1¼ to 1¾ miles from the belt line, a number of siege batteries and pivots; brings up his siege guns and arms all his siege batteries simultaneously in a pre-arranged night. This second line forms the *main attack position* and is destined for the artillery duel with the fortress. More detailed instructions for the conduct of the above operations are given in the 3rd section of the "Instructions."

With this preface the "Instructions" then deal with a few questions of siege warfare.

### Organisation of the Siege Troops and of all Other Means of Attack.

The organisation of the besieging army follows the same rules as the division of an army in the field (Corps, Divisions, Brigades, etc.). This organisation is however not to be regarded as hard and fast; it may be necessary for officers in charge of besieging operations to alter it during the various periods of the siege. For instance, certain details of the parks and transport may be detached from one unit and allotted to another; or certain companies of Sappers, for whom there is no other occupation, might be organised in battalions and employed in the Engineer Park, etc.

As compared with other powers Russia possesses a special advantage as regards siege troops in that she can reinforce them by means of fortress troops;* in peace time these fortress troops are trained in fortress duties and should be especially useful in the siege of a fortress. On the other hand Russia suffers from the disadvantage that she still has a scarcity of mobile siege artillery in the same sense as that existing in Austria-Hungary, Germany and France; this artillery enables an attacker to attack advanced fortified positions or even badly equipped parts of the belt without his siege park.

In Russia, as is the case also in Germany and France, the siege artillery park comprises, besides the various components employed by us, the field railway necessary for transport, together with telegraph and telephone *matériel* and *personnel*, as well as all materials for the construction of the batteries. The park is not regarded as a depôt, but as a separate command which is responsible, from the time the park is taken over at the detraining station, for placing the guns in the batteries ready for action. In accordance with this principle the laying of the field railway and the regulation of the traffic over it, the forwarding of guns and ammunition, the construction of batteries and the work of arming the batteries, form part of its task. The artillery park is divided into sections (Issuing and Intermediate Depôts) the composition of which depends on their special task and the methods of fire adopted by the batteries allotted to them. To each section are allotted several batteries further subdivided into groups for the construction and arming of the siege batteries. The subsidiary parks (Issuing and Intermediate Depôts) are connected with the batteries and main park by a field railway, and the main park is connected with the advanced base by means of ordinary railway. The Commander of the Park has charge of the supplies and traffic on these connections.

From the above it will be seen that the whole of the artillery is united in the Siege Artillery Park and is placed under the orders of the Commander of the Siege Artillery. It would be better to place the siege artillery *with all its parks* under the orders of the officer commanding the section of investment. This would naturally necessitate a corresponding organisation of the fortress artillery. The decentralisation of command thus sought would prevent that delay or undue haste in carrying out work which usually accompanies every centralised system.

The commanders of the various battery groups in the fighting line are

* According to Drygalski's *Organisation of the Russian Army in 1902*, and therefore before the war in the Far East, Russia possessed in Europe 50, and in Asia 9, Battalions of Fortress Infantry; these were partly organised in regiments and partly distributed in single battalions amongst the various fortresses. Their training is similar to that of the other infantry; but a special point is made of their prospective employment in fortified places, including the serving of guns and execution of earthworks. As regards Fortress Artillery Russia is supposed to have had 58 battalions of 230 companies, 5 independent companies and 1 separate command. This artillery counts in peace time as part of the stationary garrison of the fortress and remains in the fortress when war breaks out. In technical troops there existed:—12 Fortress Companies and 4 independent sections or detachments, 13 Mining Companies for the defence of fortified harbours and mouths of rivers, 2 River-Mining Companies for the Vistula and Narew, 8 Fortress Balloon detachments and 12 (?) Fortress Telegraph detachments, which are subdivided according to their strength into 3 classes; besides these there were 1 instructional park for ballooning and 1 electro technical instructional company.

therefore in Russia under dual control: (*a*) In an artillery technical sense, they are under the control of the commandants of subsidiary depôts, who are in turn under the orders of the commandant of the main park; (*b*) In a military sense they are under the control of the commander of the section of the investment, or under the orders of a senior artillery officer allotted to the front of attack. (But the siege artillery commander is responsible for fire discipline). Besides the group commanders there also exists in the "section" a special "artillery commander of the section," who, however, only commands the field artillery and mobile heavy artillery* in that section.

This organisation of the Siege Artillery Park† certainly makes the fortress artillery self-supporting and independent of other technical troops; but has the disadvantage that it increases the size of the already very comprehensive and bulky park, and renders more difficult the training of the already very much taxed artillery troops. It is true that this training is to a certain extent lightened in Russia by allotting certain duties—for instance the illumination of the field of fire, which in our service is performed by fortress artillery—to certain special troops. In conclusion one may remark that such a comprehensive organisation of the siege artillery park (incorporating the field railway) is not applicable to every theatre of operations; for instance in mountainous country the use of the field railway is almost entirely excluded in stretches where it is most wanted, *i.e.*, between the parks and the batteries. But still it may be affirmed that, in localities where it is of use, such an organisation is of material assistance in simplifying the service and in avoiding disputes concerning responsibility.‡

Contrary to the siege artillery park the engineer siege park is only a depôt. It is called Engineer Depôt and has arrangements similar to those in our service. In a siege it is subdivided similarly to the siege artillery park. It therefore consists of a main depôt and advanced intermediate and entrenching depôts. The forwarding of *matériel* from the main depôt onwards is done by means of wheeled transport. The transport of siege *matériel* up to the detraining station is carried out by placing railways, rivers, etc., at the disposal of the siege troops, these

* As already mentioned Russia possesses no mobile siege artillery organised as such; therefore, only such mobile artillery detachments can here be referred to as are organised, in the event of war, by detaching a number of mobile heavy guns from the siege artillery regiments. To these would also be added the 7 Mortar Regiments with, altogether, 24 batteries of six 6" (15·24 c.m.) field mortars. But as these latter are, on account of their small range, ill adapted for use as mobile siege guns, they are (in accordance with the latest reports) to be replaced by the 15-c.m. howitzers now on trial.

† Contrary to the practice in other states Russia possesses in peace time a properly organised siege artillery. The necessary guns and *matériel* are in peace time allotted to the 4 siege artillery regiments. As there are supposed to be 4 parks (each of about 200 guns) in Russia, 200 guns would be allotted to each siege artillery regiment or 6 guns to each of the 32 companies. The advantages of this organisation are not quite apparent; for in peace time the regiment is hampered with all sorts of details of administration and interior economy, and the training suffers; whereas in war time the regiment has to precede the artillery *matériel* and gets separated from its park on account of the necessary preliminary preparations and (in Russia) pending the construction of the field railway.

‡ Such differences—principally between gunners and sappers—occurred even in Vauban's times and repeated themselves at Antwerp, 1792, Badajos, 1811, and to a small extent at Paris, 1870–71.

lines being in charge of the line of communication staff. The transport from the detraining station onwards is in the hands of the artillery, which also, as above mentioned, supervises the construction of the field railway. This latter is destined exclusively for artillery transport; it may however, if available, be used by special order of the siege commander for transport of wounded, sick and supplies. This limitation of the use of the field railway might follow as a matter of course in the investment of a middle-sized fortress, on account of the comprehensive nature of the artillery transport requirements and the usual scarcity of railway *matériel* and rolling stock; yet such regulations do not seem out of place, as they prevent the field railway being overloaded, ensure the fullest possible use of regimental and other transport with the besieging force, and preclude from the very outset any latent hopes of the assistance of the field railway. Since every delay is a gain to the defender, and delays are unavoidable in using rivers as lines of transport for the siege parks, on account of the slower journey and the frequent shifts entailed, it is better to use railway lines for the transport of siege *matériel* and river lines for the regular forwarding of supplies and for transport of sick, etc.

### ORGANISATION OF COMMANDS IN THE ZONE OF INVESTMENT.

The division of the line of investment (preparatory position) into sections and sub-sections, the allotting of the section troops and reserves, and the settlement of the size and composition of the general reserve, follow by direction of the Officer Commanding in accordance with generally recognised principles. Section Commanders are made fully responsible for the security and protection of their sections. All troops are under their respective Section Commanders, but only in urgent cases have the latter unlimited control of the siege artillery. In the front of the attack the Officer Commanding personally directs operations. But the regulation is not meant to limit the freedom of decision and independence of the Section Commanders; they are therefore justified (in accordance with the "Instructions") in ordering an advance in the attacking front, if they consider a favourable opportunity presents itself. This is in accordance with the spirit of modern regulations, which encourage individual action in every battle. The idea applies also to an attack on a fortress. In the case under discussion a Section Commander, whose troops have been in continual touch with those of the defence, might possess later and more detailed knowledge of the immediate state of the defender than the Officer Commanding in rear, in spite of the latter's numerous connections by telegraph and telephone; it is therefore only natural to demand that the former should without hesitation make the fullest possible use of any opportunity for a forward movement. As the sections of the front of attack are generally allotted to Divisions, the Section Commanders possess the means of initiating an opportune attack and of effectively occupying the position gained. On account of the high rank of such section commanders, and the grave responsibilities they incur by acting in accordance with their own independent decisions, the danger that this independence of action will betray them into hasty

action at an inopportune moment is slight and is not borne out by military history. The condition of Paris on the arrival of the first German troops offers an example to the contrary; on this occasion Moltke said that a surprise might have succeeded, if a subordinate leader had undertaken it on his own responsibility. In this respect our own *Infantry Training* states: "Each Commander must seek to gain the initiative in the preparation and execution of a combat. Bold resolution, based on an intelligent appreciation of the situation, is indispensable in a leader. In doubtful cases the bolder plan is always the better. A mistake in the choice of a plan does less damage than hesitation and inaction. Where possible surprising an enemy must always be aimed at."

The Russian "Instructions" further lay down that during the advance in one section the commanders of adjoining sections must co-operate. This also is in accordance with our *Infantry Training*, which states: "Commanders in the firing line, who are best able to notice the effect of our own fire and must rapidly avail themselves of any advantages the immediate situation offers, may also give the impulse for the execution of the assault. They act however on their own responsibility. The remaining commanders at once co-operate." In the sections of the front of attack Generals of the higher ranks take command and relieve each other day by day; they are designated "Generals of the Day." The working out of details,—viz., the division of working parties, their supervision, the arrangements of the infantry positions and the approaches, the erection of sign posts, the construction of dressing stations, the guarding of the approaches, etc.,—is the duty of the "Trench Major" of the section (usually a staff officer of engineers), who has several engineer officers under him. It will be seen therefore that the technical officer has to deal simultaneously with technical and military matters, and it is therefore necessary that he should be master of both.

### PRELIMINARY INVESTMENT.

Decisions necessary for the conduct of the siege are given in the 3rd Section of the "Instructions." These agree generally with the views accepted by most of the Great Powers, but are naturally suited to the special cases of Russian fortresses, organisation of the troops and their methods.

The preparatory operations are concerned with the preliminary investment of the fortress, which also in Russia is caried out principally with cavalry and the advanced troops of the investing army. During this period the preliminary reconnaissance is carried out by the General Staff, and by the officers commanding the artillery and technical troops. The Officer Commanding the investing army points out to the arriving troops their preliminary destinations. The line connecting these various destinations corresponds to our preliminary line of investment, and, according to the "Instructions," should be 4,400 yards from the defensive belt. There is no particular name for this position, as is the case with the subsequent ones; for it only serves the purpose of enabling the

troops arriving to equalise the differences in the lengths of their marches, to take up their new organisations, and to bring up the heavy artillery of the field army.

### CLOSE INVESTMENT.

From this preliminary line the investing army advances simultaneously, if possible, against the whole circumference of the defensive belt of the fortress up to a distance of about 4,650 yards from the works of the defence. This line is called the line of close investment or the "Preparatory Position." In the zone of close investment advanced positions of the enemy may be met with, round which a number of obstinate engagements may develop. These positions may be strengthened by fortifications, for the overwhelming of which field artillery may not suffice. For this reason the attacker must at once bring up the heavy guns of the field army. For the establishment of the line of close investment the attacker need not wait for the siege park. The line should be strengthened by field works, and serves as a base for the formal attack; in this line the siege park is awaited.

Whilst the wording of the 1st edition of the "Instructions" defines the line of close investment as "withdrawn from the effects of the guns of the fortress," the 2nd edition admits the possibility of not only advancing this line to within 2½ miles of the fortress but also of maintaining that position without the presence of the siege park. This decision is in accordance with the views of those writers who, relying on the experience of the 1870–71 campaign, advocate the capture of any advanced positions and their inclusion in the line of investment; and in opposition to those who advocate their capture being deferred until rendered necessary after the preparations for the artillery attack have been completed. The proper course can only be decided by the particular circumstances of the case, and depends on various considerations, such as strength and attitude of the enemy, the nature of the advanced position, its command over the defensive belt and over the field of attack, the general condition and preparedness of the fortress, the nature of the country, etc. Even after the investment has been made as close and complete as possible, the rapid capture of advanced positions is still to be sought as soon as one can count on their being occupied for a prolonged period without the assistance of the siege artillery. This decision in the 2nd edition also possesses the advantage of not forcing an attacker to inaction, and of enabling him to use the heavy artillery of the field army in overcoming the resistance of the advanced positions, for which purpose it might in most cases amply suffice. The contention that such a procedure discloses prematurely the direction (not frontage) of the attack hardly holds ground, for a defender has many other means of ascertaining this, if he carries out his reconnaissance and intelligence duties properly. He can moreover already infer this from the general conduct of operations, the state of the railways leading to the fortress, the choice of the detraining stations and the activity of the thousands of men employed there for weeks, the construction of the field railway and arrangement of the siege parks. To wait until the arrival of the siege park would force the

attacker to make, in the greatest haste and with extraordinary exertion, the comprehensive preparations which precede the opening of fire, and would give the defender unnecessary opportunities of rectifying mistakes and of strengthening himself.

*Organisation of the Close Position of Investment.*—In order to anticipate all doubt and friction, which is more liable to occur in fortress warfare than in field operations, the extent and duties of the most important commands are exactly defined. Without unduly restricting the independence of the commanders of sections, the Officer Commanding the investment is given the necessary independence in order to personally supervise the conduct of the attack. In accordance with the regulations for field operations the protection of the sections is secured by outposts, which are however made stronger in fortress warfare on account of the repeated attacks they have to withstand. The garrisons of the pivots in the sections avail themselves of natural cover in their vicinity, and only occupy the positions allotted to them to repel attack.

This latter instruction, which has for its principal object the comfort of the troops, would however only be possible in a country well intersected by roads, where the garrison could be accommodated in the vicinity of the pivots by means of natural cover. In a flat country, affording no cover, the troops would, in order to avoid the enemy's artillery, be accommodated some distance to the rear, and might easily arrive too late to occupy their position. There might be neither time nor labour for the provision of artificial cover (shelter and overhead cover) or for the construction of inter-communication trenches, since at this period the commander of the section might only have available for the strengthening of his section of the investment line the technical troops allotted according to the organisation of the troops under his command. (In our army at most a company of engineers and 3 to 4 detachments of regimental pioneers). When one further takes into consideration the requirements of the section besides fortification—*e.g.*, camps and shelters, improvement of communications, clearance of field of fire, etc.—there appears in most cases no other course possible than to accommodate the troops near the positions they have to occupy, provide alarm posts there, and allot to them a portion of the outpost line which they can relieve daily. Thus it would be possible to reduce technical labour to a minimum, spare the troops, and keep them capable of resistance. This method should be all the more feasible, since the fortifications should not form a continuous line, but the fullest possible use should be made of the configuration of the ground by grouping them in localities where attack may be expected. The arming of the close position of investment is carried out by the heavy artillery of the field army and by a portion of the field artillery (machine guns might also well be used). The remainder of the field artillery remains in reserve. In the more important positions, according to the Russian "Instructions," batteries (normal siege batteries) should be constructed for the expected siege artillery. In case of necessity these are armed with guns, which could be used for bombarding the forts or such targets as do not sufficiently come under the fire of the heavy artillery of the field army in the preparatory position.

### THE CHOICE OF THE FRONT OF ATTACK.

The choice of the front of attack is incontestably one of the most important considerations of the Officer Commanding the investment. It is of course understood that he can only make his choice after careful personal reconnaissance and prolonged deliberation; yet he will be able to clear up the situation as regards its most important aspects—as far as existing fortresses are concerned—by means of the plans prepared in peace time. The "Instructions" make no mention of such plans although there can be no doubt that they exist in Russia as well as in other countries.

In the choice of the front of attack the Russian "Instructions" lay special stress on the direction of the railway line nearest the fortress. Up to a certain point one can agree with this view; it is remarked in parenthesis that the most advantageous case is that in which the railway line debouches immediately in rear of the chosen front of attack; this is however very seldom the case. In view however of the complete development of the technical means of the present day (amongst which the field railway and the automobile take the first place) too much account should not be taken of the above-mentioned advantage, particularly if its acceptance involves other serious disadvantages. The choice of a front of attack on either side of a line of communication forfeits all chances of surprise; an attacker should not give these up if he wishes to avail himself to the fullest possible extent of the advantages of the initiative, in spite of the present very complete means of observation and intelligence possessed by the defence. Moreover the disadvantage of transporting to a flank, entailed by the choice of a front of attack which is not too far on one side or other of the line of communication, is not prohibitive as soon as the flank shifts can be carried out under cover, particularly if the field railway and other means of transport at the disposal of the attacker are taken into consideration. The distance of the detraining station should not be less than 6 miles from the defensive belt, and at the time the *matériel* for the field railway arrives the attacking troops are already in the investing position, which is at a distance of 4,400 yards or less from the defensive belt. Since observations by balloons, which are most to be feared, could hardly be carried out nearer than in the belt, it will be seen that, apart from the difficulties of observations at so great a distance, quite small elevations of ground or low cover will suffice to screen the loads on the field railway, barely 5 ft. high, from the observer's plane of sight ($\frac{1}{20}$). Even supposing the defender has discovered the field railway, he still does not know, except in very special cases, which forts or intervals it is intended to attack.

There is a further reason which might induce an attacker to digress from a line of communication. Localities where railway lines enter the line of forts are usually strongly fortified and well defended by artillery; therefore an attacker might be influenced to choose another direction of attack, since his supplies of *personnel* and *matériel* cannot be unlimited, although they are not restricted to the same limits as those of a defender.

Siege guns and their ammunition constitute some of the most difficult

stores to replace or bring up. It is true that they are placed in readiness in peace time; but their number is limited by their prohibitive cost, and can hardly suffice for every possible attack on a fortress during a campaign. Therefore an attacker can only dispose of a certain limited number of guns, which might be less than that of the fortress.

This circumstance will force him to look for a front of attack where, in spite of his inferiority of strength, he may gain a relative superiority of fire. This is the main object of an attacker in fortress warfare, as well as in operations in the field; and the number of guns that a defender is able to mount in a fortress does not play such a decisive *rôle* in his power of resistance. For instance, should one portion of the defensive belt be cut off from another by a river, possess few lines of supply with communications, and have bridges within range of the guns of the investment,—and should this portion of the defensive belt be limited and commanded by the surrounding country,—it will offer such prospects to the attacker for the attainment of a relative superiority in the artillery battle that he will choose it as his front of attack, even if his base is indifferent and he is forced to make a considerable digression from his lines of communication. That such cases can occur is proved by glancing at those fortresses which are situated at the confluence of lines of communication by water or in marshy country.

### METHOD OF ATTACK.

With the choice of the front of attack the commander of the investing army also determines the *method of attack*, in which he has to choose between the normal (siege) attack and the more expeditious attack (assault). To this latter method which, according to latest ideas of fortress warfare, should be carried out by the heavy artillery of the field army, the writer of the Russian "Instructions" devotes a special paragraph which is given in detail.

"45. *Assault.*—This may be undertaken when—

(1). The works and intervals possess no bombproof cover.
(2). The surprised fortress possesses no armament for the intervals, or an insufficient garrison.
(3). The investing corps has at its disposal numerous field artillery and sufficient heavy guns of the field army.

The advocates of the assault recommend the following procedure:—The investing troops, divided into various independent columns, advance towards the fortress and appear simultaneously at different intervals in order to force the defender to scatter his forces; the attack is then prepared by the heavy artillery of the field army; after which the intervals are to be forced. From this it follows that an assault only offers prospects of success when the fortress is of obsolete construction, when it does not possess sufficient bombproof cover against 15-c.m. howitzers or 21-c.m. mortars and has no means of traversing guns under cover to protect the intervals, or when the fortress is surprised. When these

conditions are absent it is better to adopt the normal method of (siege) attack than the assault, and to begin with a bombardment."

The *Joint Plan of Attack*, to be submitted by the officers commanding the siege artillery and the engineers to the Officer Commanding the investment should comprise:—The limitations of frontage of attack, its subdivision into sections and sub-sections, the fresh grouping of all troops, the connections of the parks to the front and rear, the establishment of the siege artillery and the construction of the main attack *position*. Since the latter is not mentioned in the 1st edition it merits closer inspection.

The instructions respecting it are as follows:—Under cover of the preparatory position (4,700 yards distant from the belt) the main attack position is prepared at a distance of 3,500 yards from the belt. In this the artillery of the attacker, destined to conduct the decisive battle with the artillery of the fortress, plays the decisive *rôle*. By reason of the proximity of the fortress and the corresponding danger to the works to be constructed in the main position, care must be taken to construct these step by step and in concealment, and to direct the defender's attention to other portions of the investing line. The works are constructed under the superintendence of engineer officers in accordance with a pre-arranged plan; the first thing done is to provide shelter trenches for the covering troops in advance. Day by day the cover provided is extended and the old cover made more perfect; after some days of this procedure a sort of backbone of the main position is developed, which must be perfected during the period preceding the arrival of the siege park, so that the mounting of the siege artillery may possibly follow in one night. The batteries are further perfected by the establishment of points of observation (observatories, balloons), construction of telephone lines, and other arrangements necessary for firing. From the above one sees that in the "Instructions" the term "main attack position" comprises the artillery position as well as the covering position.

In von Gerwien's instructional book on fortress warfare the average distance of the artillery position is given as $1\frac{3}{4}$ to $2\frac{1}{2}$ miles, and that of the covering position as $1\frac{1}{2}$ to 2 miles; according to the *Leitfaden für den Unterricht in der Befestigungs lehre auf den Königlichen Kriegsschulen* the former is $1\frac{3}{4}$ to 3 miles and nothing is given for the latter; the French instructions give no distances at all. Regarding the covering position the Russian "Instructions" lay down generally that it should be as near the belt as the hostile fire permits, and sufficiently far in front of the siege artillery to prevent damage from shells directed at the siege artillery. It will be seen, therefore, that the idea prevails of advancing the artillery as well as the covering position as near to the belt as possible, in order to use only one artillery position; moreover the Russian "Instructions" give the smallest figures for the respective distances. According to German views the exact following of these distances has no important bearing on the conduct of the attack, as soon as the siege guns are advanced to within effective range and there are good means of observing their fire.

The "Instructions" give no detailed rules as to frontage and nature of the covering position, the moment for advancing it, its construction and armament, connections to the rear, or division of the garrison. One can

however recognise from the general rules and the accompanying plan that the arrangements do not differ from the usual form of a modern normal (siege) attack. The presumption that several days are necessary for arranging the main position (close line of investment) is specially significant as according with present views, *i.e.*, that the works of the covering position and the batteries are separated not only as regards space but also as regards time. The "Instructions" do not indicate how long the work is likely to last. Von Gerwien gives the whole period as five nights, and allots two nights to the covering position and two to the construction of batteries; so that the arming of the latter could be effected in the fifth night and fire could be opened on the sixth day after the commencement of the work mentioned above. In these calculations he assumes however that the laying of the field railway is commenced simultaneously with the covering position, that it is led to the sites for the batteries, and that materials for the construction of the batteries are ready to hand. The calculations of von Gerwien therefore represent the most favourable circumstances which, as we learn from the 1870–71 campaign, hardly ever exist; on the contrary the establishment of the 1st parallel, barely 1¾ miles long, before Strasburg could only be accomplished between the 29th and 31st August (two nights) by using 59 battalions, and in most cases from 2 to 4 nights were necessary for the construction of batteries. The laying of the field railway might also not be so quickly accomplished in fortress warfare as von Gerwien assumes, since the arrangements connected with it,—such as shunting stations, stations and park arrangements,—are much more numerous and more extensive than in ordinary field operations, and therefore demand more time; the contemplated immediate use of the line for railway traffic makes its construction much more difficult. One would not therefore go very far wrong if one allowed double the time given above for the works of the main attack position. But the stipulation contained in the Russian "Instructions" to arm all the batteries in one night is unlikely to be accomplished.

The moment for advancing the covering position is dependent on the commencement of the laying of the field railway necessary for the preliminary construction of the batteries. It can only be worked out further for each particular case by labour and time calculation, since it depends on conditions of country or cover, favourable or otherwise to the laying of the railway.

As regards the strength of the siege artillery, its employment and fire discipline, the "Instructions" take the same views as those advocated in most German publications and also in the French instructions. Superiority in number of guns and sufficient ammunition ready to hand are laid down as the only unconditional stipulations for the attainment of certain success and for opening fire. How large the superiority, expressed in numbers, should be is not given in official or semi-official regulations (German, French and Russian); but this is more closely indicated in *Grundriss des Festungs Krieges* by W. Stavenhagen and in our *Pocket Book for Officers of the Engineer Staff and for Pioneer Officers*. For the conduct of a decisive artillery attack in the front of attack the former demands 1½ times, the latter double, the number of guns which, inclusive of guns in reserve, the

defender can bring to bear in the immediate front and adjacent to it. It may be true that the latter figures, which have taken root as a convenient rule to be followed in artillery circles, mean a sure success; yet as mentioned elsewhere, this number of guns will not always be at the disposal of the attacker; nor will they always be absolutely necessary to attain superiority of fire, since the latter depends also on the superiority of the artillery positions, the guns themselves, fire discipline, direction of fire, observation, amount and supply of ammunition. It is not clear why the siege gunner should alone possess the right to enter battle unconditionally with two-fold superiority; certainly the aim of other arms is also always to gain superiority of force. Apart from this however, how often has it not happened that weaker forces have gained a victory over a stronger adversary? Does not an attacker possess a very important superiority, even with equality in number of guns, when one considers that his guns are nearly always better than those of the defence, that his positions only offer small targets, that the employment of enfilade and reverse fire is easier for him than for the defender who is bound to his defensive belt, etc.? One may therefore assume that an attacker, who understands how to make clever use of the prevailing circumstances in his favour, may accomplish his task with a less number of guns than is given above, and that the above rule as to numbers only becomes imperative when the positions of the attack offer no advantages; these numbers therefore only give a maximum. In order to prove this aspect of the question some examples from the 1870-71 campaign are given.

According to the supplementary report by Lieut.-General Muller of the bombardment of Paris, the German artillery of 76 guns not only maintained its position during the bombardment of Mont Avron on the 26th December against the enemy's superior artillery, but gained an important success by forcing the defender to abandon Mont Avron during the night of the 29th December. In January, 1871, the German artillery was in a similar position in attacking the southern front of Paris with extraordinary success, having 110 guns against the French 180 or 190.

There is a contradiction in the paragraphs of the Russian "Instructions" dealing with *Employment of the Siege Artillery* and *Opening of Fire;* the former places the destruction of the shelters and magazines in the defensive belt before the silencing of the defender's artillery; while the latter lays down that the siege battery should direct its fire against those batteries of the defence which have been located at the time of opening fire. The latter instruction would appear to be the more correct, since, in accordance with tactical principles, the nearest and therefore most dangerous targets (in this case the artillery positions ready for action) are the first to be attacked, and not the infantry garrisons remaining under cover or the munitions of war in the magazines.

The orders given in the Russian "Instructions" as to the use of the field artillery do not appear very advantageous. In accordance with these, the field artillery is to assist the siege artillery in front of it from the preparatory position (4,700 yards), for which "it is considered adapted on account of the effective shrapnel fire of modern quick-firing guns." Although no one denies the necessity of the co-operation of modern field

artillery in future fortress warfare, opinions differ as to its employment. Many writers (Frobenius, Hubner and partly Rohne), who consider field artillery ineffective in the bombardment of the forts, would employ it in the destruction of the living forces of the defender and in fighting these when they are either behind cover of the fortifications or behind cover in advanced positions; others however (Stavenhagen, Kasbeck) include the field artillery in the battle against the guns of the fortress. The principle must be followed that at no period of the investment is an attacker justified in not using *all* his means to gain a quick and decisive effect, and that he is therefore bound to use them according to their capabilities to the fullest possible extent. The mobility, improved range and effect of the field artillery enable it by changing position to engage the guns of the fortress with success even within effective range of them. Thus it can be of material assistance to the siege artillery. This becomes all the more evident when one considers that the targets the first-named writers have in mind for the field artillery do not exist at the commencement of the artillery battle, and having no targets it would be forced to inaction. Therefore the second view is the right one, but with this provision (as far as the Russian "Instructions" are concerned), that the field artillery allotted to co-operate with the siege artillery should be in advance of the latter, *i.e.*, in or in rear of the covering position, since the grazing nature of its fire is more effective there and is not masked by the siege artillery. By leaving it in the more distant line of investment one could not make full use of its mobility, and one would have to abandon all idea of its co-operation from any concealed positions, which might even be within range of the guns of the fortress. The Russian "Instructions" give no further hints as to subsequent employment of the field artillery, although well merited by modern field guns. The light field howitzers, the value of which has nowhere been discussed in detail, should have received special attention.

The following train of thought is adopted in the discussion of the fire discipline of the siege batteries. Endeavours should be made first of all to silence a portion of the artillery of the defence whilst the remaining portion is only kept employed. This can be attained either by grouping a superior number of guns against the target or by a quicker rate of fire. These instructions should be compared with the procedure recommended by von Gerwien, as exponent of the German view, who states: "At the commencement of the artillery battle the hostile fire from the most dangerous batteries must first be silenced whilst the others are merely kept employed." The difference between the two views is principally that in the first the artillery of the defence is to be reduced in *sections* and in the second in *order of importance*. Which of these plans is the best, *i.e.*, which would be the quickest in overwhelming the artillery of the defence, could only be decided by concrete cases, in which the nature of the country would most influence the plan to be adopted. Theoretically one may only surmise that, in adopting the method of overwhelming a section of the artillery of the defence, an attacker might be enabled, after overwhelming a particular section, to take up more advanced artillery positions from which he could bring enfilade fire to bear on the remaining

portion of the front of attack, and thus more quickly attain superiority of fire throughout its whole extent.

With respect to the commencement of fire the Russian instructions are similar to the French and German ones; and demand that the fire of the attacking artillery should only be opened when the whole of the siege batteries have been constructed, armed, supplied with ammunition, connected to the rear, and provided with observing stations and means of communication.

### THE INFANTRY ATTACK.

As is the case with most technical literature dealing with instruction in fortress warfare, the *Infantry Attack* forms the least considered portion of the Russian "Instructions"; with barely a few lines they dismiss the functions of infantry within a zone of roughly a mile, although the latter will be the theatre of the most vehement and bitter engagements. Of a connection between the infantry and artillery attack there is also no mention; the form the infantry attack will take is merely given in general terms. In favour of this representation of the infantry attack it may be urged that it ascribes to the defender, even after the overwhelming of his artillery, such power of resistance that he can bring the infantry attack to nought; and therefore this attack is represented as a "series of day and night engagements extending throughout the whole extent of the front of attack." This standpoint is remarkable in that it contradicts those military writers who assume that, with the attainment of superiority of artillery fire, the whole of the resistance of the defence is broken. That this is not the case is shewn by the present campaign, as far as can be gathered from the reports in the papers; the resistance of the Russians, even in positions strengthened by fieldworks only, was only broken by a formally fought out infantry attack and bayonet charge, in spite of an artillery battle lasting for days and of the superiority of fire gained by the Japanese.

As is commonly the case the "Instructions" regard the covering position as a base for the infantry attack. They are not very plain however regarding its commencement; they merely state: "Under cover of the siege artillery, which gradually destroys all means of defence, the attacking infantry occupies the country in front, advancing by rushes, and is assisted by the field artillery." The "Instructions" therefore do not clear up the existing differences of opinion with respect to the moment for launching the infantry attack. The differences of opinion are especially with respect to the following questions:—Should the attack only be launched (as demanded by some writers) "when fire effect is beginning to impress the enemy after his own has been reduced"; or should the attack begin at the same time as the siege artillery opens fire, and continue during the artillery battle until a position is gained from which the next hostile position can be swept by rifle and machine gun fire? Since the moment for commencing the infantry attack principally depends on the resistance offered by the defender, and cannot therefore be judged in advance, General Kasbeck may have desired to leave it to the judgment of the Officer Commanding the

besieging army, without binding him to any hard and fast rule. Reviewing the above aspects of the question theoretically, one may therefore say that in the former procedure (launching the infantry attack after gain of superiority of fire) the fire superiority gained by the artillery is regarded as the only decisive factor in the attack on the defensive belt, infantry only being added to gather the ripe fruit; in the latter procedure (commencing the infantry attack when the siege artillery opens fire) it is intended on the contrary to aim at mutual assistance by employing both arms (infantry and artillery) simultaneously, and thus to gain the desired object by more expeditious and approved methods. But in order to comply simultaneously with the double demand in the last-mentioned procedure, *i.e.*, reduction of the defender's artillery and assistance of the infantry attack, numerical superiority of guns and unfailing amount of ammunition on the side of the attacker are more important factors than they would be in the first-mentioned method.

In the first method the separation of the artillery and infantry attack is clearly defined; while in the second the moment when one merges into the other is as unnoticeable as possible, and the defender might—if such were within the bounds of possibility—be more easily misled. The further case might occur that an infantry attack becomes necessary for the very purpose of enabling the besieging artillery to open fire, on account of the defender's artillery being withheld; for the discovery of retired and well-masked batteries is rendered more difficult from a distance, but is quite impossible in their vicinity, if there are hostile lines of infantry pushed forward. An example of such failure is given by the first part of the South African War, in which the English could not succeed in discovering the Boer positions. Plevna and the Boer War (at Magersfontein, Colenso and the Upper Tugela) have effectively demonstrated how unsuccessful is a mass of fire against insufficiently reconnoitred positions. In the case of the defender withholding his artillery the attacker must endeavour to undertake a reconnaissance in force, under cover of his siege artillery placed in readiness for action.

The German training regulations for field artillery speak in a similar sense and state, in the description of the danger incurred by a noticeable separation between the artillery battle and the infantry attack, "It is however to be borne in mind that quantities of ammunition expended against fortifications, with no garrisons or only weak ones, are of no appreciable value. This is to be dreaded when the separation of the battle into a long drawn-out artillery preparation and subsequent infantry attack is also apparent to the defender. The effect of the artillery against the main points will be most remunerative if the infantry, by creeping forward and keeping touch, force the defender to occupy his lines and show his troops. It is one of the principal tasks of leading to combine the gradual deployment of the infantry with the protection afforded by the artillery fire." By proceeding thus the defender is forced—unless he wishes to dispense with the co-operation of his artillery—to open with his flat trajectory guns on the advancing infantry, and to push forward the guns into positions with little or no cover, where they are rained on by the shrapnel of the attacking artillery. The

attacking infantry need not fear the high-angle armament of the defender (about ⅔rds of his whole armament), since indirect fire cannot as a rule follow moving targets quickly enough. If the advancing infantry of the attacker comes within rifle fire of the defender, it discontinues its movement and takes natural cover. On account of its mobility and shrapnel fire the field artillery accompanying the infantry (also the siege artillery) is able to take part with success in engaging the flat trajectory guns directed against the attacking infantry.

If the defender has pushed forward lines of infantry in advance of his belt (which, according to the Russian methods of defending a fortress, may with certainty be assumed), the covering position may already be within long distance rifle range of the hostile infantry; therefore as soon as the attacking infantry leaves the covering position it may be forced to open fire within effective rifle range from the nearest hostile position. In this case (bombardment of the infantry lines) the resulting assistance rendered to the attack by the attacker's artillery will not be particularly effective and continuous during the attack, on account of the frontal nature of its fire and the increasing danger to the infantry from the great dispersion of splinters and shrapnel with curved trajectories. Therefore, before launching the infantry attack, one must either wait until the defender's infantry has been shaken by the siege artillery or, as in field warfare, delegate the task to the field artillery which accompanies the attack; in the latter case the best gun to bring to bear on the infantry lines, as also on their means of cover, will be the light field howitzer (counted as part of field artillery), because it can rapidly change from common shell to shrapnel, and because it is suited to oppose counter-attacks and in case of necessity to quickly change position. According to Hoffbauer: "The expenditure of the same weight of ammunition from several light, as opposed to few heavy, field howitzer batteries corresponds better with the liberal provision of light cover in the positions of a mobile war strengthened with field fortifications. The advantage of hitting 2½ times as much cover with lighter shells and making certain of penetration is of more value than increasing the force of the penetration with a considerably increased expenditure of ammunition." The few isolated cases of improved cover, capable of withstanding the penetration of field howitzers, do not enter into the question, for which reason the German regulations also state: "The penetration of improved cover or casemates, although very desirable, is not to be considered absolutely necessary." From the above it follows that the time for the commencement of the infantry attack must be settled for each particular case, since it depends on the one side on the organisation of the defence in the immediate front of the fortress and on the resistance of the defender, and on the other side on the superiority of guns.

Regarding the *Method of Infantry Advance* from the covering position against the fortress, the "Instructions" merely mention, without giving distances, that the advance should be by rushes; but the distances can be readily inferred from preceding principles. The covering position, as previously ascertained, is from 2,000 paces to 2,666 paces distant from the belt, and the Russian method of defence presupposes intermediate

positions; therefore an attacker of a Russian fortress will not find that undefended zone which would exist according to those writers who bind the defender to the defensive belt and deliver up to the attacker without offering resistance the country in front between the distances of 2,666 paces and 1,200 paces. Therefore also against Russian fortresses—as is confirmed by reports from Port Arthur—it is out of the question to cover the zone intervening between 2,200 yards and 1,000 yards in one swoop. With the procedure advocated by von Gerwien there will also be no unprotected zone of above depth; in accordance with this procedure, the outpost position to be occupied by the defender should be arranged in exactly the same way as the investing line of the attacker, and should be pushed forward for the better protection of the forts to a distance compatible with the strength of the garrison and effective protection of the guns of the fortress; this distance will generally not be more than 1 kilomètre (·621 mile), but beyond the position will be the outpost companies with the necessary picquets and sentry posts. For the above reasons the attacker, on leaving the covering position, must be prepared for "serious encounters" with the defender, and will even at this early time be forced to employ rifle fire and to advance in rushes. In consequence of the above-mentioned circumstances the number of rushes is not indicated in the "Instructions," and this is also in complete accord with modern views.

With reference to the *Division of the Infantry for the Nearer Attack*, the Russian "Instructions" incline towards the French ones; they similarly distinguish between two bodies of troops,—covering troops and advanced groups,—corresponding to the tasks to be undertaken by the infantry in the front of attack, *i.e.*, the protection of the section and the battle for the capture of fresh positions. The task of the covering troops is to occupy the position captured, to maintain it, and to protect the troops in rear; they are under cover and in trenches, and offer a passive resistance. The advanced groups consist of single detachments of troops, usually detachments or companies of sharpshooters, and take post in front of the occupied position. These groups have to advance, fighting step by step, towards the fortress, and observe the activity of the defender. For this reason they are in continuous touch with the enemy and utilise every opportunity of involving him in a skirmish, and thus capture a fresh position in which they at once entrench themselves. This cover serves in turn for the establishment of still further infantry positions. The conduct of these troops is therefore offensive.

Let us compare this division with the distribution of outposts advocated by German writers and ourselves, which seeks to attain the same object as the Franco-Russian one, yet differs materially. The mode of attack of our distribution consists in this: the new infantry positions, gained by having driven back the defender during the day, are entrenched for considerable distances at night by working parties under cover of covering troops, and are perfected and placed in communication with the positions in rear during the following days. From the above it is seen that, whilst the Franco-Russian method adapts the elastic form of an attack in the field to that of an attack on a fortress, the Austro-German

procedure chooses the stiff and immovable method of outposts. It follows from the nature of the two problems—security and attack—that they cannot be solved by one and the same body of troops. For whilst the duty of protection only presupposes a passive engagement, best carried out by close groups or advanced posts, the contemplated infantry battle demands freedom of movement in all directions and cannot be bound to the maintenance of the security of a particular point or section. It therefore follows that the capture of fresh sections must devolve on special bodies—as intended in the French and Russian instructions. That the outposts should also be able to assist vigorously, if possible, is a matter of course, and is anticipated by the last-named instructions. The first method moreover gives to subordinate commanders the opportunity of immediate and independent action in making the fullest possible use of favourable conditions for attack. In the second method the complicated system of command from the rear has to be put in motion, the advance organised and various preparations made, which not only means that a correspondingly great loss of time (and of immediate advantages) is incurred, but that the defender's attention is drawn to the procedure in plenty of time and he is able to take counter measures; besides, the latter method uncovers larger masses of troops to the enemy and must lead to much greater loss. But, in spite of the disadvantages inherent in the last-mentioned (Austro-German) method, it must be acknowledged that there are not unimportant advantages; these consist of unity and increased effectiveness in action, and of a methodical and simultaneous advance throughout the whole extent of the front of attack, which cannot be the case with the isolated actions of the generally weak commands of the first (Franco-Russian) method. The Austro-German plan ensures therefore, when successful, a greater probability of a further rapid progress in the attack.

No general rule can be given as to which is the better method, since it depends in each case on the particular condition of the defender. If, however, one imagines to oneself the distribution of the foremost forces of the defender from the time the attacker leaves the covering position (2,666 paces distant) until he occupies the position of assault (266 to 400 paces distant), one may imagine that, as the attacker advances, the defender will draw his forces closer together and retire them nearer the belt; during the time that the attacker is occupying the covering position the defender will only have weak covering troops in advance; but he will have to oppose close lines to his enemy occupying the position of assault. The attacker therefore will be able to utilise both methods of pushing forward and gaining ground, viz., the Franco-Russian at the closer distances and the Austro-German at the far distances; in the former case the attacker will be enabled to sneak up to the close hostile lines with small detachments and patrols, and in the latter case he can advance in long and close lines up to the weak chain of outposts of the defender.

There is a further question to be considered in regard to the infantry attack, and that is the method to be adopted in driving the defender out of his infantry positions. Should rifle and artillery fire suffice, as generally assumed, or will it be necessary to drive him back at the point of the

bayonet? Although a purely theoretical answer to this question is useless, one may state, in respect of the disclosures of the Russo-Japanese war, that an energetic and tough defender will even fight at the point of the bayonet before ceding his position. In the said war this happened in the battles in the field (nothing reliable is yet known about the battles round Port Arthur); therefore why should it not happen in fortress warfare, when the conditions of holding positions are much more in favour of the defender? The danger threatening a defender, that when he retires the attacker will penetrate at the same time to the next position or to within the belt, may be avoided in the same way as in operations in the field, *i.e.*, by an opportune occupation of the position in rear with reserves and by the advanced troops clearing the front.

The technical works in connection with the infantry attack are regulated in accordance with special instructions; these follow the generally recognised principles of a modern attack and need not be further explained. It need only be mentioned that the fullest possible use should be made of the ground; and where such is unsuitable, deep, inconspicuous and well-masked cover should be provided artificially.

### THE ASSAULT.

In the measures to be taken for the *Assault* the Russian "Instructions" first fix the conditions under which the Officer Commanding the besieging army may decide on this closing act of the attack on the fortress; the greatest weight is laid on the destruction of the trenches and flanking defences of the intervals, and it is pointed out that it is better to defer the assault if these conditions have not been fulfilled. The breaching of the escarp demanded in the 1st edition of the "Instructions" is left out of the 2nd edition; from this one may conclude that in Russia also it is intended to use appliances for assault, and that they are preferred to the tedious and questionable bombardment with the object of breaching; in modern fortifications moreover there are no more walled escarps.

The *Mining Attack* is still, and rightly, mentioned, although it is allowed that its use will only be necessary in certain cases. But in spite of this, and contrary to views held elsewhere, Russia still considers mining operations of the highest importance, and such exercises are practised every year at the camps of the Engineer troops.

As of special importance in deciding to assault the "Instructions" mention the moral depression of the garrison of the fortress. Should this be present before the destruction of the material means of defence, and be ascertained to exist beyond doubt, the Officer Commanding the besieging army must at once decide to assault the front of attack.

The "Instructions" dealing with the preparation and conduct of the assault agree with our views on the subject. It is only noticed that they lay special stress on surprise, and therefore recommend that the enemy should be deceived; this should be enhanced by organising assaulting columns on neighbouring parts of the frontage. Would not the man deceive himself who at this moment still believes he can deceive the defender as to the choice of the front to be attacked?

In conclusion the "Instructions" do not bring to notice forcibly enough the necessity for the most exacting mutual co-operation between all detachments and means of assistance used in the assault. This demand is made all the more important by the fact that all preparations for the assault can only be made in the last hours, *i.e.*, under strong pressure of time, since otherwise the danger threatening the defender will be made too easily apparent. Therefore, to reckon with some certainty on the success of the assault, all concerned must be minutely instructed as to the parts they have to play, and must have practised them beforehand, that is learnt them from the very beginning.

The second part of the Russian "Instructions" deals with the Defence. Its discussion is being reserved for a later study.

BOOKS CONSULTED.

v. Brunner: *Permanent Fortification*, Vienna, 1901.

v. Brunner: *Fortress Warfare*, Vienna, 1899.

v. Leithner: *Permanent Fortification and Fortress Warfare*, Vienna, 1893.

Smekal: *Attack in Fortress Warfare*, Vienna, 1902.

Smekal: *Directions for the Instruction in "The Art of Fortification in the Royal Academies,"* Berlin, 1902.

Smekal: *General Instructions of the 4th February*, 1899: *Siege Warfare.*

v. Lobell's Annuals on the *Alteration and Progress in Military Matters*, years 1901, 1902 and 1903.

Stavenhagen: *Elements of Fortress Warfare*, Sondushausen, 1901.

Stavenhagen: *Elements of Instruction in Fortification*, Berlin, 1896.

v. Gerwien: *Fortress Warfare.* An addendum to the books of instruction on the art of fortification and war, Berlin, 1902.

v. Hoffbauer: *The Employment of Field Howitzers in Field and Position Warfare*, Berlin, 1901.

v. Muller: *The Action of the German Fortress Artillery at the Sieges, Bombardments and Investments of the Franco-Prussian War*, 1870–71 (Supplementary pamphlet: "The Bombardment of Paris, 1870–71"), Berlin, 1904.

v. Drygalski: *The Organisation of the Russian Army*, Leipzig, 1902.

# *REVIEWS.*

## DETAILED HISTORY OF THE RAILWAYS IN THE SOUTH AFRICAN WAR, 1899—1902.

(R.E. Institute, Chatham. £2 2s.).

The "Detailed History of the Railways in the South African War," lately published in two volumes by the Engineers' Institute at Chatham, contains much valuable information drawn from experience, many useful deductions, and some interesting historical reading. In the second volume there are sixty-one photographs and ninety-three plates, showing what damage was done by the enemy, how it was temporarily and how permanently repaired, plans of armoured trains, and much matter that is of purely technical value.

Of course we shall be told that it is a waste of space to discuss the matter. In case of an invasion of England the use of our railways (to condense the argument) may be left to the Fleet, and, happily, we shall never again be called upon to invade a foreign State. But it is not the best but the worst that one has to consider in making preparations for war, and a hostile force might quite possibly evade the Fleet. Again, in conjunction with some other Power, we might be compelled to invade, shall we say, Ruritania. The lessons of these volumes, therefore, demand consideration no less than the other lessons of the war.

Before considering some of the questions here raised we may be allowed to praise the admirable method in which the history is written. It is based on reports drawn up for the information of the War Office by the officers who were in charge of their departments. Not a word is wasted, but the logical conclusions are clearly indicated. And the result is more interesting than the merely literary historian would imagine.

Half-a-dozen useful articles might be drawn from this work, but for the present we shall be content to indicate its contents in two directions. The history of the war, from an engineering point of view, is graphically set forth, and the importance of a thoroughly equipped—that is, a carefully-trained—military railway staff is fully explained. Continental nations have long been alive to the importance of railway military organisation, and have laid down proper instructions. The matter has also been closely studied in India, "where on occasion 50,000 men and more have been moved to the frontier." But, as the writer of one chapter guilelessly remarks:—

"In England, on the other hand, the great railway companies have from time to time moved troops, and it has not been necessary to ask for

military assistance; as a consequence neither the organisation nor the necessary rules had been thought out in 1899."

Yet the deduction from experience is as follows:—

"The facts which have here been set down make it abundantly clear that for the management of railways in war there must of necessity be a Military and not a Civil Controlling Staff; and, further, that it would be to the advantage of the Army generally that there should be an appreciable number of officers conversant with at least the elements of railway traffic work."

This is the proper system. Have we that appreciable number of officers? Of course, good work is being done at Chatham and elsewhere, but is a sufficient number of officers engaged in studying the rudiments of railway work, or shall we have to rely, as in the South African War, on a small railway staff, assisted by intelligent men whose experience is chiefly drawn from other branches of engineering? It is not enough to make honorary colonels of the managers of the great railways. We need the trained officer to act in conjunction with them, and there should be a large, not a small, railway staff, intimately associated with the Intelligence and Mobilisation Staff.

Some of the defects of our system in the early part of the war may be indicated. We find the traffic delayed on the whole system for three hours and more while an armoured train protected a convoy of cattle on the march; a station commandant who would not let an engine coal because the coal stack formed part of his defences; troops conveyed by rail without reference to the railway department; trucks left loaded for days on sidings; telegrams sent from different staffs at headquarters so confusing that the railway department did not know whether to send 40 or 120 trucks of provisions to railhead, and then was not sure whether it had sent the right sort; unnecessary movements over short distances by rail, as once when a brigade, having to move a distance of 80 miles by rail and 60 by road, was 48 hours late at its destination owing to the delay caused by entraining and detraining, and to the fact that the line had other services to perform as well as its transport. The most signal instance of this lack of co-ordination was seen when General French did not know whether or not to off-load a large number of trucks sent to him at Naauwpoort Junction, as he had not been instructed whether he was to hold or evacuate the place. "This absolute blocking of Naauwpoort Junction to such an extent as to prohibit any shunting naturally caused chaos in the traffic department." One of the first lessons the soldier on a railway in war time has to learn is that a loaded truck is no truck at all for transport purposes.

Afterward, we have the story of order evolved from chaos. As the Orange Free State gradually fell into our hands the necessity of centralising the control of the railway became more and more evident, and the Railway Staff Officers were removed from the control of the Station Commandants and placed under the orders of the Director of Railways. Results justified the wisdom of the decision. Soon the Imperial Military Railway organisation was created, and we have here the record of its work. This history contains Sir Percy Girouard's

figures. From October, 1899, to June, 1901, roughly 140,000 truckloads of Army stores were forwarded from the Cape ports, namely, 300,000 men in 10,000 waggons, 193,000 animals in 22,000 waggons, 446 guns in 500 waggons, 4,175 road transport waggons in 5,000 trucks, and 570,000 tons of stores (of which one-fifth were forage) in 100,000 waggons. All this despite breakages on the line caused by the enemy and the necessity of supplying the civil population. While the Army was advancing from Bloemfontein to Pretoria the repairing corps had to mend no less than 61 bridge spans, of which 22 were over 100 feet in length, and of which many involved the construction of deviations and the building of temporary bridges. Some of these deviations were, in fact, solidly-laid railways over a mile long on either side the river. Fifty-seven culverts were mended, 28 sets of crossings put right, and 17 serious breaks set in order. Yet at the Vaal River the reconstruction department was only eight days behind the Army.

The management of the line after Pretoria had been taken is really a masterpiece of swift organisation. The details of the establishment are set forth here in full, and we may be allowed to doubt if anything so complete exists in England to-day. Several tables show what the Imperial Military Railway was able to do in the moving of troops. Take the movement of troops between April 5th and April 11th, 1901, to repel the invasion of Natal. The troops were concentrated between Volksrust and Dundee. Including those placed in support of the force or to replace necessary garrisons 882 officers, 23,536 other ranks, 32,836 animals and 45 guns were concentrated from Klerksdorp, Vereeniging, Bloemfontein, Springs, Kroonstad, Aliwal North, Springfontein, Harrismith, Middelburg—in fact, the garrisons of these towns were satisfactorily concentrated on a single line of rail. This could not have been done under the old system. Only Sir Percy Girouard's organisation made it possible.

Briefly, under his system the Director of Railways alone was responsible to the Chief of Staff for the working of the lines, and the military and civil staff of the Imperial Military Railway was responsible to him, the duties of each being clearly defined in several orders. The relations between the fighting arm and what may be called the traffic arm were established by the order that Commandants and Officers Commanding must communicate their requirements through their Railway Staff Officers to the Assistant Director of Railways. The duties of the Assistant Directors of Railways were described as follows: To be intermediaries between the Army and the technical administration of the railway; to see that the ordinary working of the railway was so carried on as to secure the greatest military efficiency; and, most difficult of all, to see that the demands of the Army interfered as little as possible with the working of the railway system as a whole.

One further lesson the book contains. The Imperial Military Railway knew well how to make use of trained civilians, as the history of the Railway Pioneer Regiment shows.

An article which has outlined a record of technical work and shows how by organisation order grew out of chaos may seem dull to the general reader; but who can read without a spring of generous emotion

the story of the volunteer engine-driver who, "with his fireman dead beside him and himself shot through both arms, brought his train safely through a force of the enemy, one hand on the lever and one on the brake?"—(*Morning Post*).

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In our issue of the 29th ult. we welcomed the above publication, although space being scanty we were obliged to dismiss it in brief. We now recur to the two volumes, the first of which is letterpress and the second full to repletion with illustrations, including sketch plans, many and diverse. We congratulate the agents, Messrs. W. and J. Mackay and Co., Limited, Chatham, upon so excellent and serviceable a couple of volumes. Some of the views showing the nature and extent of the damage done during the war are very realistic. As a practical epitome of the subject by the Director of Railways himself this series could hardly be excelled.

Perhaps the most difficult task which the Director had to face was the education of the army with regard to the services of the railway and the railway staff in war. The great point which had to be made intelligible, he tells us, was that the railways should be regarded as one totality, the chief object being to expedite the large movements of troops and supplies required by the Headquarters Staff. Of course, few people who do not know South Africa could realise the immense area covered by the theatre of war unless volumes like these brought the facts into prominence.

We understand that the War Office, in the first place, arranged to publish in four volumes the general report by the Director and the more detailed accounts of various services. It did publish the general report. The Treasury stopped the publication of the rest from motives of economy. The R.E. Institute then decided to publish the remaining volumes themselves.

Sir Percy Girouard's report traces from the very beginning the evolution of a department which had to be created, and which unavoidably made many mistakes before it had got into proper working order. Sir Percy did herculean service at a critical time in the history of his country, and his country will not forget it.—(*South Africa*).

## *NOTICES OF MAGAZINES.*

### Electrical Review.

*June 10th*, 1905.

High-Speed Traction.—*The Marienfelde-Zossen Experiments.*—This number contains some account, by Mr. Mudge, late of the Allgemeine Electricitäts Gesellschaft, of the experiments carried out last year.

The line used is about fourteen miles long, very straight, having only two decided curves, and those of 1¼ miles radius. The line thus practically consists of almost four miles at each end for acceleration and seven miles for running in the middle. The rails are about 82½ lbs. per yard, and the track had been stiffened and well ballasted since the former experiments.

The car body was 69 ft. long and 9¼ ft. wide, with a machine room containing starting switches and rheostats in the centre, and compartments for registering instruments and passengers at the ends. The weight was about 100 tons loaded, plus certain balancing weights afterwards added.

Three-phase current was used, the highest recorded voltage in the car being 14,150. It was collected by six sliding bows placed in groups of three at each end of the car.

Perhaps the most interesting observations were in regard to air resistance. It was practically established that at 50 miles an hour a pressure of 7 pounds per sq. ft. is attained at the front end; at a double speed the pressure is quadrupled, and at treble speed the pressure is increased ninefold. By shaping the nose of the car, however, a ten per cent. reduction of these figures can be effected.

With respect to power, the 100-ton car, at 50 miles per hour on the level, requires about 150 horse-power to move; doubling the speed means increasing the power six times; and trebling the speed to 150 miles per hour necessitates an increase of power to eighteen times (2,700 h.p.).

The balance of the car is most important. Below 100 miles per hour no great oscillation was experienced, but above that speed a rolling or swinging lateral motion was apt to be set up to so great an extent as to endanger the overhead work. It was found that this could be remedied by arranging the heavy weights of the motors and transformers symmetrically. Actually counterbalancing weights were used on this car.

Bringing the car to a stand, again, was not easy. Very great brake pressures were necessary—at 110 miles per hour the initial pressure had to be 1½ times the weight of the car, and the car could not be stopped in less than half a mile, which means a retardation of 3¼ miles per hour per second. Particulars of the brake are not given, but it was apparently rather complicated.

Signalling was also a difficulty. At 125 miles an hour persons standing on the platform could only be approximately identified when 50 feet or more off, and, unless the light was very good, signals could not be read unless of large dimensions or very pronounced colour. It is thought practicable, however, to make an arrangement for electric signals by means of a special brushing contact alongside the rail.

The general conclusions drawn as to the design of car, etc., are as follows:—

(1). The car body should be kept as near the rails as possible.

(2). Any apparatus placed above the floor should be as light as design will permit.

(3). The overhead contact should preferably be above the car.

(4). The motors should be mounted flexibly on the axes of the bogies.

(5). The front end should be wedge shaped.

(6). The car body should be supported on the bogie frames at a little distance from their centres, so as to allow a certain amount of flexibility in rounding curves.

(7). All heavy weights should be central or symmetrically placed.

(8). The wheel base of the bogies should be long, not less than one-fifth of the body length.

(9). The road should be as straight as possible, and if two lines are used they should be separated more than is customary in present practice.

(10). On curves the approach should be lengthened out considerably.

The main interest of the experiments of course centres round the results attained as regards train resistance. Experiments so far made, and formulæ propounded, seemed to shew that the attainment of such high speeds was practicable only at enormous expenditure of power, and one theorist went so far as to characterise such hopes as a mere "iridiscent dream." It is true that those who commented on Mr. Mudge's paper confined themselves to remarks on the future of electricity as a motive power for ordinary train services and the economy of central generation of power. *Apropos* of these experiments it was remarked, for instance, that a single phase electric locomotive had recently been tried in comparison with a freight engine in hauling a 50-car train, and had shewn great efficiency, particularly in starting. (Weight 135 tons, capacity 1,500 h.p., drawbar pull 80,000 lbs., overhead construction, voltage 6,600).

C. E. VICKERS.

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## NATURE.

*May and June*, 1905.

SPECTROHELIOGRAPH RESULTS (*No.* 1,853, *p.* 9).—The pictures produced by this new method of solar research give us photographs of the sun in monochromatic light, or in rays of any particular wave-length that is desired. Thus, if we require to study the distribution of hydrogen on or

around the solar disc, we employ a line in the spectrum of hydrogen, if calcium a calcium line, or iron an iron line. At South Kensington a stationary solar image is formed by means of a siderostat and lens, and the spectroheliograph is mounted horizontally and moved from east to west across this fixed image, thus securing an easy and uniform motion with perfect steadiness of the solar image under examination. The photographs taken during the past year have been of two kinds, the first. to investigate the distribution and area of the flocculi (or calcium clouds) on the sun's disc, and the second, the distribution and forms of prominences round the limb. It appears that flocculi and prominences are not always interdependent phenomena, but sun spots are always accompanied by a flocculus. In fact the duration of a spot is only a brief interval in the life history of a flocculus. The article is well illustrated with typical cases of spots and flocculi, showing also changes in prominences to a height of 60,000 miles with a velocity of three miles a second. These photographs have been taken with the "K" line of calcium, but other lines in the solar spectrum, such as hydrogen, iron, magnesium, etc., remain to be examined, for which purpose a representative body has been formed to undertake the work and to cope with the large demand of facts relating to our sun.

THE PHYSICAL HISTORY OF THE VICTORIA FALLS.—The origin of the falls has generally been explained by calling in volcanic agency, which caused a crack to be made in the hard basaltic rock from the right to the left bank of the Zambesi, and then prolonged from the left bank away through 30 or 40 miles of hills. Mr. A. J. C. Molyneux, F.G.S., in the *Geographical Journal* for January sketches the geology of the country around the falls and claims that, as at Niagara, the combination of cañon, gorge, chasm and falls is due to erosion and the constant reducing action of the Zambesi river. The falls have checked the deepening of the Upper Zambesi, preventing the Zambesi from becoming a navigable river throughout and markedly influencing the geography of South Africa. *Nature*, No. 1,852, p. 619, gives a good plan and a view of the falls.

SEISMOLOGY.—After the collapse of the campanile at St. Mark's in 1902, there was a popular demand for the cessation of the usual mid-day gun from the fear that its detonation was likely to precipitate the destruction of other historic buildings in Venice. A microseismograph was therefore attached to the wall of the ducal palace, which faces the lagoon and is directly exposed to the sound waves of the cannon; it indicated a vertical displacement, in consequence of the reports, of 0·013 m.m. and a horizontal displacement of 0·01 m.m., being about one-half of those produced by a person jumping on the floor of the room in which the instrument was installed, and one-fifteenth of that caused by a high wind. The sound waves of a cannon have therefore no appreciable effect, though loose plaster may be detached thereby.

THE Japanese advance in MEDICAL EQUIPMENT IN TIME OF WAR is great. Many of the problems which have been the terror of war in European

countries are stated by Sir F. Treves to have been solved. British troops enter a war expecting to have 10 per cent. of sick, whereas the Japanese are quite content with 1 per cent. of sick, and they get it.—(No. 1,854, p. 11).

ANTARCTIC EXPEDITION.—Its scientific results have been issued in a kind of preliminary report in five papers. There are innumerable glaciers on the coast of Victorialand, but few run back to the inland ice. The Ferrar glacier is typical of the dead glaciers; the ice lies in the valley practically stationary, gradually wasting away from the summer thaw; probably the inland ice stood at one time 500 feet above its present level. It does not make any important contribution to the ice-barrier of the Ross Sea which is probably afloat and in a state of fairly rapid retreat, moving northward at the rate of about 600 yards a year. The expedition collected much valuable material as to climate, the snow-bearing winds were warm, rising to a temperature of 15° C. even in the depth of winter. Biological work could be carried on all the year round, "even with comfort." Animal life is very abundant in the Southern Seas; sponges exist in enormous quantities and a "Nemertine worm was found close on 20 feet long and about the diameter of an ordinary bootlace."—(No. 1,855, p. 57).

THE SEWAGE PROBLEM.—Mr. Martin has provided a book which will be eagerly sought after by members of sewage committees who are appalled by the mass of matter in the numerous blue books published by the Royal Commission. In spite of the great amount of work that has been done, sewage purification is still rather an art than a science, and, on many questions, knowledge is still extremely limited. The Royal Commission has arrived at the conclusion that adequate purification can be effected without land treatment, but no system can be effective without efficient local management.—(No. 1,857, p. 97).

SPECTRO-CHEMISTRY.—Professor Bruhl shows the principles on which spectro-chemical methods of examination can be applied to the solution of many scientific problems, and to the discovery of the chemical structure of single substances, or whole classes of bodies. Research, in the atomic structure of hydrogen piroxide and many other unstable compounds, by purely chemical methods is often difficult and sometimes impossible, because owing to their sensitive organisation, chemical interference leads either to changes in the grouping of the atoms, or even to total decomposition; but by observing the behaviour of light on its passage through these substances, we gain an insight into their structure, without in any way disturbing it. Assistance has thus been rendered to the synthetic preparation of valuable scents, such as ionone, the artificial scent of violets. Special forms of instruments are in use for the examination of fats and oils, milk and butter; the amount of salt contained in salt solutions; the amount of alcohol in beer; the examination of blood and albuminoids in pathological fluids, etc., etc.—(No. 1,859, p. 161).

W. E. WARRAND.

RAILWAY AND LOCOMOTIVE ENGINEERING.

*February*, 1905.

SINGLE LINE WORKING.—*Train Staffs.*—The use of the Train Staff system for single lines has not gained much ground yet in America, possibly because the cost of installing the apparatus is an obstacle in the way; the Staff system, as ordinarily used, also entails a stop at every block section to exchange staffs.

We have here an account of certain mechanical arrangements for exchanging staffs without stopping. Such apparatus, adapted for the Webb and Thompson Staff, is in use on some British lines; but the pattern of staff here used (on the Cincinnati, New Orleans and Texas Pacific) is smaller and lighter. It is suspended in a rubber staff case, hung from a delivering arm, and is caught by a "catcher" projecting from the engine. The exhibition of the Train Order signal indicates whether staffs have to be exchanged.

The Santa Fé line uses the train staff on some of its sections, and we have a description of a Permissive Staff system, *i.e.*, electrical staff combined with tickets. The reason for this arrangement is that on the section referred to the balance of traffic, owing to a heavy grade, is all in one direction. Either the absolute staff or permissive staff can be taken out of the same machine, but not both at once. Apparently the train carrying the Permissive Staff may either proceed, follow or go between those having Tickets, which is contrary to our rules; in this country, when Staff and Tickets are used, the driver who accepts a Ticket must always *see the Staff*.

The Absolute and Permissive Staffs are of the same general shape, but one is fluted and the other milled.

A somewhat similar "Tablet and Ticket" ticket is or used to be used on the Midland Railway, between Little Eaton and Ripley (if I remember right).

C. E. VICKERS.

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REVUE D'HISTOIRE.

*May*, 1905.

THE CAMPAIGN OF 1794.—*Army of the North.*—Deals with the proceedings of Pichegru from the time when he took over the command of the army of the north, up to the failure of his attempt on le Cateau, at the end of March.

THE CAMPAIGN OF 1793.—*Army of the North and of the Ardennes.*—This is the beginning of a study of the operations on the Belgian frontier from the surrender of Valenciennes (August 1st) to the Battle of Hondschoote (September 8th), showing how the Allies allowed the initiative to fall into the hands of the French, by sitting down before Dunkirk and Quesnoy.

The composition and character of the French army is described in great detail.

THE WAR OF 1870–1871.—The movements of the Third German Army are followed from the 13th to the 22nd August. By the latter date it was joined by the newly-formed army of the Meuse, and orders were issued for the march on Chalons. At Chalons 130,000 French troops had been assembled under Macmahon, but how defective this new army was from every point of view is forcibly brought out. To the many shortcomings which had been apparent from the outset in the army of the Rhine, the army of Chalons added want of cohesion, homogeneity, and organisation, and (as regards part of it) want of the most elementary training. It was disheartened and demoralised, and was short of necessaries of all kinds.

*June*, 1905.

A MILITARY OPERATION OF EUGENE AND MARLBOROUGH.—While Eugene was besieging the citadel of Lille in 1708, and Marlborough was covering the siege, the Elector of Bavaria tried a counterstroke against Brussels. The main French army held the line of the Scheldt from Tournay to Ghent, and the Bruges canal; but the Allies, without raising their own siege, forced the passage of the Scheldt, cutting the French army in two, and obliged the Elector to hasten back to Mons. This is the operation described, and the leadership of the French is contrasted unfavourably with that of the Allies in respect both of skill and harmony.

THE CAMPAIGN OF 1797 ON THE RHINE.—The first instalment of the history of this campaign goes only as far as the surrender of Kehl to the Austrians. Much fault is found with Moreau.

THE WAR OF 1870–1871.—*The Army of Chalons.*—The plan of the Minister of War (Count Palikao) for the advance of Macmahon to the assistance of Bazaine is severely criticised. A movement in Metz might have served an useful purpose if it had been a mere demonstration, abandoned as soon as the Germans gathered to meet it; but arrangements should have been made for falling back eventually on Paris. Without allowing itself to be shut in there, the army of Chalons, 130,000 strong, might have delayed the investment of the city by opposing the passage of the Seine, and should then have retired on Orleans to gather reinforcements.

E. M. LLOYD.

## THE TIMES.

*Extract from Issue of June 13th.*

SPADE WORK IN THE JAPANESE ARMY.—The following report by Capt. P. C. March, General Staff, U.S.A., is of extreme interest:—

"On October 15th, 1904, during the battle of the Sha-ho, I witnessed a practical exhibition of the Japanese use of the intrenching tools carried

by the men. The 40th Regiment of the 10th Division, 4th Japanese Army, took up a position along the crest of a hill near the River Sha, which marked the furthest position of the Japanese advance at the time, and on the front of the 4th Army. The Russians were visible in force almost immediately in front of us and an attack was expected.

"The companies detailed to construct the trenches came up without arms and squatted on their haunches under cover of the reverse slope of the hill. N.C.O.'s stepped forward from the companies, and threw themselves on their faces on the crest of the hill. They then worked themselves forward by their hands and feet until they arrived at a point where they could see all the ground in the immediate front—no dead space—and put a peg in the ground at that point. The pegs thus established were joined by marking a line on the ground with the point of a pick. The men then came forward, working parties alternating with pick and intrenching spade, the files taking intervals from each other by extending hands at full length, each man covering that much of the line of the trench. While the relief was working the other men of the company remained below the crest squatting on their haunches, and after the first batch had worked about five minutes relieved them. The soil had not been under cultivation and apparently was virgin and hard. The trench, which was 3 ft. by 3 ft., making 4½ ft. cover, was finished in 20 minutes.

"The larger intrenching tools, such as the regular commercial pick and long-handled shovels, were carried on pack ponies with the battalion or regimental train, and were only used when intrenchments and works of a more permanent character were constructed, and when they had plenty of time. There never has been a great war in which intrenchments have been used more than in this war. The whole of Manchuria passed over by the Japanese 1st Army, from the Ya-lu to the Sha-ho, was intrenched, and the army never took a position of any importance without intrenching immediately."

## UNITED SERVICE MAGAZINE.

### *July.*

Three articles in this number are on R.E. subjects:—

THE FUTURE OF SUBMARINE MINING, written a year ago under the *nom-de-plume* of "Sic Fidem Teneo," is a careful exposition of the case against handing over submarine mines to the Navy. The best argument used is probably:—"That we have not sufficient trained men for the 'fleet in being.' How then do the Navy propose to detach 2,000 additional men for coast defence work? or is the important work of coast defence to be carried out in a haphazard way by any men who happen to be available?"

MILITARY ENGINEERING IN PEACE AND WAR (With More Particular Reference to Lines of Communication), by Capt. H. E. G. Clayton, R.E.—The writer takes as his text the preface of the *M. of M.E.*, 1903, and

states how the experience of war has made him modify the types given in that book. He principally advocates the use of very narrow trenches, provided with numerous traverses and "back-cover." Firing Trenches should not be widened to admit of easy communication, but separate trenches should be constructed for communication and drainage and to provide earth for back-cover. These latter trenches should be separated from the fire-trenches by solid partitions of earth. He gives a method of constructing loopholes with the least number of sand-bags possible, also some hints on bridging, roadmaking and the destruction of railways, etc. The last portion of the article is taken up with a somewhat detailed description of the construction of sangars, in which many practical hints are given. The article is profusely illustrated with some ten plans and sections, taken from works actually constructed in the field, and is generally full of tips to officers engaged in such work.

ENTRENCHING AND RANGE-FINDING, by Lieut.-Colonel Alsager Pollock, is principally an account of the Wemyss Multimpiement. Colonel Pollock gives the verdict that this entrenching tool is a valuable invention, though in its present form it requires a few small improvements, which, however, could be easily effected.

## *RECENT PUBLICATIONS.*

*Military Operations and Maritime Preponderance*, by Colonel C. E. Callwell. (9 × 5½. 15s. Blackwood).

*The Peace of the Anglo-Saxons*, by Major Stewart L. Murray, with preface by F.M. Earl Roberts. (8 × 5. 2s. 6d. Watts).

*History of the War between Japan and China*, by the Japanese Imperial General Staff, translated by Major Jikemura and Rev. A. Lloyd. Vol. I. (4to. Tokyo).

*The War between the Union and the Confederacy, and its Lost Opportunities*, by Brigadier-General W. C. Oates. (8vo. New York).

*Geschichte des Schlesischen Pionier bataillons.* In dienstlichen Austrag für das Bataillon, bearbeitet von Hauptmann Tiersch.

*Festungskrieg.* Eine Applikatorische Studie über den modernen Festungskampf. Heft 1. Die Tätigkeit von Angreifer und Verteidiger bis zum Gewinnen der Einschliefsungslinie, von Major Schwarte, Generalstabes. (7 mks. Mittler & Sohn, Berlin).

*Infanterie Telegraphen patroiullen*, by Oberst Leopold Schleyer. (8vo. Vienna).

*Bedeutung von Befestigungen in der Kriegführung Napoleons*, by Oberst W. Wlaschütz. (8vo. Vienna).

*Der Unterricht des Inftschiffers*, von Hauptmann v. Tschudi, Lehrer im Inftschiffer-Bataillon. 2 Auflage. (3 mks. Eisenschmidt, Berlin).

*Brückenzerstörungen im Ruckzugsgefecht, einst und jetzt*, von Major Scharr. 2 Auflage. (3 mks. Mittler, Berlin).

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*An Introduction to the Theory of Optics*, by A. Schuster. (15s. Arnold).

*Electric Railways* theoretically and practically treated, by Sydney W. Ashe and J. D. Keiley. (8¼ × 5¼. 10s. 6d. Constable).

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*The Complete Golfer*, by Harry Vardon. (10s. 6d. Methuen).

*Maintenance of Health in the Tropics*, by W. J. Simpson, M.D. (2s. 6d. Bale, Sons, & Danielsson).

*London to the Nore*, painted and described by W. L. & M. A. Wyllie. (9 × 6¼. 20s. Black).

*In Remotest Barotseland*, by Colonel Colin Harding, C.M.G. (8¾ × 5½. 10s. 6d. Hurst & Blackett).

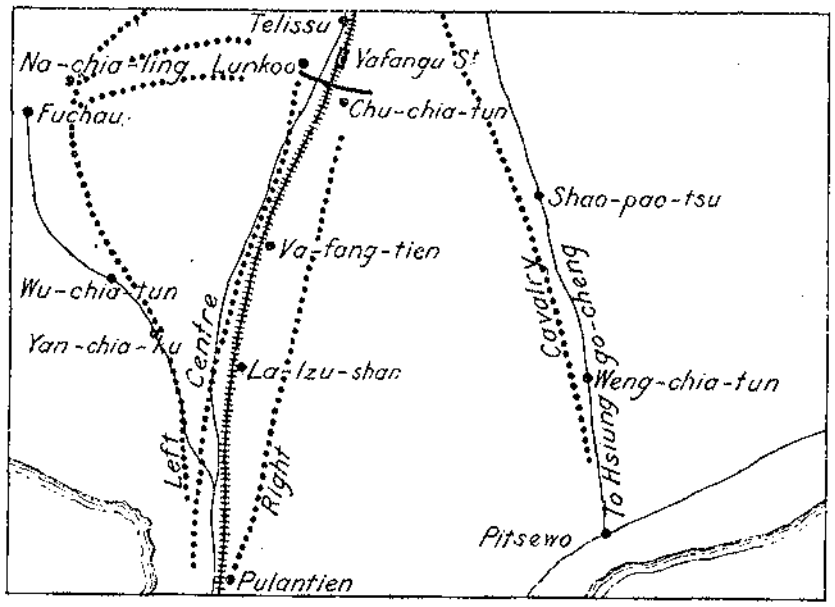
*Russia*, by Sir Donald Mackenzie Wallace, K.C.I.E. New edition. 2 vols. (9¼ × 6. 24s. Cassell).

*Jiu-Jitsu*, the Japanese Method of Attack and Self-Defence, by Capt. H. H. Skinner and B. H. Kuwashima. (8 × 5½. 5s. Gay & Bird).

*The Native Races of South Africa*, by G. W. Stow, edited by G. McC. Theal. (10 × 6. Sonnenschein).

*The Far Eastern Tropics*: Studies in the Administration of Tropical Dependencies, by Alleyne Ireland. (8vo. 1905).

DIAGRAM
OF
JAPANESE ADVANCE FROM PULANTIEN



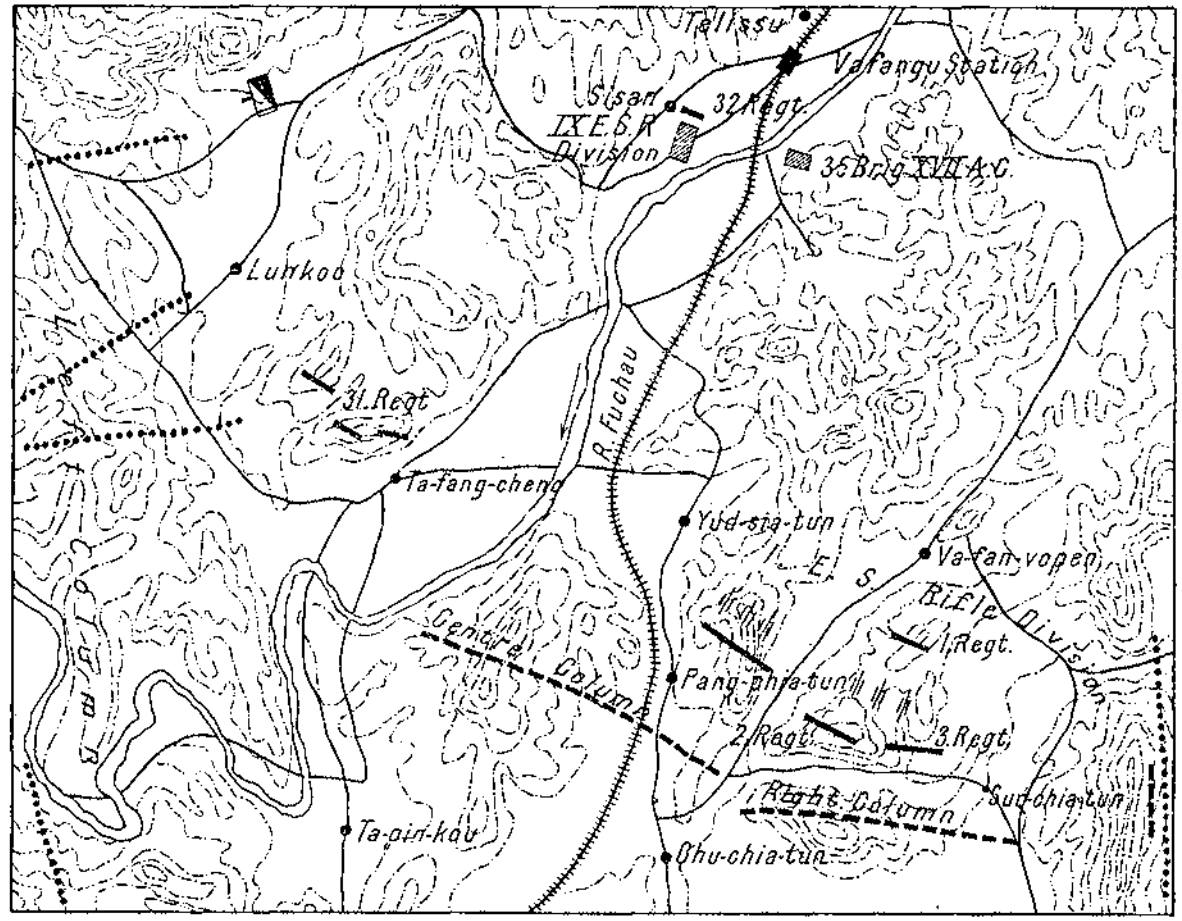

Scale (Approx.) = 12 miles to 1 inch

REFERENCE

Russians —— Japanese .....

THE BATTLE OF TELISSU

*Positions at 12 midnight on 14th – 15th June 1904*




*Reproduced by permission of the Imperial Russian Military Authorities.*

Scale. 1/85000.

0 1 2 Miles

REFERENCES

Russians in position —— Reserves ▨ Cavelry ⛵

Japanese in line ------ in Column .....

# THE 3RD COMPANY 1ST (BENGAL) SAPPERS & MINERS
ON THE THIBET MISSION, 1903–04.

Plate II.

Fig.1. CROSSING THE BRAHMAPUTRA.
Arrangements at Chaksam Ferry.

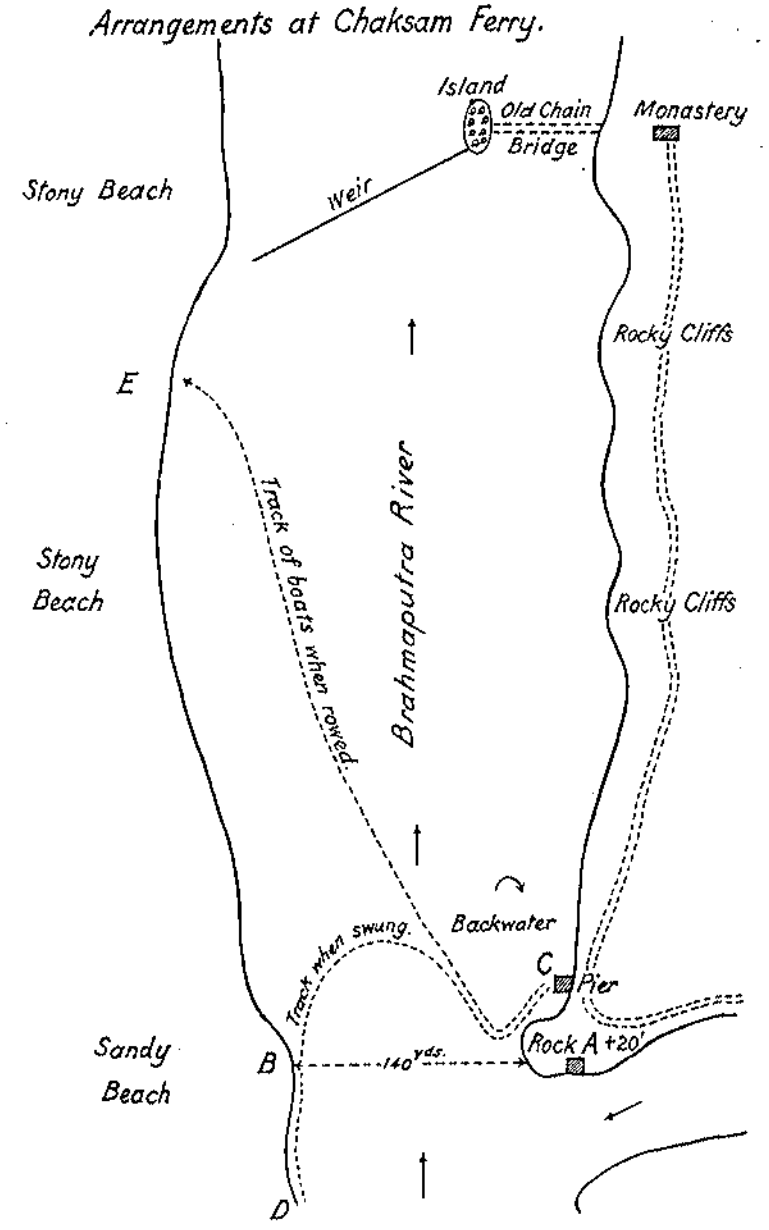



Fig.2. Section on BA of Fig.1.

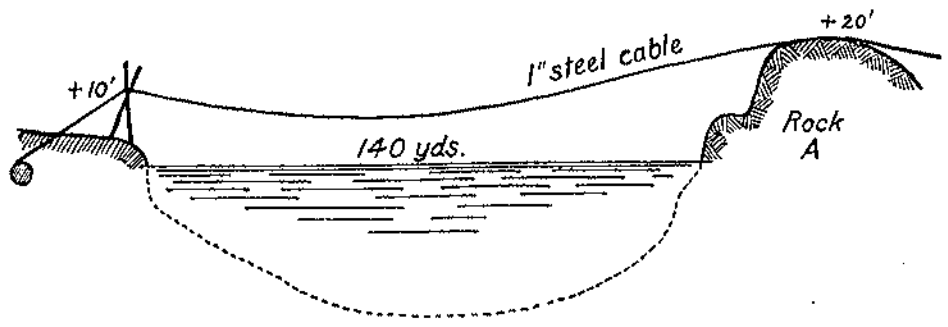



Fig.3. Arrangements at Parte Ferry.

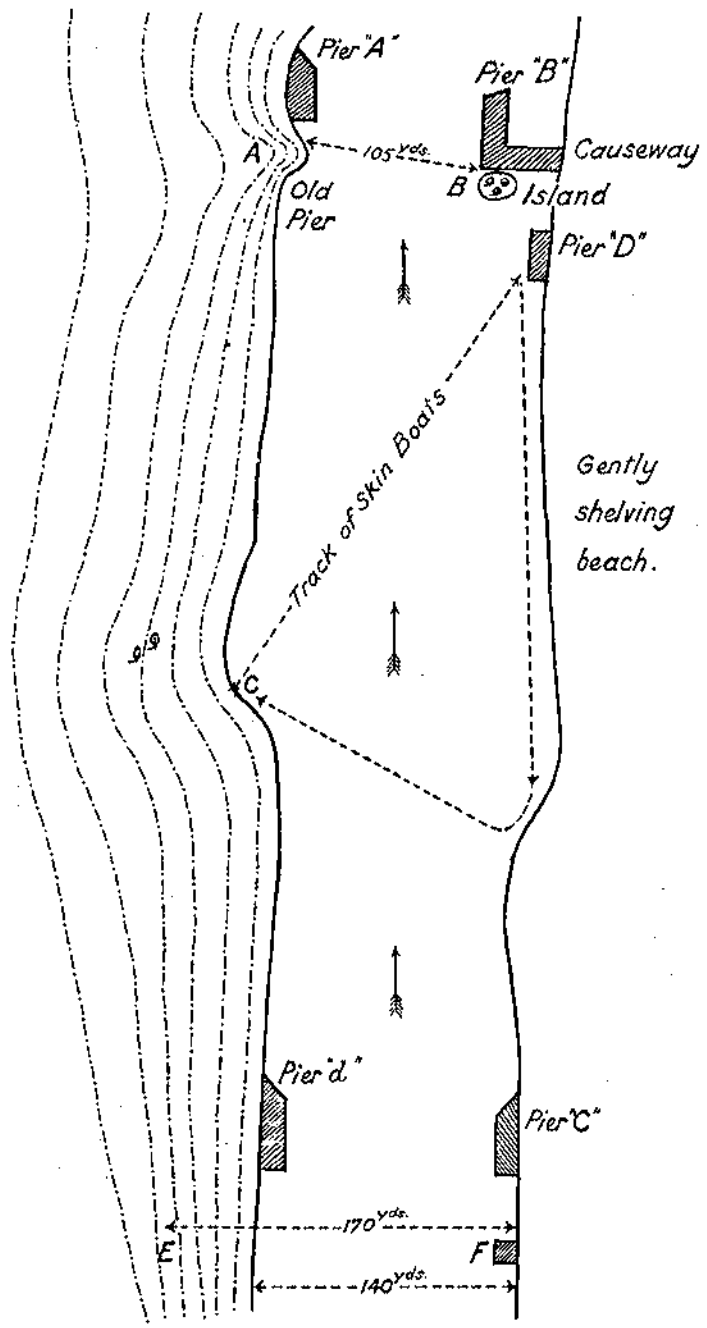



Fig.4. Section at AB of Fig.3.

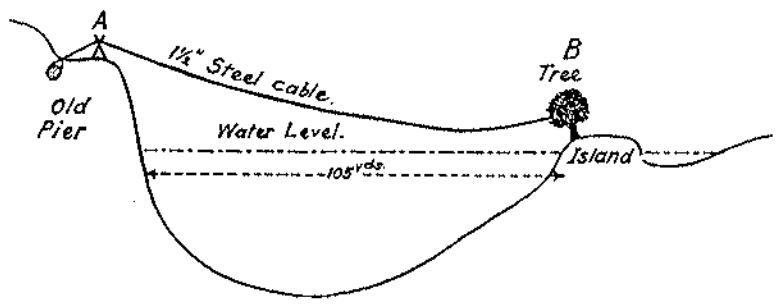



Fig.5. Section at EF of Fig.3.

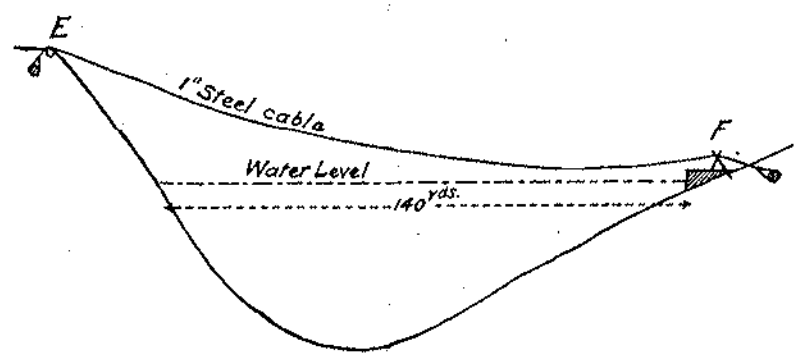



Fig.6. Details of traveller on AB of Fig.3.

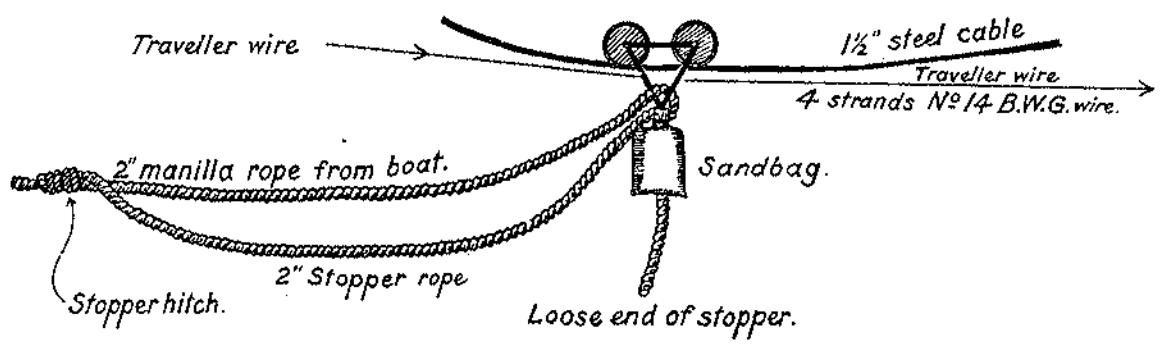
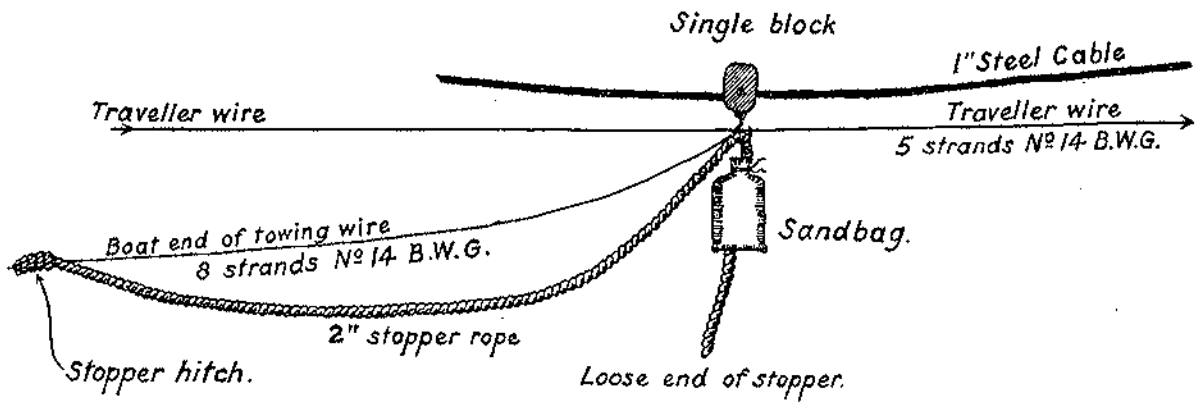


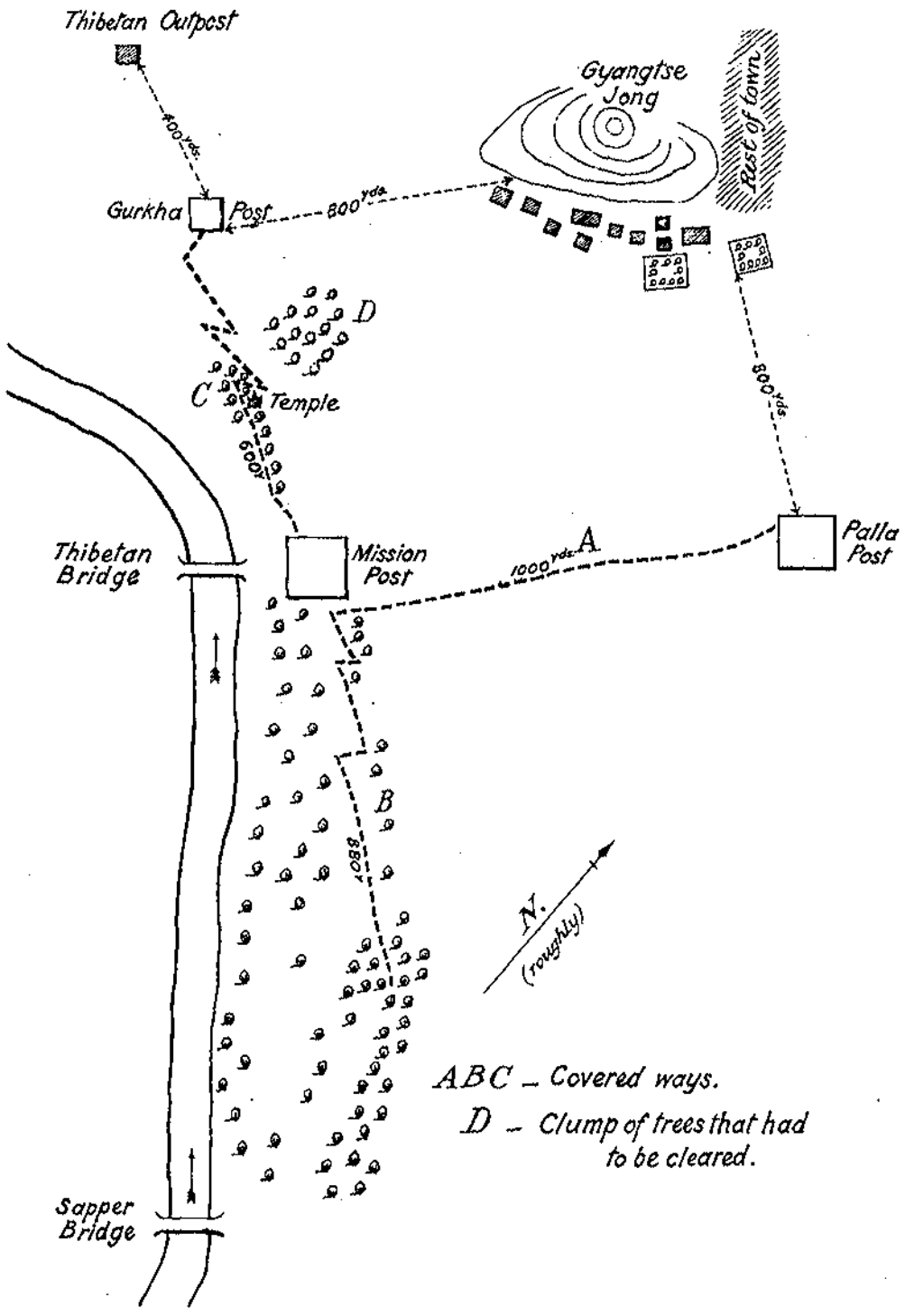

Fig.7. Details of block traveller on EF of Fig.3.



# THE 3RD COMPANY 1ST (BENGAL) SAPPERS & MINERS
ON THE THIBET MISSION, 1903-04

*Plate I.*

*Fig 1. SKETCH OF GYANGTSE JONG AND ENVIRONS.*




*ABC – Covered ways.*

*D – Clump of trees that had to be cleared.*

*Fig. 2.*
*Plan of Sapper Bridge*

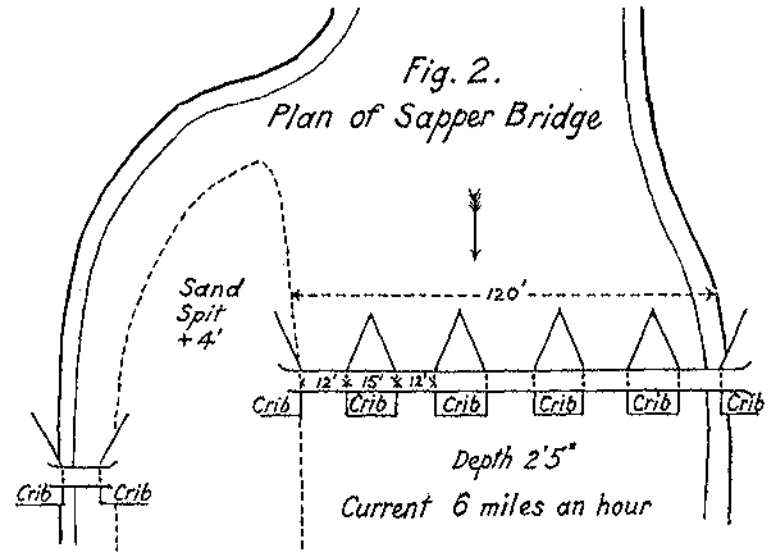
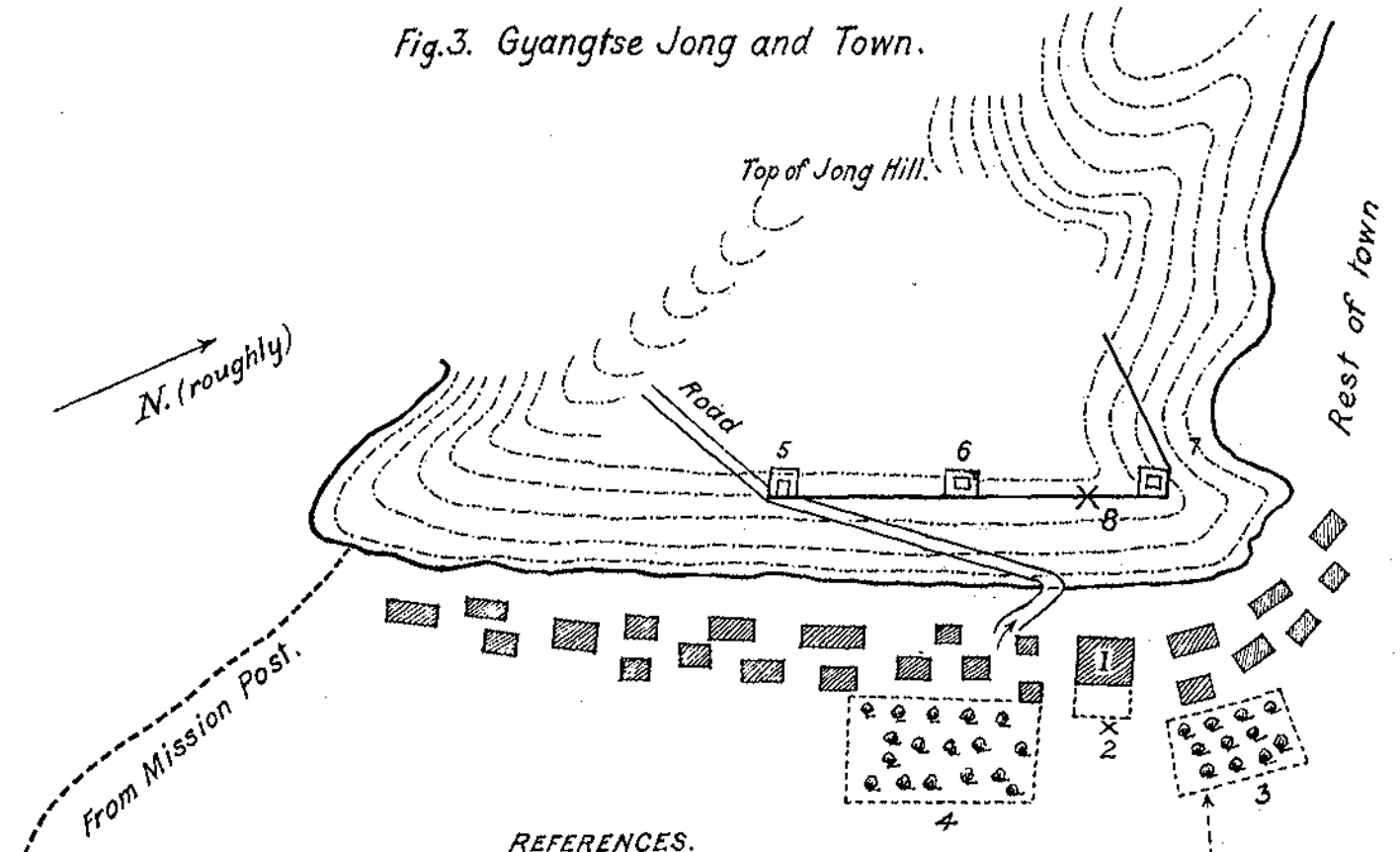



*Fig.3. Gyangtse Jong and Town.*




*REFERENCES.*

— = *Defensible wall of Jong, which was carried right round hill.*
1 = *Chinese house, key of town, objective of centre column.*
2 = *Courtyard gate of same.*
3 = *Garden, objective of right column.*
4 = *do do left do .*
5 = *Big gateway, main entrance to Jong, commanded by endless sangars above.*
6, 7 = *Towers on each side of curtain wall.*
8 = *Breach in curtain wall, made by guns and taken by 8th Gurkhas.*

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