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CONTENTS.

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TO

# VOLUME I. Nos. 1 to 6.

*Original Articles are entered in thick type; Translations, Reviews and Notices of Magazines in thin type.*

*The capital letters in brackets after certain of the entries are abbreviations of the titles of the periodicals indexed under "Magazines, Notices of."*

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Contributions should be written *on one side only of the paper*, and preferably on white paper of foolscap or bank post size.

Each article must be accompanied by the name of the author, but the question of publishing it over his signature or under a pseudonym is left to his discretion.

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# *GLAREANUS.*

*By* Major C. F. Close, C.M.G., R.E.

The *De Geographia Liber* of Glareanus, printed in Basle in 1527, is well known to those interested in geographical studies. But it is only recently that the original manuscript has been discovered. This manuscript is bound up with other sixteenth-century and seventeenth-century manuscripts in a volume which is now in the possession of Major-General E. Renouard James (late R.E.). The ownership of the volume can be traced back to Jean Henri Ott (1617—1682), Major-General James's direct ancestor.

Heinrich Loriti, called Glareanus from his birthplace in the Canton of Glarus, was born in 1488 and died at Freyburg in 1563. He was "one of the early promoters of physical science, a scholar and a man of very varied learning." He was a friend of Erasmus, and the volume contains a letter, dated 1516, written to him by Erasmus. We get a glimpse of their friendship in Froude's *Life and Letters of Erasmus*: "His (Paul III.'s) first act on his accession had been to make advances to Henry VIII. . . . He sent the Cardinal of St. Angelo to Germany to feel his way towards a reconciliation. In Clement's time Erasmus had been denounced, as he complained, in every church and at every dinner. The Cardinal of St. Angelo now sent him profuse compliments along with a handsome present." 'The Cardinal (wrote Erasmus at Freyburg, 9th January, 1535) has given me a magnificent gold cup as a sign of his good will. I produced it for my friends Glareanus and Rhenanus, who were dining with me.'

Mr. E. Heawood has shown that the manuscript was probably written about the year 1510, seventeen years before the book was printed at Basle.

It will be interesting to note the state of cosmographical knowledge in the year that the treatise was written. Columbus had discovered the new world eighteen years before, and the spherical shape of the earth was an accepted fact; but the conception of the universe as a whole was still very primitive. Glareanus gives a diagram in which the earth occupies the centre; the sun and planets revolve round the earth after the elements of Air, Fire and Water; there is then the 9th Heaven, the Aqueous or Crystalline Sphere; the 10th Heaven, the "primum mobile"; the fixed stars; and the Cerulean Sphere, or abode of the Souls of the Blessed Departed, outside of all. In the description of this planetary system occurs the quaint phrase, "the spheres slide loosely over each other like the skins of an onion."

Copernicus was at this time working at the planetary motions, but his book *De Orbium Cœlestium Revolutionibus* was not published till 1543. Until this date the onion theory held the field, and indeed it did not finally vanish from certain conservative institutions for nearly three centuries.

The treatise consists of forty-five pages of paper, about the size of a sheet of foolscap, written on both sides. The work is entirely in Latin and the writing is beautifully clear. There are numerous illustrations in the body of the text and seven full-page maps in colours; a reproduction of one of these, the map of the Northern Hemisphere, forms the frontispiece of this number of the *R.E. Journal.* Great care has been taken to make the reproduction as exact as possible, but the aged appearance of the paper, resulting from the passage of four centuries, has not been imitated; the reproduction must closely represent the appearance of the original as it came fresh from the old geographer's hands.

The principal headings of the chapters into which the book is divided are: De Geometriæ Principiis; De Partibus Essentialibus Totius Universi (illustrated by a diagram of the celestial spheres arranged on the onion theory); De Motibus Corporum; Quid Sphæra, Axis, Poli, et Polorū Nomina; Quid per Elevationem Poli Intelligatur; De Parallelis; De Climatum Ratione; De Latitudine; De Longitudine; De Ventis; De Pictura Globi; De Inducenda Bapyro in Globo; De Divisione Terræ; De Europa; De Regionibus Quæ Libro Sunt Apud PTOLEMÆUM.

The chapter last mentioned commences with an account of Ireland:—HYBERNIA insula maxime ad occasum et septentrionem, a septentrione Hyperboreo alluitur oceano. . . . Hodie dicitur Irland. Paret hodie Anglorū regi. Homines sunt agrestes.

The description of the various countries of Europe is followed by similar accounts of Africa and Asia, and at the end of the book there are a few lines on the newly discovered land called America: "Sūt qui putent tempore Augusti Cæsaris eam terrā quoq fuisse notā." . . .

To modern readers the most interesting features of the treatise are the map projections used. There are seven full-page maps. Three of these are on a projection of which, on account of the comparative roughness of the drawing, it is difficult to discover the exact law. It is a modification of a projection used in previously published editions of Ptolemy. The parallels are circles but are not concentric; the meridians are circles and the lengths along the meridians are true.

The other projections are more important. One is a conical projection with rectified meridians; the pole is the centre of the parallels and there is one standard parallel. This projection was copied from Ruysch (1508). The result is two fan-shaped maps, stretching from the North Pole to 37° S., each showing 180° of longitude. The angle at the pole is 108°, and the parallel 5° S. is therefore true to scale. This is an early instance of the use of that important projection "Conical, with Rectified Meridians and Two Standard Parallels"; in this case the pole is one of the standard parallels.

The other projection is the "Equidistant Polar Projection." Glareanus shows two maps on this projection, one of the Northern Hemisphere (see *Frontispiece*) and one of the Southern. This is the first known instance of the use of the Equidistant Projection.

None of the projections used are derived from the sphere by any obvious geometrical process, and it would have been well if modern map-makers had always followed this excellent example.

The writer of this note is much indebted to Major-General Renouard James for so kindly lending the manuscript, and for permitting the reproduction of the map.

# *THE BATTLE OF NANSAN.*

22ND MAY TO 26TH MAY, 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.*—Roughly speaking the battlefield is bounded on the north by the hills north of the town of Kinchau; on the east by Ta-ho-shang-shan; on the south by Talienwan Bay; and on the west by Nan-kwan-ling Hill and Kinchau Bay.

*Hills.*—The principal feature is the line of Nansan—Nan-kwan-ling Hills, running from the town of Kinchau in a southerly direction; these hills formed the main Russian position. About the centre they are some 300 ft. in height, but on the flanks towards Talienwan and Kinchau Bays they are much lower. Nan-kwan-ling is about 800 ft. in height, and indirect fire on the country about Yen-chia-tun was freely used from it by the Russians. Ta-ho-shang Mountain (2,000 ft.) is a very rough and rugged mass of hills, the slopes of which command the Kinchau position, and was largely used by the Japanese for Artillery positions.

*The Isthmus* or narrow neck of land between Kinchau and Talienwan Bays is about 1½ miles wide, very flat, and hardly above sea level. The ground generally is stony, wet and sandy, affording little or no cover for an advance against the Nansan position.

*Roads.*—The principal roads in the area are :—

1st. The Port Arthur—Su-kia-tun—Kinchau—Shi-san-li-tai route to Pulantien (Port Adams) and Liao-yang.

2nd. The Kinchau—Wan-chia-tun route to Pitsewo.

3rd. A route from Pitsewo to Kinchau, *viâ* the south base of Ta-ho-shang-shan.

All these roads were of an inferior character, rough and in indifferent condition.

*Railway.*—The Siberian or Manchurian railway runs through the area in a south-west direction, passing a little to the east of Kinchau and thence close under the base of Nansan Hills to Ta-fang-shan

Station (head of Talienwan Bay). At the station the line diverges, the main line going west, *viâ* base of Nan-kwan-ling Hill, to Port Arthur, while a branch runs south to Talienwan. The line was in good order and was freely used by the Russians in their retreat from Kinchau.

*Towns.*—Kinchau is a large Chinese city, about 700 yards long by 600 yards wide, surrounded by a wall 30 ft. high. It is of little use as a military position as it is commanded by hills on the north, east and south-east sides, within easy artillery range, and though occupied as an advanced post by the Russians, it was not seriously held.

There are a number of small villages scattered about the area, but none of them are of any importance.

*The Weather.*—All through the 25th May, there was a very strong wind, succeeded by heavy rain. There was a very severe storm with lightning about 2 a.m. on 26th, and the bad weather prevented the Japanese Naval detachment (in Kinchau Bay) coming into action as early as had been intended. There was a very thick fog early on the 26th May, which necessitated postponing the opening of artillery fire till 5.30 a.m., an hour after the appointed time.

## II. THE OPPOSING FORCES AND THEIR DISPOSITIONS.

### A. THE RUSSIAN FORCES.

#### (*a*). *Military.*

The Russian troops available for the defence of the Nansan position were :—

In command—General Stoessel, Commanding IV. Siberian A.C.

| | | |
|---|---|---|
| 4th East Siberian Rifle Division (Gen. Fock) | 1st Brigade (Gen. Dimitrowski)... | 13th Regt. (3 battalions) |
| | | 14th Regt. (3 battalions) |
| | 2nd Brigade (Gen. Nadjejin) ... | 15th Regt. (3 battalions) |
| | | 16th Regt. (3 battalions) |
| 4th East Siberian Rifle Artillery Brigade ... | | 5th Regt. (3 battalions) |
| | | 2 batteries—16 guns. |

In addition to the above there were technical troops, some sailors employed in manning the heavy guns, and 5 companies of Railway Guards.

The Nansan position stretched across the isthmus, from Kinchau Bay to Talienwan Bay, Kinchau town being held as an advanced post on the left, while the batteries about Ho-shang-tao formed a support to the right of the position. Nansan Hill itself was strongly fortified, with 14 gun batteries and numerous trenches ; the front and north flank were also well defended by barbed wire entanglements, deep military pits and contact or observation mines. There were search lights at Hon-ying, Tso-ying and Yang-pao-ying.

The gun batteries were as follows (No. 1 being at the south point of the defences, No. 8 at the north, and so on) :—

*Nansan Hill.*—No. 1, eight field guns 8·7 cm.; No. 2, four guns 8·7 cm.; No. 3, four guns 10·5 cm.; No. 4, one gun 15·45 cm.; No. 5, two guns 8·7 cm.; No. 6, four guns 15 cm. and 4 mortars 15 cm.; No. 7, four guns 8·7 cm.; No. 8, four field guns 8·7 cm.; No. 9, four field guns 8·7 cm. and 4 guns 8·7 cm.; No. 10, six field guns 8·7 cm. and 2 guns 8·7 cm.; No. 11, not armed; No. 12, not armed, ammunition store; No. 13, two field guns 8·7 cm.; No. 14, two guns 8·7.

*Kinchau.*—Two guns 7·5 cm.; two guns 8·7 cm.

*Nan-kwan-ling.*—Four guns 8·7 cm.

*Above Ta-fang-shan.*—Two guns 15 cm.; two guns 10·5 cm.

*Various.*—Five guns 15 cm.; two guns 12 cm.

The heavier calibre guns were chiefly guns taken from the Chinese when the Russians acquired Port Arthur.

On Nansan Hill, the batteries on the north slopes fired chiefly to the north, over Kinchau Bay; the batteries on the east slopes fired to north and east and south-east, while those on the south slopes fired south, south-east and south-west.

The fieldworks on Nansan and Nan-kwan-ling Hills were of a very ordinary type; the batteries, trenches, entanglements, pits, etc., being of designs very similar to those shown in our *Manual of Military Engineering.*

The following points are noticeable :—

1st. The trenches followed the contours of the ground; they had a low command and were blinded in parts; there were good covered communications from the batteries to the trenches.

2nd. The batteries were well revetted and well traversed; shell stores under the traverses; guns about 33 ft. from centre to centre.

3rd. The principal batteries were connected by telegraph and telephone.

4th. Wire entanglements were very largely used; nearly the whole front and north flank being protected by them; the posts were 5 ft. high.

The outpost line was approximately Shi-san-li-tai (3½ m. north-east of Kinchau)—Palichwang—Yang-pao-ying.

The total force comprised about 11,000 infantry, 2 field batteries, 500 railway guards, 1,500 sailors, technical troops, etc.; total about 13,400 men with 70 guns.

(*b*). *Naval.*

The Naval detachment was as follows :—

| | |
|---|---|
| Gunboat *Bobr*<br>Destroyer *Burni*<br>" *Boiki*<br>5 steam launches used as transports | In Talienwan Bay. |

### B. THE JAPANESE FORCES.

#### (*a*). *Military.*

The Japanese Military force was as follows :—

In command—General Oku, Commanding II. Japanese Army.

| | | |
|---|---|---|
| I. Division. Lt.-Gen. Prince Fushimi. | 1st Brigade | 1st Regt. |
| | | 15th Regt. |
| | 2nd Brigade | 2nd Regt. |
| | | 3rd Regt. |
| III. Division. Lt.-Gen. Oshima. | 5th Brigade | 6th Regt. |
| | | 33rd Regt. |
| | 17th Brigade | 18th Regt. |
| | | 34th Regt. |
| IV. Division. Lt.-Gen. Ogawa. | 7th Brigade | 8th Regt. |
| | | 37th Regt. |
| | 19th Brigade | 9th Regt. |
| | | 38th Regt. |

Independent Artillery Brigade (1 regiment)—Maj.-Gen. Uchiyama.

The total strength was 36 battalions, 144 guns (108 with the Divisions, and 36 with the Independent Artillery Brigade), and miscellaneous troops ; or about 45,000 men and 144 guns.

#### (*b*). *Naval.*

The Naval Detachment comprised :—

| | |
|---|---|
| Gunboat *Akagi* | In Kinchau Bay. |
| ,, *Chokai* | |
| ,, *Tsu-kushi* | |
| ,, *Heirgen* | |

### III.—NARRATIVE OF EVENTS.

*22nd May.*—The Russians held the Nansan position, their outposts having been driven in during the period 16th May to 22nd May, 1904. The Japanese were occupied in reconnoitring the position.

*23rd May.*—The Japanese, who had advanced by the following routes :—

IV. Division : Shih-san-li-tai—Kinchau,
I. Division : road south of Ta-ho-shang-shan—Kinchau,
III. Division : Pitsewo—Kinchau,

occupied the line Chiu-li-chwang—Chen-chia-tien—Chiu-li-tai (3 m. north north-east of Kinchau), with outposts along the base of the

Ta-ho-shang-shan. The general results of the reconnoissances premised :—

(*a*). About 8 heavy guns on Ho-shang-tao facing Talienwan Bay; some fired north-east towards Hon-ying; calibre could not be ascertained.

(*b*). The works at Nansan Hill held guns of following calibres, 20 cm., 15 cm. short Canets, 10 cm., 8·6 cm., 7·6 cm., and some Q.F. field guns.

(*c*). Wire entanglements were in position from Yen-chia-tun round base of Nansan Hill to Kinchau.

(*d*). There was a small work on the heights of Nan-kwan-ling.

(*e*). Search lights were in position at Hon-ying, Tso-ying, and Yang-pao-ying.

The Russians on this date were well aware of the Japanese strength, and estimated their force at about 45,000.

*24th May.*—The general advance of the Japanese began. Further reconnoissance showed that the south defences of Nansan Hill were possibly not quite so strong as those to the east and north. Orders for the attack of the position on 25th May were issued. A naval detachment was instructed to co-operate, in Kinchau Bay.

*25th May.*—Owing to the bad weather the Japanese Naval detachment was unable to co-operate with the land forces, and the attack was consequently postponed. The outpost line was however pushed in further towards the Russian position, and there was a general artillery engagement between 5.30 a.m. and 9 a.m. Further reconnoissance showed that the entrenchments on Nansan were still under construction. At 6 p.m. orders for the attack were again issued.

IV. Division : to attack Kinchau, and left flank of Nansan.
I. Division : to move direct on Nansan.
III. Division : to attack right flank of Nansan.
Independent Artillery Brigade : to take up a position about 2 miles east of Nansan, on the slopes of Ta-ho-shang-shan.
Attack to take place at daybreak ; artillery to open fire at 4.30 a.m.

The Russians used their military balloons very freely this day ; ten balloons were up for about 6 hours, and though constantly fired at, none of them were hit.

*26th May.*—*12 midnight.*—The IV. Division attacked Kinchau ; but owing to the very bad weather and the darkness, had to desist.

*5.20 a.m.*—Part of the I. Division succeeded in capturing Kinchau, blowing in the north gate. The Russian detachment, some 600 strong, suffered severely in the retreat.

5.30 *a.m.*—Owing to the thick fog it was not possible to commence the artillery bombardment at the hour ordered, but from 5.30 a.m. to 9 a.m. a heavy fire was kept up on Nansan.

6 *a.m.*—The Japanese Naval detachment opened fire on Nansan from Kinchau Bay; owing to the rising tide the gunboats were able to push well in, and maintained a very severe fire on the left rear of the position.

9.30 *a.m.*—The Russian fire, which up to this time had been very heavy, appeared to slacken. The Japanese infantry commenced their attack, advancing all along the line by a series of rushes to within 300 to 500 yards of the entanglements; but could get no closer. The two Russian field batteries retired to Nan-kwan-ling, from which point they kept up a very heavy indirect fire on the Japanese III. Division south of Yen-chia-tun.

10 *a.m.*—The Russian gunboat *Bobr* appeared in Talienwan Bay east of Ho-shang-tao, and kept up a vigorous fire on the III. Division which suffered severely. The Russians also tried to land a party from steam launches, but the attempt failed.

11 *a.m.*—By this hour some of the Russian guns on Nansan had been silenced, but the fire from the Russian position generally was still so heavy that the infantry attack could make no progress.

2 *p.m.*—The position of the III. Division was now rather critical. It was under a heavy fire from Nansan and Nan-kwan-ling, while on the left flank the Russian gunboat *Bobr* was still in action. Some little assistance however was given to it by the fire of the Japanese gunboats *Akagi* and *Chokai*, which kept up a heavy bombardment of Nansan, and to a certain extent held the Russian batteries on North Nansan in check. The *Chokai* lost her captain, but their light draught enabled both vessels to remain in Kinchau Bay, and there is no doubt that their fire contributed considerably to the final success of the attack.

5 *p.m.*—The Officer Commanding the Artillery reported that the gun and wagon supply of ammunition was running out, and General Oku decided to make a determined infantry attack all along the line. This was done, and nine attacks were made with the greatest bravery but with little success.

7 *p.m.*—About this hour the IV. Division, assisted by the Japanese Naval detachment, managed after a severe fight in the water to gain a footing on the north of Nansan Hill; a general vigorous advance was then pushed all along the line, and by 7 p.m. the Japanese infantry occupied the whole position. The Russians retreated to Nan-san-shih-li-pao, and there was no further fighting.

The Japanese losses were:—Killed, 33 officers, 716 other ranks; wounded, 100 officers and 3,355 other ranks.

The Russians had 10 officers and 694 other ranks killed, who were buried by the Japanese on the field of battle, the total losses being about 4,000. Their losses in guns were:—heavy and field guns of different kinds 68, machine guns 10.

## IV. COMMENTS.

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

The Nansan position formed the extreme east line of defence of Port Arthur, and was a natural one for the Russian Commander to take up. The general line held was, as far as land defence goes, a strong one, especially against attack by infantry; but the slopes of Ta-ho-shang-shan formed good positions for the Japanese artillery, and were a distinct disadvantage to the defenders.

The real weak points of the position were however the flanks, as these were both within easy artillery range from ships in Kinchau and Talienwan Bays. Fortunately for the Russians the gunboat *Bobr* and two destroyers held Talienwan Bay; but the final success of the Japanese was very largely due to the heavy fire kept up on the left flank of Nansan Hill by the Japanese Naval detachment; in fact it is very doubtful whether the position would have been taken if the Naval detachment had been unable to come into action.

With regard to the actual conduct of the defence, it is rather curious that the Russians did not make a vigorous counter attack, about 5 p.m. on the 26th, on the Japanese left flank round the south of Nansan Hill. The Japanese III. Division had suffered severely all through the afternoon, and it is probable that a sharp counter attack would have seriously inconvenienced the attacking forces. Possibly the want of troops was the reason for the purely defensive tactics practised by the Russians; but with the large number of troops available at Port Arthur, it seems unfortunate that an extra brigade could not have been spared for offensive operations. Probably the defenders felt so confident of holding the position that they did not think offensive tactics necessary.

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

Owing to the very limited front the Japanese Commander had little choice of ground on which to make his attack. Virtually a direct frontal attack all along the line was necessary, as the position could not be approached in any other way, at all events in the early stages of the action.

The employment of the Naval detachment in Kinchau Bay was of very great importance; and had more ships been able to take part in the attack, the battle might have been won at a very much earlier hour and at a far smaller cost. The Japanese do not seem to have been aware of the presence of the Russian Naval detachment in Talienwan Bay, or no doubt some of the Japanese ships would have been detailed to deal with it.

With regard to the question of frontal attacks against entrenched positions, there can be little doubt that, on this occasion, such attacks failed. The final success of the operations was due to the combined fire of the land and sea artillery, and to the magnificent flank attack of the Japanese IV. Division.

The general lesson of the action seems to be that a direct attack against an enemy well entrenched in a good position is almost certain to fail; and that success can only be attained by operating against the flanks, or against some particular weak point in the position, simultaneously with the direct attack.

### 3. *Reconnoissance.*

The very careful manner in which the Japanese reconnoitred the Russian position should be noted. The greatest care was taken to try and discover the positions of the guns, trenches, obstacles, etc., and at least *four days* were devoted to this work alone. The result was most successful; for when the assault really commenced on the 26th May, the Japanese Commander had very full information as to the enemy's position and was considerably assisted thereby in making his preparations for the attack.

### 4. *Artillery.*

The principal points to notice about the Japanese artillery are:—(1) The skilful manner in which it supported the infantry attack, and (2) the excellent combined action of the land and sea artillery forces.

The Russian artillery worked well, especially the two field batteries at Nan-kwan-ling and the Naval detachment in Talienwan Bay; but the guns on Nansan Hill appear to have been a good deal exposed, and it was probably on this account that they were unable to obtain the best results.

### 5. *Engineers.*

The Russian position was strongly entrenched and well provided with wire entanglements, military pits and land mines. The type of gun shelter used does not seem to have been a good one; but the obstacles were very effective, and would have been more so if the wet weather of the 25th—26th May had not caused the positions of the mines to show up so much.

The Japanese Engineers showed great skill and courage; the destruction of the gate of Kinchau Castle and the cutting of the land mine cables, both operations being conducted under heavy fire, were splendid feats of arms and highly creditable to the Japanese scientific corps.

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

# *THE ANGLO-FRENCH BOUNDARY COMMISSION IN NORTHERN NIGERIA, 1902—1904.*

*By* BT.-LIEUT.-COLONEL G. S. MCD. ELLIOT, R.E.

THE boundary between Northern Nigeria and the French possessions to the north, as defined by the Paris Convention of 1898, is shown on the map.

It started from the east bank of the Niger near Dole ; and followed the median line of a depression, called the Dallul Mauri, till this line was cut by an arc of a circle of 100 miles radius, with the city of Sokoto as centre. This arc was the boundary till, after passing the meridian of Sokoto, it cut the parallel of 14° N. This parallel was followed for 70 miles, and then the frontier turned due South till it reached the parallel of 13° 20′ N. After running 250 miles along this parallel, it turned North till it regained the 14° N., which again became the boundary till it cut a meridian 35′ East of the centre of the town of Kukawa. It finally followed this meridian down till it reached the southern shore of Lake Chad.

The British Section of the Boundary Commission* left Liverpool on the 4th October, 1902, and on the 21st reached the Forcados mouth of the Niger, where we left the ocean steamer and got on a stern-wheeler that took passengers and mails up to Lokoja. This place we reached on the 27th.

At Lokoja we heard through an officer of the French Niger Flotilla that the French section of the Commission had not left Europe. We waited there some weeks, unpacking our cases, getting everything into carrying loads, and overhauling our instruments, camp equipment, etc.

On the 20th November we left Lokoja on a Niger Company's stern-wheeler, and in six days reached Jebba. Here five days were spent endeavouring to get longitude by telegraph from Lagos. It seemed impossible however to get messages through under several hours, so the attempt had to be abandoned.

On the 1st December we left Lokoja with a flotilla of 20 canoes,

* The British Commissioner was Bt.-Lieut.-Col. G. S. McD. Elliot, R.E., the Assistant Commissioners at first being Lieuts. C. H. Foulkes and G. R. Frith, R.E. Later on Lieut. G. F. Evans joined, together with Corpls. Healy, Archer and Kingston and Sapper Johnson, R.E. Lieuts. Foulkes and Frith and Corpl. Archer were invalided home in October, 1903.

collected by the Officer Commanding the post there, and started to pole up against the current to Dole, where our frontier crossed the Niger. This place we reached on the 26th after a wearisome journey.

The river was falling; and as our canoes were not large enough to sleep in, we had to camp among the swamps along its banks, which swarmed with mosquitos.

Our rate of progress was about 10 to 15 miles a day. The canoes were propelled against the current by poling. Paddles were only used when it was necessary to cross the river at bends, so as to get away from the side where the current ran deep and strong to that where the water was shallow and less swift. In many places both sides of the river were equally unsuitable, and then the canoes were hauled up stream by pulling on the overhanging branches that fringed the banks, a very unsatisfactory mode of progression. Worse than this however were the reaches where the river ran deep between banks of reeds. Here cross pieces were lashed to the heads of the poles to enable a purchase to be taken and the canoe was forced up close along the banks by pushing against the reeds. We found occupation in repelling the attacks of the mosquitos dislodged by this operation.

We were glad to get rid of our canoes at Dole, which is on the left bank of the Niger a little above Illo. It is a village of reed huts surrounded by a stockade of hard wood logs, lying a little way up a creek to which it gives its name and which is the mouth of the Dallul Mauri. At this point the Niger is bordered for a mile or two on each side by reedy swamps. Wherever the ground is firm fan palms grow. These are very plentiful round Dole, and run up the Dallul Mauri to some distance above Yelu; they require moisture however, and disappear where the country gets drier. For this reason too they are only found along the centre of the Dallul Mauri, and are in many places the best way of recognising where the bed of that depression lies.

When we reached Dole the Harmattan wind was well established. The air was thick with a yellow dust haze. The view was limited to about a mile or two all round and consisted of little but fan palms and reeds.

The Convention defined the frontier as starting from the bank of the Niger and following the median line of the Dallul Mauri. What was the Dallul Mauri was at first a disputed point. Major Lang-Hyde, C.M.G., R.E., had set this matter at rest by a survey he made from Dole to above Beibei in 1900, after he had completed the demarcation of the boundary west of the Niger.

Given the Dallul Mauri, a further question arose as to what was its median line. A description of the Dallul Mauri will explain this difficulty. Following the Dole Creek up from the Niger we find it ends in a line of marshes, dry (or nearly so) at the time of our visit, with fan palms in abundance along their borders. Soon laterite scarps appear on either hand, and these and the country round are covered with thorny bush. Large forest trees are at first plentiful, but they gradually disappear as one gets further up away from the Niger. Opposite the village of Banna, the depression we have been following bifurcates. The westerly branch is known as the Rafin Foga or Valley of Salt, and this really is the correct name for the depression all the way down to the Niger. Dallul Mauri is the name given by the natives to that part of the easterly branch that lies in the Arewa or Mauri country, which is not entered till we get nearer Bale, a good deal further up.

In the Rafin Foga are salt workings. The method of obtaining the salt is the same as that practised in the salt desert in Bornu. After the rains, when the marshes begin to dry, the salt workers leave their homes, often many days' journey away, and come and camp in temporary villages built of palm leaves and generally placed on the spoil heaps left by their predecessors. They scrape up the soil from which the water has just dried and fill it into strong baskets, shaped like inverted truncated cones, placed in frames over earthen pots. Water is poured in at intervals and the brine is caught in the pots. These are taken away and the water is evaporated by boiling. The resulting salt is far from palatable to Europeans, and looks very yellow and dirty. A good trade is however done in it.

Above the junction of the Rafin Foga the scarps disappear on the west of the Dallul Mauri and their place is taken by rolling bush-covered undulations. After passing Nasserawa the Dallul Mauri can be traced with difficulty, but this was not of much importance as far as the demarcation of the boundary was concerned for the arc had intersected its median line before Beibei was reached. The difficulty about the median line was to determine whether it was to be considered to lie midway between the crests of the scarps or watersheds on either hand, or whether it was the middle of the line of marshes. Both were equally hard to define, as neither the scarps nor the marshes were continuous. A compromise was therefore resorted to.

From the beginning of the arc right round to the Chad the whole of the frontier lay along the fringe of the desert, and, though crossed in places, had not previously been traversed by Europeans. It is an uninviting region of deep sand covered with thorny bushes, unrelieved by any striking features and rendered still more wearisome by the haze of dust which hangs over it while the Harmattan is blowing.

There appear to be evidences that the desert is extending to the southward. One of these seems to me the fact that the limits of certain trees, notably the shea butter-tree and the baobab, may almost be defined by parallels of latitude. It looks as if the country were once well forested; and that, as the rainfall gradually diminished, the trees requiring the most moisture were the first to disappear, whilst the hardy varieties continued to exist a while longer under the changed conditions. To make this argument complete it would be necessary to find remains of the other varieties north of the zones where they now exist. I daresay some of the fossil roots and plants which our French colleagues have brought home may supply the proofs that are wanting.

Stronger evidence than this, however, is to be gained by a study of the physical features of the country. There are no water-courses or valleys drained by streams. The little rain that falls seldom flows far along the surface; it either soaks into the ground at once, or forms pools which dry up for the most part a few weeks after the rains are over. The Dallul Mauri is a fair example of what were evidently old water-courses, that are to be met with throughout this region. Originating, seemingly, along a line of fault in the laterite sheet that covers the country, it became the valley of a river draining into the Niger basin. In course of time, as the rainfall decreased, the prevailing winds, charged with sand from the desert, blocked its channel with dunes which its then dwindling current had not the power to sweep from its path; marshes were thus formed along its course, and they in turn collected less and less water as the rainfall decreased in the areas that drained into them.

That the rainfall was once considerably greater than it is now is evinced by a series of deep water-worn valleys that divide up the laterite surface to the S.E. to Tawa. These are about 100 to 200 feet deep, and a mile wide in parts. They were evidently river valleys, but like the Dallul Mauri no stream now drains their entire length. Such water as flows in them in the rains sooner or later finds its way into pools and marshes, few of which contain water through the dry season.

These deep valleys are interesting too in another way. The geological section exposed on their sides shows the laterite sheet to overlay shales and chalk. The latter is full of fossils, a large number of echinoids among them, which have been identified as belonging to Eocene times. This is a point of considerable importance as it shows the vast extent of this Eocene sea, which, to judge by the similarity of these fossils with those found in Northern Africa, Arabia, Sind and Baluchistan, seems to have included the Mediterranean, the Saharan part of Africa, Egypt, Arabia and the N.W. of India, and to have extended as far south as Sokoto, if not further.

Leaving the evidences of the past, we may turn to what we can see going on to-day. We have the fringe of the desert inhabited by a people mainly pastoral. There are, as is well known, no more deadly enemies to forests than the native shepherd and his goats. The former, with the axe he always carries, wantonly hacks the trees about to satisfy his most trivial needs or cuts down their branches to feed his flocks; while his goats love to bite off young shoots and particularly the tops of seedlings. In addition there is the damage done every year by the forest fires when the old grass is burnt to make way for the new.

The method of cultivation too is most wasteful. To clear the ground the smaller trees are cut through at about the height of a man's waist; the larger ones are ringed. When the branches are dry they are burnt, being piled, if necessary, round the ringed trees, which are consumed with a completeness that is astonishing. The field, dotted over with stumps, which render ploughing impossible, is now ready for the hoe. When the ground is exhausted fresh fields are prepared in the same manner. The country was thus steadily being deforested under native rule.

With diminution of vegetation goes diminution of rainfall. The prevailing wind is the Harmattan. This commences in October soon after the rains cease, and is well established before November is out. Thence till the end of March or middle of April it blows without intermission from the north-east; and the air during its continuance is so heavily charged with fine sand that one exists in a sort of fog, and vision is limited to two or three miles, and occasionally to half a mile or less, a state of affairs very unfavourable for surveying and disagreeable from every point of view. Nothing is free from this sand; and coming straight up from the moist Niger valley to this extremely dry and dusty region was very trying and caused a certain amount of sore throats, earaches and other annoyances till one got accustomed to it. From April to June, when the rains fairly break, the Harmattan is still the prevailing wind; but there are intervals of a few days together when the air is clear, the wind blows from other quarters, clouds due to water vapour instead of dust are to be seen, and even a few drops of rain fall. It can readily be conceived how a wind like this, ever carrying before it in the same direction the loose particles from the soil that has lost its protective covering of vegetation, is busy before our eyes in changing the face of nature, slowly, it is true, but steadily and surely. The lee side of every bush and rock becomes the starting point of a sand dune, and naturally hollows and bends in the river courses are the first to get blocked. The process of deforesting thus acts in a twofold manner on the drainage of the country. It diminishes the rainfall and consequently the volume and strength of the currents; and it lays bare the soil to the depredations of the wind, which thus more readily gathers the material to block the channels. Before leaving this subject I must guard myself against seeming to imply that the influences I have just enumerated are the ones that have mainly operated to bring about the great change that has undoubtedly taken place in these regions. The vast sheets of inland water, remains of the Eocene sea referred to above, must, while they existed, have contributed very largely to the rainfall of the interior of Africa; and the water-worn valleys were doubtless carved out in a great measure during their time. Naturally, as they dried the climate and conditions gradually changed. I have merely been trying to explain my reasons for thinking that the view that the desert is extending southward has every probability of being correct.

After leaving the lower portion of the Dallul Mauri near the Niger, no surface water was encountered along the frontier till the Salt Desert was reached. In the rains, after a shower, the ground was running with water for a few hours, and the forest pools filled up, but there is no stream that has water in it throughout the year. Even the river we crossed several times when marching from Maradi to Katsena, and over which we got our caravan with some difficulty, dries entirely, I believe, between the rainy seasons. As far as my knowledge goes this river flows past Sokoto. Near that town there is water in it throughout the year, but this is some distance from the frontier.

The water supply of the country is all from wells, usually over 60 feet and sometimes much more in depth. In some places the water is charged with salts and is most disagreeable, but it is usually good, though muddy when first drawn. The natives seem to despise any sort of wheel, inclined plane, or other mechanical contrivance whatever, to enable them to draw the water with greater ease. They lower their vessels, either pots, gourds or skins on an iron ring, into the wells by ropes, and pull them up again by hand. The ropes, it is true, rubbing on the hard wood logs lining the top of the well, cut deep grooves, and this perhaps is of some little assistance.

Large flocks of sheep, herds of cattle, horses, everything in the village or town, depend for water on these wells. The labour of supplying them is considerable. A horse usually takes several hauls of water before he is satisfied. Round the wells are troughs made of hollowed-out logs into which the water is poured for the cattle. There is often a rough fence to keep the animals from the edge of the well, but even then the sanitary conditions are not ideal. Worse still are they when the rains have commenced and the wells can no longer be used, as, being lined for only a short distance from the top, the sides are apt to fall in if weight is brought on them when sodden with water. Then recourse must be had to the surface pools, the catchment for which is the village and its neighbourhood.

I have referred to the Salt Desert. This lies, roughly speaking, round the second crotchet made by the frontier, where it regains the parallel of 14° N. from that of 13° 20′ N. The name has an uninviting sound; but compared with the monotonous tracts of heavy sand or laterite covered with thorny bush, through which we had been passing during so many months, it was a relief to the eye to get out on to wide open plains covered with grass and diversified occasionally by lines of borassus palms. True, the soil was sand as heavy as ever, the grass was dry and full of horrible burrs, and the Harmattan, for it was the end of November, had again cast its yellow veil over the landscape; yet all the same there was a sense of freedom that was lacking where the view was restricted to a few yards of monotonous bush, inhabited by little else but grey hornbills, whose dismal notes seemed most appropriate to their surroundings.

The curious feature of the Salt Desert was the pans or hollows that are dotted about it. There is nothing in the open undulating plain to denote the presence of these, and one is unaware of their existence till right upon them. Some of the hollows were dry or drying, others contained water deep enough for hippopotami. Round the edge of the water is usually a dense border of handsome feathery reeds, and on the firm ground outside these a belt of borassus palms. These pans were of varying sizes and shapes, sometimes roughly circular, about half-a-mile to a mile across, and 100 feet or more below the general level of the surrounding country. To our eyes, unaccustomed to the sight of water in the landscape, they were a welcome sight. In such of the pans that the water dried from, a deposit of salt or potash was left. The salt was obtained in the same way as in the Dallul Mauri.

After leaving the Salt Desert we struck down to the Yo river and followed its course to the Chad, which was reached on the 26th December, 1903, exactly a year from the day we reached Dole on the Niger, where our work began.

The appearance of the lake is disappointing. No vast stretch of open water meets the eye. On emerging from the bush which skirts its shore a grassy plain is entered from one to several miles in width; beyond this are marshes as far as the eye can reach. The shores are so low that it is impossible to get an extended view. There are no native boats that are able to cross the lake. The Boudouma, who live on the lake, make canoes of bundles of reeds lashed together, forming a sort of raft tapering to the ends. The gunwales are formed of similar bundles made fast round the edge of the raft. These vessels, however, are only suitable for poling round the edge of the lake, and dare not venture into the open, where it is often very rough. On the western shore we noticed that at night, when the Harmattan usually died away, the waters receded some hundreds of yards, being piled up during the day by the strong north-east wind.

Game was plentiful on the grassy plain bordering the marshes, but though the number of animals was large there were not many varieties. Korrigon (the Senegal hartebeeste), cob, several kinds of gazelles, elephants and ostriches were seen and shot, and there were numerous traces of hippo. A wart-hog was also ridden down and stuck. No traces of lions were seen; and hyenas, which were plentiful enough further west, did not appear to be much in evidence on the shores of the lake. Buffalo, that once existed, appeared by native accounts to have been killed off by sickness of some sort. Giraffe tracks were seen a few miles from the lake, but none of the animals themselves. Compared with other parts of Africa, Northern Nigeria does not appear to be remarkable for the numbers and variety of its big game.

The methods of survey adopted were dependent on the political situation as well as on the nature of the country and the climate. When we arrived at Dole, where our work began, the ruler of Sokoto was hostile, and it would not have been possible to go there without a larger escort than we had. My instructions were not to go nearer that place than Argungu till the Expedition, which was shortly to start, had dealt with it.

Argungu was the headquarters of a small Column that was employed in watching Sokoto, and in passing French convoys from the Niger for Zinder through the upper part of the arc and consequently through British territory. The roads outside the arc were impracticable, except in the rains, for want of water; and pending the settlement of the boundary the French were allowed as a temporary measure to use the roads in our territory. They had, however, in 1903, made a practicable route from Filingi (about in the left-hand top corner of the map) to Tawa by sinking wells along it at intervals. This was a very creditable achievement, carried out in the face of considerable difficulties.

The latest Convention has given them a slice off the top of the arc so as to let them have the road they wanted,—roughly through Matankari, north of Tolleh and Sabun Birni, south of Maradi, and into the parallel of 13° 20′ N.

Captain Merrick, R.A., was in command of the Argungu Column, and he and his officers between them had marched round the arc and made reconnaissance sketches which proved very useful. Later on work had to be organised from maps compiled from native information, a tedious process and not very accurate, but certainly interesting, as the result depends partly on one's own skill in making the meaning clear and partly on the habits of observation and intelligence of the people questioned. At such a time one realises the value of any information that is correct as far as it goes, and how important it is that travellers in little known countries should make careful notes of their journeys, even though they may not have appliances or opportunities for making good maps.

How to survey the arc was the first question to be considered. Sokoto, the centre of it, was for the time unattainable; but we had been supplied with the co-ordinates of a conventional centre that we had been directed to adopt. These had been arrived at by taking the means of the observations of the various travellers who had visited the place, and the position thus given proved to be not very far from the actual centre of the town.

Various circumstances combined to decide the eventual method of surveying the arc. It was as follows :—

(i.). Triangulation near Beibei and Junju with a line of latitudes and azimuths to Matankari.
(ii.). Line of latitudes and azimuths from Tawa to Sokoto.
(iii.). Triangulation in the neighbourhood of Buza and Chara.

On these three sections occultations were observed as follows :—

On (i.) 1 at Junju, 1 at Beibei and 2 near Matankari ; on (ii.) 2 at Illela, 1 at Tawa ; on (iii.) 3 at Buza.

All the intermediate ground was sketched in between the points so fixed ; and frequent latitudes and longitudes by watches were taken.

Had the three sections above mentioned been connected by some more accurate system of survey, such as a triangulation or a careful traverse, it would have been possible to use the mean of all ten occultations for the determination of longitude. The nature of the country and the state of the atmosphere would however have made this a long and costly operation, and the circumstances did not appear to demand it.

The sketches were nearly all made with the prismatic compass ; and distances were measured by wheels fitted with cyclometers, such as are used on bicycles. By first checking these wheels over a measured distance, so as to estimate what correction should be made for the little deviation from a perfectly straight path and also for a certain amount of slipping unavoidable in bush and heavy sand, very satisfactory results were obtained. The surveyor marched with some portion of his caravan at any rate well in front of him. The road could seldom be gone over twice ; and usually the only way to see where the narrow bush path was going was to observe on the people winding along it ahead. The magnetic variation was very steady ; and this was fortunate, as, owing to the flat bush-covered nature of the country and the hazy dust-filled condition of the air for the greater part of the year, we were forced to depend on our compasses.

We took frequent azimuth observations to check the magnetic variation, and found it to change steadily from about 14° W. near the Niger to 10° W. near Lake Chad. This corresponds very well with the lines of equal magnetic variation shown in the chart opposite page 82 in Vol. I. of the Royal Geographical Society's *Hints to Travellers*, 1901.

As regards astronomical observations, longitude was of course the main difficulty. We relied for absolute longitude on occultations of stars by the moon. The French stipulated that we should have at least three observations in one place and take the mean before we could consider that place properly fixed in longitude. This was by no means an unreasonable condition, as anyone who has studied the question will admit ; but it was far from easy to fulfil, because, for an occultation to be of any use, the conditions must be very favourable,—a clear sky, not too bright a moon, and star entering the dark limb at a suitable angle, *i.e.*, travelling as it were towards the moon's centre and not on a path approaching a tangent to its disc. Emersions from the dark limb were also observed; but these are not so satisfactory, as the exact moment of the reappearance of the star is harder to get than its disappearance.

In several instances we got over the difficulty about getting three occultations in one place by connecting points where occultations had been observed by a triangulation; or, if they lay north and south of each other, by lines of latitude and azimuth, or by a combination of both these methods. The method of latitude and azimuth has much to recommend it when following a nearly north and south line.

We got our intermediate longitudes by carrying time with us. We had seven deck-watches, half chronometers, such as are used at sea. Observations for time were taken nearly every night. We found that, though few of the watches had a really very good rate, yet the error on Local Mean Time as given by the mean of the corrected watch times was very fairly constant. The watches have to be treated with the greatest care possible. They must always be wound at the same time and kept in the same position. After a halt they take up a different rate when the march is resumed, and this not at once but during an interval of some days; and similarly when halting after a march. The best way to get over this difficulty is never to let the watches halt. Every day that is spent in halting, the watches should be carried round the camp till they have traversed a distance equal to an average day's march, as much as possible under marching conditions. This of course has to be done under proper supervision. Careful men should be selected to carry the watches; they should receive a special rate of pay, and be impressed with the dignity and importance of their task and also with the fact that the watches, if not properly treated, will tell their own tale.

If this system is pursued, only the marching rate of the watches need be known. The best way to obtain this is to return after some days' marching and surveying to a camp where time observations have been taken, and take them again. If the conditions of work allow of it, a very good method, one practised by a very painstaking French officer, is to progress in a series of circuits (closing his polygons, as he expressed it) and take time observations whenever revisiting a spot where they had taken them before. A modification of this somewhat rigorous method will however be more usually practicable.

After the day's march, watches have to be wound and compared, and observations taken for time and latitude, and sometimes for azimuth. Though each of these operations is not in itself lengthy when practice has made the observer expert, yet, even under favourable circumstances, a considerable amount of time is occupied in waiting for stars to reach the desired position, and the work to be done at night is an appreciable addition to the labours of the day.

In places triangulation and latitudes and azimuths were, as I have said, resorted to; but the bulk of the work was compass sketches checked by as careful astronomical observations as were possible. I had much more ambitious ideas when I first started, but found that my feelings as a surveyor had to yield to a common-sense view of the case. Any other method than the one adopted would have taken very much longer, and the whole party might have been forced to return to England and go out again for another tour. The instructions given me before starting admitted of the possibility of my having to do this, but it would have added enormously to the expense. As it was five officers and one N.C.O. were sent home sick from the Boundary Commission.

The field sketches were done to a scale of $\frac{1}{100000}$, and the maps compiled in the field were to a scale of $\frac{1}{250000}$. This compilation was effected by plotting the ordinates of the points fixed by astronomical observations on graticuled sheets of that scale, which we had brought out with us, and reducing and fitting the sketches in between these points.

After returning home all calculations were worked out again, those for the occultations with the observed co-ordinates of the moon; and the maps were re-compiled to a scale of $\frac{1}{250000}$.

## TABLE OF OCCULTATIONS, 1903–4.

### OBSERVED BY ANGLO-FRENCH BOUNDARY COMMISSION.

| Date. | Place. | Condition of Moon. | Star. Name. | Star. Magnitude. | Correction to Moon's Tabular R.A. | Correction to Moon's Tabular δ | Longitude by Tabular Co-ord. | Longitude by Observed Co-ord. | Adopted Longitude. | Immersion or Emersion | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1903. | | | | | s. | " | h. m. s. | h. m. s. | h. m. s. | | |
| 10th Jan. ... | Beibei. | Full on 13th Jan. | ι Tauri. | 5·1 | +0·54 | ±0 | 0 15 32·63 | 0 15 38·5 | 0 15 33·76 E. | Imm. | Final positions of Beibei, Junju and Rumboki obtained by combining results of occultations observed at these three places. |
| 12th " ... | " | " | D.M.+17 1479. | 6·2 | +0·51 | +0·4 | 0 15 34·83 | 0 15 44·3 | | Imm. | |
| 6th Feb. ... | Junju. | 1st qr., Feb. 4th. | $\delta^3$ Tauri. | 4·2 | +0·49 | +2·4 | 0 14 4·85 | 0 14 13·6 | 0 14 7·29 E. | Imm. | See remark opposite Beibei. |
| 8th Mar. ... | Illela. | 1st qr., 6th Mar. | D.M.+17 1479. | 6·2 | +0·79 | −1·8 | 0 20 55·68 | 0 21 4·7 | | Imm. | |
| 19th April ... | " | Last qr., 19th April. | β Capricorni. | 3·2 | +0·14 | −0·3 | 0 20 55·36 | 0 20 55·3 | 0 21 0·6 E. | Imm. | |
| 6th May ... | " | 1st qr., 3rd May. | 76 Leonis. | 6·5 | +0·49 | −1·2 | 0 20 54·78 | 0 21 1·8 | | Imm. | From occultation observed at Tawa and connected with Illela by line of Lat. and Az. |
| 1st " ... | Duza. | " | B.A.C. 2116. | " | +0·46 | −0·3 | 0 24 7·5 | 0 24 17·8 | | Imm. | |
| 6th " ... | " | " | 76 Leonis. | " | +0·49 | −1·2 | 0 24 6·28 | 0 24 17·5 | 0 24 17·6 E. | Imm. | |
| 14th " ... | " | Full moon, 11th May | Y Sagittarii. | var. | −0·14 | −0·1 | 0 24 9·3 | 0 24 5·9 | | Em. | Rejected. |
| 8th July ... | Rumboki. | Full moon, 9th July. | B.A.C. 6287. | 5·7 | −0·13 | −0·3 | 0 15 57·91 | 0 15 58·2 | — | Imm. | |
| 10th " ... | " | " | β Capricorni. | 3·2 | +0·03 | −0·1 | 0 16 39·16 | 0 16 3·5 | — | Imm. | *Vide* remark opposite Beibei. |
| 10th " ... | " | " | " | " | " | " | Not calculated. | 0 16 10·9 | 0 16 8·2 E. | Em. | |
| 30th Oct. ... | Maikouri. | 1st qr., 27th Oct. | B.A.C. 7804 | 6·1 | −0·03 | −1·12 | 0 35 48·44 | 0 35 50·88 | | Imm. | |
| 3rd Nov. ... | " | Full moon, 4th Nov. | o Piscium. | 4·5 | −0·09 | −1·79 | 0 35 14·87 | 0 35 47·95 | 0 35 48·43 E. | Imm. | |
| 3rd " ... | " | " | θ Aquarii. | 4·3 | " | " | 0 35 37·30 | 0 35 46·45 | | Em. | |
| 6th Dec. ... | Kania. | Full moon, 4th Dec. | D.M.+17 1479. | 6·2 | +0·07 | −0·3 | 0 44 37·53 | 0 44 39·07 | 0 44 38·5 E. | Imm. | |
| 13th " ... | " | Last qr., 10th Dec. | ♍ Virginis. | 5·3 | +0·05 | −1·00 | 0 44 36·94 | 0 44 38·08 | | Imm. | |
| 31st " ... | Kukawa. | 1st qr., 26th Dec. | 63 Tauri. | 5·6 | +0·5 | +1·5 | 0 54 7·42 | 0 53 53·57 | 0 53 52·46 E. | Imm. | |
| 1st Jan. 1904 | " | Full moon. | 119 Tauri. | 4·6 | +0·6 | +1·4 | 0 54 6·06 | 0 53 51·25 | | Imm. | |

# *THE DESIGN OF TALL CHIMNEYS.*

*By* MAJOR C. AINSLIE, R.E.

HAVING lately had to deal with several projects for tall chimneys, I have found that designs based on a formula used by a well-known engineering firm appears unsatisfactory when tested by the method given on pages 319 and 320, Part I., of *The Principles of Structural Design* by Bt.-Colonel G. K. Scott-Moncrieff, R.E.; and I should like to see a discussion on the subject. To illustrate my point I will take the chimney given on *Plate* VIII. of that book, viz., one 100 ft. high, with top and bottom external diameters of 7′ 10″ and 13′ 8″ respectively and thickness of brickwork varying from 14″ to 2′ 3″ (a batter of ·03 in a foot).

In designing a chimney, the height is first settled with reference to the coal consumption, the height of the station above sea level, and any special local conditions and regulations. The area of the flue is then determined by one of the formulæ connecting the height, flue and grate areas. The thickness of brickwork at the top depends on the diameter of the flue at the top, 9 inches being taken for flues up to 4 ft. 6 inches diameter. The chimney can then be drawn with a batter of not less than 2½ inches in 10 ft. (by London County Council rules), and the brickwork arranged in offsets of 4½ inches at every 25 ft. or less to suit the required size of the flue. The weight of brickwork is then taken out, and calculations made for stability and for the foundations. I do not propose to deal with the last named.

According to the formula used by Messrs. Babcox & Wilcox (page 328, *Electrical Engineering Formulæ*, 2nd edition, Geipel & Kilgour), the weight of the brickwork in lbs. must not be less than $\frac{C \times d \times h^2}{b}$, where $b$ is the diameter (external) at the base in feet, $h$ the height in feet, $d$ the mean diameter (external) in feet and C a constant of 56 for square, 42 for octagonal and 28 for round chimneys, representing the wind pressure in lbs. per square foot. If this formula is applied to the chimney given on *Plate* VIII. it gives W = 98·4 tons, and as the actual weight is 255 tons there is a large margin of safety.

If we disregard the local conditions of that chimney as to the foundations and imagine it built on solid rock, the base might be reduced to 12 ft. in diameter, giving a batter of 1 in 48. Such a chimney, built with a top ring of 14 inches and 4½-inch offsets at every 25 feet, would weigh roughly 491,800 lbs. against 231,450 lbs. required by the formula quoted, showing still a large margin of safety. But this particular chimney could not be made lighter, as the 14-inch thickness at the top is required for the flue, which is $5\frac{1}{2}$ feet in diameter.

If such a chimney is checked by Colonel Scott-Moncrieff's method, we get—

Moment of Inertia $= \cdot 7854\ (6^4 - 3\cdot 75^4) = 862$ ft. units,
Weight $= 220$ tons approximately,
Area of brick ring at base $= \cdot 7854\ (12^2 - 7\cdot 5^2) = 68\cdot 5$ sq. ft.,
Overturning moment at base $= 100 \times 9\cdot 92 \times 50 \times 28$ ft. lbs. $= 620$ ft. tons, with 56 lbs. wind pressure per sq. foot.

Thickness at base $= 12$ ft.

And $y = \frac{220}{68\cdot 5} - \frac{620 \times 12}{2 \times 862}$ tons per sq. ft. $= 17$ lbs. per sq. inch tensile stress.

This is not more than good mortar could stand, although the limit given on page 38 of the same book is 14 lbs. per sq. inch.

If, instead of $\frac{56}{2}$ ft. lbs. of wind pressure, we put X, we get $X = 21\cdot 33$; that is to say the mortar will not be exposed to tensile stress up to a wind pressure of 43 lbs. per sq. foot only. I cannot find it stated anywhere what tensile stress on the mortar is admissible with the formula $W = \frac{C \times d \times h^2}{b}$; but I should think little, if any, especially as cement mortar is not recommended for the lower half of a chimney which is exposed to great heat (page 330 of Geipel & Kilgour).

If we take the case of a chimney with a small flue, the difference is more marked. Take for instance a design I have lately had to deal with (A). In this the height is 85 ft., diameter of flue 2 ft., thickness at base $8\frac{1}{2}$ ft., thickness of brickwork at the top 9 inches, with offsets of $4\frac{1}{2}$ inches at every 14 ft. The weight of such a chimney is approximately 242,300 lbs.

By the formula $W = \frac{C \times d \times h^2}{b}$ the required weight is about 142,800 so the chimney is stable. But if tested by Colonel Scott-Moncrieff's method the tensile stress on the mortar at the ground line, with a wind pressure of 60 lbs. per square foot, is about $42\frac{1}{2}$ lbs. per square inch, or 37 lbs. with a wind pressure of 56 lbs. Surely the trade formula does not contemplate such a tensile stress. Yet the design is well within the conditions laid down by the London County Council; the batter is only 1 in 34 and the base $\frac{1}{10}$th the height.

I have worked out a chimney of this height with a diameter of 7 ft. 1 inch at the base (*i.e.*, a batter of 1 in 48 and a base of $\frac{1}{12}$th the height), the thickness of brickwork at the top being 9 inches, with

$4\frac{1}{2}$-inch offsets at every 20 ft. except the lowest length of 25 ft. Such a chimney weighs 177,400 lbs. against 161,900 lbs. required by the above formula, and conforms to the London County Council rules; but shows a tensile strength of 78 lbs. per sq. inch on the mortar with 60 lbs. wind pressure, and a crushing stress of ·71 tons per sq. inch (B). What conclusion are we to draw from this?

The formula $W = \frac{Cxdxh^2}{b}$ quoted above is evidently arrived at by equating the moments of resistance and the overturning moment, taken about the leeward edge of the ground line section. For $M_r = Wx\frac{d}{2}$ and $M_o = hxdx\frac{h}{2}xC$, the wind pressure being considered to act on a plane equal to the mean external diameter at half the height, and being taken at 28 lbs. per sq. ft. for round chimneys, 42 lbs. for octagonal and 56 lbs. for square chimneys. There does not seem any objection to taking the moments of resistance and overturning moments about the leeward edge, provided the crushing stress at the leeward edge is not more than the bricks can stand safely. Take for instance the chimney designed as at (A) above, and calculate the crushing stress at the leeward edge by Colonel Scott-Moncrieff's method. Here we have

| | | |
|---|---|---|
| Moment of inertia at base | $= \cdot 7854\,(4\cdot 25^4 - 1\cdot 55^4) = 250$ ft. units, | |
| Overturning moment at base | $= 85 \times 6 \times 42\cdot 5 \times 30$ | $= 290$ ft. tons, |
| Weight | $= 242300$ lbs. | $= 108\cdot 2$ tons, |
| Area of brick ring at base | $= \cdot 78\,(8\cdot 5^2 - 3\cdot 1^2)$ | $= 49$ sq. ft., |

Crushing stress $= \frac{108\cdot 2}{49} + \frac{290 \times 8\cdot 5}{2 \times 250} = 7\cdot 14$ tons per sq. ft. or ·05 tons per sq. inch; so there is no fear of crushing.

Looking at the great difference in weight of chimneys designed by the two methods and the stresses given at (B) above, I am forced to the conclusion that Colonel Scott-Moncrieff's method gives unnecessarily heavy chimneys, and I am led to ask where the neutral axis of a chimney lies. Surely not up the middle of the shaft, which his method seems to require? I have not worked out the calculations for the chimneys given on page 438 of Molesworth's *Pocket Book of Engineering Formulæ*, 24th edition; but I feel sure, from the heights and diameters given, that these chimneys are very much lighter than Colonel Scott-Moncrieff's method would require.

From a study of pages 234 and 235 of *The Principles of Structural Design*, I am inclined to think that the overturning moment is really less than that taken in both the Babcock and Wilcox and Scott-Moncrieff methods. In these pages we are told that the wind pressure up to a height of 15 ft. is low, and at 100 ft. is only about 42 lbs. per sq. ft. Considering that the diametral plane of the chimney is greatest where the wind pressure is least and *vice versâ*, may not the overturning effect be much less than half the maximum pressure (say 60 lbs.) acting at half the height on a diametral plane equal to the height multiplied by the mean diameter ?

Can anyone tell me what is the real effect of wind pressure, as determined by experiment, on chimneys which are built

(*a*) on fairly level ground ;

(*b*) on uniformly sloping ground ;

(*c*) on a narrow spur, with steep slopes on both sides and a fairly steep slope up and down the spur.

## *TYPHOID AMONG SOLDIERS IN THE FIELD.*

THE ravages caused by typhoid among soldiers in the field have long been a constant cause of weakened numbers, embarrassing to commanders, distressing to the nation, and the despair of the medical branch of the army. No other disease, short of an epidemic, is so widespread and so constant. The matter is one which should be of vital interest to all officers who have to command men or administer camp services. It is believed, therefore, that a short *résumé* of the facts connected with typhoid in the American army during the Spanish war may be of more than merely local or technical interest to laymen. The facts are of course well known to the medical profession.

Among the troops who volunteered in the United States in 1898 for the Spanish war typhoid soon made its appearance, and never ceased its ravages till the troops were disbanded six months later. The Board as far as possible investigated each case and each epidemic among the soldiers before they left the United States.

Out of the 108,000 men considered there were 20,738 cases of typhoid, and 1,580 deaths, against 252 deaths from all other diseases. The public was aroused by this state of affairs in the camps, and insisted on enquiry. The Board assembled by the War Department worked for some years on the subject, and their surviving member has now made a Report, of which the following remarks give the results.

Typhoid developed in from 3 to 5 weeks after the troops joined their first camp, and became epidemic in both small and large camps. Crowding seemed to have no place as a cause of typhoid, neither did the position of the camps, nor the water supply. The results of the investigations conclusively controvert the theory that camp diarrhœa can in itself conduce to typhoid. It appears that inoculation by a specific typhoid germ is necessary.

Typhoid is of such frequent occurrence in civil life that the chances are that in any camp, however perfect sanitarily, one case would develop among every 1,300 men assembled. It seems certain that each case becomes at once a centre of infection, so that the disease spreads rapidly.

Typhoid is only spread by the transference of germs from the excreta of an infected patient to the alimentary canal of another. This transference may take place by direct contact, or with food or water swallowed, or by indirect contact with fouled and infected bedding, tentage, clothing or seats, while fouled hands may infect pipes, knives, forks, spoons, utensils or food. It must be noted that a patient may spread infection *before* he is recognized as suffering from the disease. He is a source of danger from his excreta during the incubation period, which is from 8 to 10 days.

The proportion of typhoid cases was nearly one-fifth of the force in the six months during which the troops were out, and 14·63 per thousand of the troops, or one in thirteen of the cases, died of this disease.

It is probable that in any body of troops at least a quarter are susceptible of contracting typhoid. The spread of this disease is certain to occur wherever soldiers are massed together, unless rigid precautions are taken. It is important that all officers should know what these precautions are, and should realize the certainty of the spread of typhoid if they are neglected. They will thus be able to impress vividly on their men the necessity of cleanliness for good health ; this is far more important than care over food and water.

The whole evil springs from camp pollution. Camps should frequently be changed, and they cannot be too carefully cleaned. Every camp must firstly be capable of being drained of all surface water, lest the surface become fouled with excreta. The disposal of excreta is the most important matter in camp ; no flies must be allowed to settle on them. No pollution of the ground, or of tents, or of boots must take place ; any system of removal in carts or tubs is liable to pollute the ground. The pit or trough should be disinfected ; burning petroleum is largely used for this in the U.S. manœuvre camps. Unwholesome water seems to have played but a small part in the epidemic. The only remedy is for the command to move camp, and disinfect all clothing, tentage and bedding. No second camp should be made on the site of a former one, or typhoid is sure to break out.

With regard to the individual soldier, his personal cleanliness is most important. His outer clothing should be removed at night, and his bed raised if possible from the ground. No man who is unwell should ever be employed in the cookhouse, as is very often the case.

These matters lie within the province of the officers commanding bodies of men to deal with. The medical officers can only advise. To back up their advice some general knowledge of the facts of the transference of typhoid, and of its deadly ravages, should exist in the army. This matter has already been taken up by the Indian Medical Department, which has issued a most useful pamphlet as to safeguarding the soldier in camp.

It is hoped that the results of the above-mentioned Board may hasten the time when (as said in their Report) Governments may "learn that military campaigns should be conducted in accord with hygienic rules, and that the officer who needlessly and ignorantly sacrifices his men to disease is as unworthy of his position as one who makes a like sacrifice in the face of the enemy."

# *CONCEPTIONS OF MATTER:—ANCIENT AND MODERN.*

*By* MAJOR W. R. LANG, R.E. (VOLS.) AND CANADIAN MILITIA.

THE science that deals with the constitution of matter has occupied the time and energies of countless generations of men since the time of Adam, who, possibly, was himself an alchemist, as one might be led to believe when reading of

> "A book where Moses and his sister,
> And Solomon have written of the art."*

The quest of the alchemist was the production of new substances and the conversion of one form of matter into other forms by a process of transmutation. This was possible, he argued, because, in nature, plants and animals were seen to grow, change, develop and die, and that therefore the same growth and development ought to proceed in the mineral kingdom. Just as a grain of seed in the ground died, and from its dead body arose the perfect plant or tree, so, in the earth, the metals were looked upon as undergoing a growth and becoming more perfect—in time reaching the highest stage of all, namely, gold.

Alchemy did not give place to chemistry proper until the 18th century, and in its long life experienced many vicissitudes. Its students and followers were not merely natural but also moral philosophers; they regarded nature from both standpoints; watched and studied the course of nature as exemplified by the growth of living things, vegetable and animal; endeavoured to discover the secret of her workings, and trusted to be able to apply this secret to the transmutation of the baser into the nobler metals, to the production of an *Elixir Vitæ*, which would be the cure of all ills; and, as a result of this, hoped for the mental happiness which would follow from the practical knowledge of the supreme secret of nature. Their quest was for an undefinable something, called by various writers "*the one thing*," "*the philosopher's stone*," "*the essence*," "*the soul of all things*," and by many other names.

Though some alchemists believed in the power of this "essence" (which was presumed to have a dual nature, material and spiritual),

* *The Alchemist*: by Ben Jonson, 1610.

to create things, yet the best writers seem to have had a real belief in the Supreme Being as alone having power to create and destroy; they hoped only to make one form of matter into a different form, not to create it. That this could be done they believed implicitly, and a simple illustration will show how far their belief was justified. The mineral galena, which is a sulphide of lead containing some silver, has somewhat the appearance of the metal lead itself. When subjected to treatment, it yields lead; and the lead in turn, on heating and removing the "calx," or earthy material formed, disappears, leaving a small portion of the precious metal silver. The alchemist took no consideration of the relative *quantities* of original material and the residual silver obtained: he used his results to confirm his preconceived theory of the transmutation of the baser metal, and did not, as would have been more logical, deduce a theory from his experimental results. The alchemist's belief remained firmly fixed in his mind, was, indeed, a part of his system of ethics, not only from the example just given but from his observation of nature. That lead could not, by one wave of the alchemistic wand, be converted at once into gold he quite understood; a series of purifications, of "trying in the fire," was required before the perfect metal was obtained. In *The Alchemist* this view is expressed in these lines:—

> Nor can this remote matter suddenly
> Progress as from extreme unto extreme,
> As to grow gold, and leap o'er all the means,
> Nature doth first beget the imperfect, then
> Proceeds she to the perfect.

It was a far cry from the earlier alchemist to the chemists of the 19th century, or to the time when the ideas of transmutation had to give way—thanks to Priestly, Lavoisier, and others—to theories evolved from the results of careful investigation of the quantitative changes occurring during chemical operations. The enunciation of Dalton's hypothesis of atoms placed chemistry on a new basis, and was the commencement of an era of phenomenal progress in chemical science. According to this theory, matter is composed of combinations of the atoms of elementary substances, which unite together, by reason of their chemical affinity, to form molecules of new substances. Matter, therefore, is composed of minute indivisible particles of the same or of different elements, and of these everything that is apparent to the senses is made up. Cut and carve down these particles as you may, in the end there is left the uncuttable particle or atom of each element.

This hypothesis of Dalton's was by no means new; indeed he merely resuscitated a theory put forward more than two thousand years previously. These early philosophers—Democritus (B.C. 460), Lucretius, the Latin poet who was born about a century before the Christian era—attempted to connect the differences of size, shape and qualities of various forms of matter with the differences of size, shape, position and movements of what they termed the *atoms* of matter. Everything material, they held, was composed of "a coalescence of certain unchangeable and indestructible particles"; no atom of anything could either be created or destroyed; when substances ceased to exist, another was formed; no destruction of matter took place, merely a rearrangement of the atoms. The ancients were evidently as fully alive to the soundness of the doctrine of the indestructibility of matter as we are now. Their conception of its various forms coincides with the modern ideas also; a solid body consisted of a vast number of atoms squeezed closely together, a liquid of a less number more loosely connected, and a gas of a still smaller number able to move freely and distributing themselves uniformly throughout the space containing them.

The atomic theory, as enunciated by the Manchester schoolmaster (Dalton), was based on observations of the manner in which the elements combined with one another, namely in fixed and definite proportions:—the atoms of each element had a definite weight peculiar to all the atoms of that particular substance. This theory has served the purposes of chemists for the past century, and has been and still is a convenient quantitative method of expressing chemical changes as they occur. The chemist can calculate the amounts of material necessary for the formation of new combinations—alike in the factory as in the laboratory,—and can prophesy the yield he will obtain from the union of known quantities of different elements or compounds. But though the atomic theory has for so long been a perfect working hypothesis from the chemist's point of view, recent researches, depending mostly on the study of electricity and radio-activity, have led to the displacement of the atom from its position as the unit form of matter. The atom is slowly but surely being proved to consist of an aggregation of still smaller units (electrons, corpuscles or ions,—call them what you will), incapable of detection by ordinary chemical methods, but readily recognisable by the physicist on account of their influence in rendering dry air a conductor of electricity. Professor J. J. Thomson, of Cambridge, claims to be able to detect with certainty, by electrical methods, quantities of radio-active substances less than one hundred-thousandth part of the least quantity which the chemist could detect by any method of analysis known. He stated in his lectures, delivered at Yale College some eighteen months ago, that the quantity of these radiations, which could be detected electrically, were to the quantity of any known element (so called), which could be detected by ordinary chemical analysis, in the proportion of a second to a thousand years!

Since the discovery of the Röntgen rays, in 1895, the properties of emanations from the mineral substances uranium, thorium and radium have occupied the attention of scientific investigators; and it is to them that we owe the new ideas and conceptions of matter as capable of existence in even a more attenuated condition than the atom. From the phenomena connected with the emission of rays and emanations from these radio-active bodies, it is evident that they consist of particles infinitely more minute than atoms. The emission of atoms themselves seems quite intelligible; as matter, in many forms, can evaporate, and some substances emit a perfume which is certainly appreciable to the lower order of animals if not always to human beings. No one has seen a smell, nor the wind, nor the minute particles worn away from a pavement, yet no one doubts the existence of these particles. But, in the case of the emissions from radio-active bodies, their speed is found to be enormous, and their atomic weight something like one-thousandth of the atomic weight of hydrogen. The atom of matter must therefore be considered as complex, not simple, and composed of a number of smaller bodies, interleaved and interlocked and in a state of rapid motion. Occasionally an atom loses one of these minute constituent parts, which becomes separated from it (chipped off, as it were) and flies away at a speed which Sir Oliver Lodge has calculated as being many thousand miles a second: these portions thus separated are known as the $\alpha$ rays. But this rupture of the atom is immediately followed by a further splitting off of other parts of it, which are so minute as to be able to penetrate through solid bodies; and yet a third or ethereal emanation, called the $\gamma$ rays, follows as a consequence of the break up of the atom. What, then, are these minute portions which the experimental physicist can recognise, handle and investigate? They may be called the corpuscles or electrons, and are of the order of many thousandths of the magnitude of an atom of matter, which is commonly estimated as being about one fifty-millionth of an inch in diameter. Sir Oliver Lodge has given an illustration of the size of these corpuscles by asking one to imagine an atom of matter magnified to the size of an ordinary church, when its constituent ions would be represented in size by a full stop—.

This research into these striking but obscure forms of radiation has laid the foundation of a new hypothesis regarding the constitution of all matter. The phenomena of radio-activity have been found not to be confined entirely to the elements uranium, thorium, etc., which possess this property to a remarkable degree, but to be common to a great number of things, possibly to all things material. It has been found that certain mineral springs are radio-active; rain, snow, hail, the air of cellars, the air contained in many soils, and the atmosphere itself possess the same properties. Indeed, it might be said that corpuscles or electrons are everywhere about, incessantly streaming from the earth, from the ends of branches, from rails, from telegraph poles, and from the sun itself. These particles, too, are all of the same nature, size and kind, no matter from where they may come; and it seems likely that they constitute the primordial form of matter, various combinations of which, interlocked together, go to make up what, up to now, have been looked upon as the elements, of which some seventy or eighty are recognised by chemists. Does this mean that the ancient alchemists were not so very far wrong after all in their belief that one form of matter could be converted or transmuted into another? It seems so, for, in experiments conducted in London by Sir William Ramsay, the emanation from radium was found to have lost its characteristics on standing for a week, and to have developed the properties of a known elementary substance, the gas helium! The radium emanation had become destroyed, altered—degenerated, one might call it—into another form of matter.

What interpretation, then, can be put on these results regarding the fundamental constitution of all material things? The existence of bodies infinitely smaller than the smallest atom has been clearly demonstrated, and, for many reasons, it has been concluded that they are akin to electricity. Sir Oliver Lodge holds that electricity possesses two of the fundamental properties of matter, namely mass and inertia; light and electricity have been shown to be closely allied to one another in their mode and speed of propagation. Is electricity matter and is matter electricity? Evidently they are closely related; and if the corpuscles or electrons emitted are not electricity, they at least are the carriers of electricity. The new conception of matter seems to indicate that it and electricity are one and the same thing, and that the chemist's atoms consist of systems of positive and negative electrons, and of nothing else. If the simplest atom, that of hydrogen, consists of, say, 350 positively and 350 negatively charged electrons, interleaved together and in a state of violent motion within themselves, then some sixteen times as many constitute the atom of oxygen, and other multiples of this the atoms of other elements.

# *MEMOIRS.*

## General John Bayly, C.B., Colonel Commandant, R.E.

General John Bayly, who died at his residence, 13, Royal Crescent, Bath, on 12th March, 1905, was the fourth son of the late Capt. Paget Lambart Bayly, 7th Hussars, cousin and aide-de-camp to Field Marshal the first Marquis of Anglesey of Waterloo fame.

He was born in 1821; and obtained his commission as 2nd Lieutenant in the Royal Engineers on the 19th March, 1839, from the Royal Military Academy, Woolwich, passing out first and receiving the Sword of Honour.

The greater part of his service, no less than 32 years, was passed in the Ordnance Survey of Great Britain.

After receiving his commission he spent a year and a-half at Chatham, and then a few months at Portsmouth, during which period he was promoted Lieutenant. He then served nearly four and a-half years in Newfoundland, returning for a couple of months more to Portsmouth.

On the 21st January, 1846, he was appointed to the Ordnance Survey, receiving his promotion to 2nd Captain in September of the following year. Posted at first to a Division stationed at Wakefield, he was subsequently Division Officer at various places in England and Scotland. In 1864 he was placed in charge of the Boundary Branch in London, where he took a prominent part in supplying information and preparing maps for the Boundary Commission (1867–8) in connection with the Representation of the People Act, 1867. In 1874 he was appointed Executive Officer to the Director General, Ordnance Survey, Southampton (at that time Major-General Sir Henry James, R.E., and subsequently Major-General John Cameron, C.B., R.E.); and he filled that post until the 31st March, 1878, when he was placed on the unemployed list with the rank of Major-General which he had attained on the 1st October, 1877. His intermediate promotions dated:—1st Captain 19. 6. 54, Brevet Major 1. 11. 58, Lieut.-Colonel 26. 3. 62, Brevet Colonel 26. 3. 67, and Colonel, R.E., 14. 12. 71.

Having been promoted Lieut.-General in March, 1882, he was placed on the retired list on the 26th April of the same year with the honorary rank of General after a total service of 43 years, 38 days.

On the 14th June, 1893, he received the honour of being appointed Colonel Commandant of his Corps, and at the time of his decease was the eldest by age and the sixth senior in that rank.

His work on the Ordnance Survey received well-merited appreciation, and the tribute (typical of many such received by his family) of one who served under him for many years is "To anyone who studied his duty, there never was a better or more just officer." The nature of his employment brought him into touch with purely civil work; in 1868, whilst a Brevet Colonel, he acted as Assistant Parliamentary Boundary Commissioner, and in 1884–85 he was Boundary Commissioner for Scotland under the Redistribution of Seats Act. His long and eminent services in the Survey were rewarded in 1875 by the Companionship of the Bath (Civil Division).

Whilst a 1st Captain, in 1854, he married Jane Coventry Ewing, only daughter of Humphry Ewing Crum Ewing, M.P., of Strathleven, Lord-Lieutenant of Dumbartonshire; he leaves a widow, three married daughters, and one son, the Revd. Paget Lambart Bayly, M.A., vicar of Netherbury, Dorset, who married the Honble. Blanche Louisa, daughter of the thirteenth Baron Inchiquin.

General Bayly was a J.P. and D.L. for Dumbarton, and a Fellow of the Royal Geographical Society and the Society of Antiquaries.

The funeral took place at Lansdown Cemetery, Bath, on the 16th March. The Assistant Adjutant-General, R.E., sent a wreath "as a tribute from the Corps to which General Bayly belonged for so many years and to which he was so much attached." Letters of condolence (expressing great regret at the loss of his distinguished father and deep sympathy with the family) were also sent to his son from other officials at the War Office and from the School of Military Engineering, Chatham; and His Majesty the King, Colonel-in-Chief of the Royal Engineers, graciously commanded his equerry to send a telegram conveying the expression of his sympathy.

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## LIEUTENANT-GENERAL A. C. COOKE, C.B., COLONEL COMMANDANT, R.E.

THE Corps lost another honoured veteran on the 6th April, 1905, when Lieut.-General Anthony Charles Cooke died in London, in his eightieth year.

He was the son of the Revd. R. B. Cooke, Rector of Wheldrake, Yorkshire, and Prebendary of York Cathedral; and was born on the 15th February, 1826, at Owston, near Doncaster, the seat of his father's eldest brother. His childhood was spent at Wheldrake and at Etton near Beverley; and his early schooldays at Southwell, Nottinghamshire, where he was a contemporary of the late Rt. Hon. Sir William Vernon-Harcourt.

When he was thirteen, Mr. Charles Wood (afterwards Lord Halifax) procured him a nomination for the Royal Military Academy, Woolwich, and he was then removed from Southwell to Mr. Miller's school on Woolwich Common. At the age of fifteen he gained admission into the Academy, third of his batch; and two years later passed out fourth, making, with another boy of the name of Inglis, a record in getting through in a shorter time than any of his predecessors.

He was gazetted 2nd Lieutenant in the Royal Engineers on the 17th of June, 1843; and after spending a little more than a year at Chatham, was sent first to Woolwich and then to Devonport. Shortly after obtaining promotion to 1st Lieutenant on the 1st April, 1846, he was ordered to Mauritius, where he spent nearly three years, and thence to Ceylon; in the latter island, during a stay of over two and a-half years, his sporting instincts had full play, including, on one occasion, the bagging of two elephants by a "right and left."

At the beginning of 1852 he came home, and spent two short periods in Scotland and two at York, subsequently being posted to the Ordnance Survey at Newcastle, where a year and a-half saw him promoted 2nd Captain.

On the outbreak of the Crimean War in 1854 he applied for permission to resign his appointment in the Survey; but his ardent desire for active service was not gratified until May of the following year, when he embarked for Malta *en route* to the front. He arrived off Sebastopol shortly after the failure of the attack on the Malakoff, and was posted to the Right Attack; his immediate superior was Captain (afterwards Sir James) Browne, whom he succeeded in his command after the assault on the Redan on the 8th of September, where Browne was wounded. Cooke was twice mentioned in despatches (*London Gazettes* of 5th October and 21st December, 1855); and for his services in the war he received a Brevet Majority, the medal with clasp, the Turkish medal, the 5th Class of the Medjidie, and eventually the C.B. He remained at the seat of war until August, 1856, two months later than his promotion as 1st Captain.

On his return to England he rejoined the Ordnance Survey at Perth. Rather more than two years afterwards he was transferred to the War Office as Executive Officer of the Topographical Department, a new appointment which he held for over ten years, this period covering his successive promotions to Brevet Lieut.-Colonel (11th March, 1865) and Lieut.-Colonel, R.E. (6th July, 1867). During the latter part of his term at the War Office the Prusso-Austrian War occurred, and a study of this campaign during its progress enabled him to write a detailed critical account (published in 1867) which received the commendation of von Moltke, whose aide-de-camp, in a letter written "by order" to General Beauchamp Walker (British Military Attaché in Berlin), stated "General von Moltke is particularly pleased with Lieut.-Colonel Cooke's pamphlet on the war. He says it contains the best and most accurate critical remarks he has yet met with."

In April, 1869, Cooke reverted to ordinary duty and was stationed at Chatham for ten months, after which he served three years in Bermuda as Commanding Royal Engineer, obtaining meanwhile a Brevet Colonelcy on 6th July, 1872. In October, 1873, he was appointed Colonel on the Staff, C.R.E., at Aldershot, and on 13th August of the following year promoted Colonel, R.E.; he remained at Aldershot until 1st August, 1878, when he succeeded Major-General J. Cameron, R.E., in the Directorship of the Ordnance Survey, which he held for nearly five years.

While he was Director of the Survey the Government expressed a determination to accelerate the completion of the Cadastral Survey of Great Britain, and he was asked if he could draw up a scheme to complete it by a given year. On this he wrote, "This means doubling the whole establishment. The organization of the Ordnance Survey is such that it is no use seeking the necessary workmen from the ranks of the Civil Engineers. I can depend only on rapidly training a sufficient number of men for the purpose. After some hesitation I determined to answer the question in the affirmative, and sent in an estimate of the necessary funds that would be required year by year for carrying out the work. The sums amount to millions of pounds and the number of employees to thousands"; and later "my estimate and report are approved"; and still later again "the work is completed by the time fixed and at the cost I estimated."

Having been promoted Major-General on 7th April, 1882, he was placed on the unemployed list in April of 1883, but he was granted an additional year in the Survey in order that the work might be continued under his immediate supervision, a compliment which he highly valued. As a reward for this work he was recommended for a Knighthood of the Bath, but for some reason or other never received the honour.

Colonel Duncan Johnston, C.B., late R.E., the present Director General, writes:—"General Cooke never got the full credit he deserved for his work as Director General of the Ordnance Survey. He held this post at a critical period, when the Government wanted the Cadastral Survey completed within half the estimated time. When he undertook to do this it was thought that his undertaking was a very bold one; but so thoroughly and judiciously did he make the necessary arrangements that the work was carried out to the day without any excess of expenditure.

"There have probably been more brilliant heads of the Ordnance Survey than General Cooke, but none whose work has better stood the test of time. He was most thorough in his work, never giving a decision on any important point till it had been considered from every point of view; and his judgment was so sound that he rarely made a mistake.

"He was of a quiet, retiring and kindly disposition, and habitually courteous to all, but when necessary firm; he was esteemed and liked by the officers who served under him, and always commanded their entire confidence.

"In 1891 he served on Sir John Dorington's Committee on the Ordnance Survey, and contributed by his knowledge and experience to the valuable report of that Committee.

"He always kept up an affectionate interest in the Survey, in connection with which he will always be remembered."

On the 6th May, 1885, he retired with the honorary rank of Lieut.-General after a total service of very nearly forty-two years; and in December, 1899, he was appointed a Colonel Commandant, R.E.

After retirement he lived in London, making frequent excursions to Ireland, Scotland and Norway for salmon fishing, a sport to which he was greatly devoted.

He was a Fellow of the Society of Arts and of the Royal Geographical Society.

The funeral took place at East Stoke, near Wareham, Dorset, where he was buried close to his only sister, the late Mrs. O. W. Farrer. The Assistant Adjutant-General, R.E., Sir Reg. Hart and the officers at Chatham, and Colonel D. Johnston and the officers of the Ordnance Survey sent wreaths as tributes of respect from the officers of his old Corps.

## CAPT. A. T. CHAMIER, R.E.

A SAD ending to a promising life was the death from hydrophobia, at Krishnagar, Bengal, on the 15th of March, 1905, of Capt. Arthur Tyrrell Chamier.

He was the youngest son of Lieut.-General S. H. E. Chamier, C.B., Royal Artillery, and was born on the 28th of November, 1871. He was educated at the Royal School at Armagh and at Cheltenham College. Originally intended for Oxford University with a view to service in the Church, he made up his mind, soon after he was sixteen, to compete for entry into the Royal Military Academy, Woolwich, in the hope of obtaining a commission in the Royal Engineers.

He passed into Woolwich ninth of his batch, and was gazetted

2nd Lieutenant on 24th July, 1891. After two years' instruction at the School of Military Engineering, Chatham, he joined the Indian Establishment. On arrival in India in October, 1893, he entered the Railway Branch of the Public Works Department, and served at Delhi, Lahore and other stations in the Panjab.

Towards the end of the tribal rising of 1897–98 on the North-West Frontier he was attached to the 1st Company, Bengal Sappers and Miners, and served with them during the latter part of the Expedition through Tirah, for which he received the medal with clasp.

On the conclusion of the war he returned to Railways in the Panjab, where he was employed in important works of construction, and received the commendation of his Engineer-in-Chief for his successful performance of his duties.

In 1902 he came home on two years' furlough; but the greater part of this period was spent on special duty in the Office of the Inspector General of Fortifications.

On his return to India in December, 1903, he was attached to the Eastern Bengal State Railway, his immediate charge being the construction of the important Jhallinji Bridge.

During his fourteen years' service he had given proofs of ability much above the average, and the career cut short by his sudden death was certain to be useful and would probably have been distinguished.

The keynote of his character was his strong religious feeling, unobtrusive and unaggressive, but none the less deep and real, carrying with it, as its natural outcome, an ardent devotion to duty and perfect unselfishness.

In his last days, when he knew that his hours on earth were numbered, he thought only of preventing his work from injury, and of lessening the trouble of those about him and the grief of those nearest his heart.

He was perhaps too retiring and too reserved to be popular in the ordinary sense, but it may be said with truth that those who knew him best loved him most.

JOHN PENNYCUICK.

## TRANSLATIONS.

### TECHNICAL COURSES OF INSTRUCTION FOR ROYAL ENGINEER OFFICERS.*

1. The course of instruction for officers of Royal Engineers has recently been under consideration in connection with the technical examination for promotion to the rank of captain, and it has been decided to institute the following courses, viz. :—

I. A junior officers' course.
II. A special advanced course for junior officers selected for India.
III. An advanced course for officers other than those selected for India.

} As shown in the annexed Syllabus.

2. It is notified that :—

(i.). All officers on the British establishment, commissioned after 1st June, 1897, who have not done Part II. of the School of Military Engineering Course, will be required to undergo the advanced course in lieu of the Barrack and Active Service Projects referred to in paragraphs 141—179, *R.E. Corps Memorandum, No. 605*, dated the 1st August, 1899.†

(ii.). All officers who were struck off the instructional strength of the School of Military Engineering, Chatham, prior to 14th February, 1899, and officers who have been through Part II. or the special course for junior officers going to India, will be required to undergo the Barrack and Active Service Projects as hitherto.

3. The following arrangements will be made with regard to officers undergoing the advanced or special advanced course :—

(*a*). Officers selected for service in India, including Submarine Miners, will, for the present, be put through the special advanced course before embarking for that country.

* As it may interest officers of other branches of the Army to know what Royal Engineer Officers are taught at the School of Military Engineering, the following extract from *Corps Memorandum No.* 619, of 1st May, 1905, is here published.—EDR., *R.E.J.*

† An officer who has qualified in the Barrack and Active Service Projects before 1. 6. 05 will be exempt from the advanced course.

(*b*). On completing the junior officers' course at Chatham, officers of Royal Engineers, not selected for India, are either:—

(i.). Sent abroad for a tour of two to five years (*K.R.*, paragraph 1465A).

(ii.). Posted for duty to a unit at home or to Engineer Services.

Those under (i.) would undergo the advanced course on return from foreign service, when they would have a maximum of seven years' service.

Those under (ii.) would, if they had more than three years' service on being ordered abroad, undergo the advanced course before embarkation. As a rule, they would remain three years with a unit, and have nearly five years' service when they do the advanced course.

4. There will be an advanced course each year at the School of Military Engineering, Chatham, lasting about six months. For the year 1905 the course will begin on or about 1st June, and in subsequent years probably on 1st July.

5. Examinations in (i.) Military Engineering subjects, and (ii.) Construction, will form part of the advanced course, and will be conducted in a similar manner to that laid down in the *King's Regulations* for Artillery and Army Service Corps subjects, and officers will be classified accordingly. The Examination Board will be composed of Royal Engineer officers, and will sit at Chatham. It will be convened under the instructions of the General Officer Commanding for a fixed term of not less than one year, if possible, and will consist of a president, not below the rank of lieutenant-colonel, and two field officers or captains. For the examination in Military Engineering, the Commandant, School of Military Engineering, will detail the Instructor in Fortification, or one of his assistants not below the rank of captain, as a member of the Board, and for the examination in Construction, the Instructor in Construction, or one of his assistants not below the rank of captain.

6. As regards the examination in Military Engineering, which will take the place of what has hitherto been called the Active Service Project, paragraph 1, Part I., *Regulations for Royal Engineer Services*, shows the duties of Royal Engineers in War, and, with the addition of "Demolitions and Hutting of Troops" will form the basis for a syllabus of the examination; but the knowledge of railways, telegraphs, balloons, and defence by submarine mines and torpedoes will necessarily be confined to elementary principles. The demolition and restoration of railways and telegraphs will, however, be taught to all Royal Engineer officers.

7. The examination in Construction will comprise—

Written answers to questions on:—

A. (*a*). Principles of Building Construction and Design.

(*b*). Principles of Sanitation.

(*c*). Strength of Materials, with Calculations for Trusses, Girders, etc.

B. (*d*). Engineer Services.
(*e*). Estimating.
(*f*). Preparation of a Design, with Specification, Approximate Estimate and Calculations.

8. In both of these examinations, a classification similar to that adopted at other military examinations will be followed by the board, viz.:—

·5 for a pass.
·8 for a special certificate.

A special certificate will be necessary to make an officer eligible for accelerated promotion.

9. With a view to:—

(*a*). Stimulating study in and attention to recent engineering practice,
(*b*). Encouraging a candidate to give the results of his own experience,
(*c*). Furnishing the examiners with a comprehensive idea of the candidate's capabilities and qualifications,

each officer will be required to submit a short essay upon some engineering subject dealt with in the course.

The essay will be awarded credit in the general report upon the results of the examination of each officer.

10. Applications of officers to undergo the advanced course will be forwarded by General Officers Commanding direct to the Commandant, School of Military Engineering.

11. During the transitional period it has further been decided to institute a system of allotting a similar decimal to the Barrack and Active Service Projects, prepared by lieutenants of Royal Engineers as a test of their technical qualifications for promotion (*vide* paragraph 2 (ii.) above).

12. In these circumstances, and with a view to securing a uniform standard for the allotment of this percentage, the Project papers of officers —referred to in paragraph 2 (ii.) above—serving elsewhere than in India will, in future, be set, and the Projects be examined and marked, by the standing Board of Officers of R.E. referred to in paragraph 5 above, but the examinations will be conducted locally.

On 15th January, 15th April, 15th July, and 15th October, the Commandant, School of Military Engineering, will send to stations requiring them a set of Project papers under confidential cover.

These will, if considered necessary by the Commanding Royal Engineer, be adapted by him to local conditions before issue to the officers concerned, and the Projects, when completed, will be returned to the Commandant, School of Military Engineering, with the opinion of the Commanding Royal Engineer as to whether they satisfy local conditions in every respect. The Commandant, School of Military Engineering, will communicate the result to the War Office, together with the marks and percentage allotted in each case by the standing board.

13. In regard to officers serving in India, the existing arrangements under which the Projects are set and examined in that country will, for the present, be continued, and the percentage will be allotted locally.

## INSTRUCTION OF R.E. OFFICERS AT S.M.E.—SYLLABUS.

### (I.). JUNIOR OFFICERS' COURSE:—

| | Days (including Sundays). |
|---|---|
| Military Training and Duties, including Tactics ... ... | 116* |
| Workshops ... ... ... ... ... ... ... | 31 |
| Electricity ... ... ... ... ... ... ... | 14 |
| Fortification ... ... ... ... ... ... ... | 105 |
| Survey ... ... ... ... ... ... ... ... | 105 |
| Construction ... ... ... ... ... ... ... | 117 |
| Leave and between courses ... ... ... ... ... | 37 |
| | 525† |

### (II.). SPECIAL ADVANCED COURSE FOR JUNIOR OFFICERS SELECTED FOR INDIA:—

| | |
|---|---|
| Construction ... ... ... ... ... ... ... | 60 |
| Survey ... ... ... ... ... ... ... ... | 15 |
| Fortification ... ... ... ... ... ... ... | 15 |
| | 90 |

### (III.). ADVANCED COURSE FOR OFFICERS OTHER THAN THOSE SELECTED FOR INDIA:—

| | |
|---|---|
| Military Duties, including Tactics, Organization and Interior Economy ... ... ... ... ... ... | 28 |
| Field and Permanent Fortification, including use of explosives and 2 days' Coast Defence ... ... ... ... | 28 |
| Survey ... ... ... ... ... ... ... ... | 28 |
| Examination in above, practical and theoretical ... ... | 6 |
| Construction (including examination) ... ... ... | 91 |
| | 181 |

VOLUNTARY COURSES.

| | |
|---|---|
| Electricity ... ... ... ... ... ... ... | 34 |
| Permanent Fortification, including Coast Defence ... ... | 14 |

* Includes time for preparation for "A" and "B" examination.

† This does not include the period during which the officer will be at the School of Musketry, Hythe, viz., about 30 days.

# PORT ARTHUR AND THE QUESTION OF WALLED ENCEINTES.*

*By* LIEUT.-COLONEL FROBENIUS, *in the Berlin* NATIONAL ZIETUNG, *of* 11*th February*, 1905.

We may confidently anticipate that the Russo-Japanese War will furnish us with an abundance of data tending to elucidate the solution of important military questions. The Siege of Port Arthur has contributed much towards the science of fortress warfare. This is just as well, since the vagueness which at present characterises the treatment of that subject requires something more than theoretical arguments to clear it up. The Siege, like a storm in early spring, has rendered a useful service in sweeping away much unsound growth in military theory. It has helped us to recognize that the principles of war, confirmed by thousands of years of experience, are not disturbed by the most perfect modern technical inventions.

"At Port Arthur scientific methods of attack, suggested by all the resources of the field engineer, have proved in every instance superior to the dashing assaults favoured by modern military theorists." Such is the conclusion drawn by a writer in the *Cologne Times* (No. 15) at the end of a long article on the Siege. It is evident from a number of minor points in his essay that the writer is not an engineer officer; and this is satisfactory, as tending to show that other arms are taking an interest in fortress warfare and as indicating a change in the views on this subject held by the army in general.

But the author goes astray when he endeavours to prove from the events of the Siege that, in a modern fortress surrounded by a girdle of detached forts, the walled enceinte is superfluous. This unsound view was at one time prevalent in our army, and has had a most mischievous influence on the design of our works of national defence. We therefore consider it desirable to demonstrate the falsity of this theory.

The author puts his case as follows:—"We have no information as to whether intermediate lines (he means intermediate works) had been constructed between the girdle forts. At one point we know that this had been done, at others no continuous enceinte existed. But during the whole course of the siege neither intermediate lines nor enceinte were of the slightest use to the besieged. At the last, both the numbers and the war *matériel* of the defenders were exhausted; the step-by-step defence prescribed by the text-books was out of the question; and after

* Communicated by the Chief of the General Staff. Printed by permission of the editor of the *National Zeitung*.

the capture of the girdle forts a last stand in the citadel became impossible. We may conclude from this that in fortress warfare the relative value of citadels and walled enceintes is not proportionate to the heavy cost of their construction and upkeep in peace-time. The view taken by many authorities, that a girdled fortress is only a great battlefield permanently equipped for war, received abundant confirmation at Port Arthur. In this Siege a continuous walled enceinte would have been absolutely useless."

We might object to this that the author's premises are not proved; we do not know that General Stoessel did not construct an inner enceinte during the Siege. Contrary to all expectations the enemy gave him abundant time to fortify. But from the strength of the garrison we may safely conclude that at the beginning of the war there was no enceinte; and the conduct of the defence tends to shew that the besieged had not the advantage of an inner line.

It is a mistake to suppose that the enceinte does not become useful till the girdle forts are captured, or that its only use is to oblige the enemy to begin his attack afresh after he has penetrated the girdle. It has long been recognised that the defender must put his whole strength into the defence of the forts, and must not attempt to reserve any portion of his force for the defence of the enceinte. The enciente could not in any case hope to hold out for long after the loss of the forts. The principal *rôle* of the enceinte is played during, and not after, the fight for possession of the forts.

The author's mistake is similar to that of the theorists who, arguing from the successful defence of Sebastopol and Plevna, maintained that field works would form an efficient substitute for permanent fortifications. The object of fortification is not fulfilled by obliging an army to abandon its freedom of movement for the sake of defending a more or less important town; the object is to relieve the field army from the necessity of hampering its movements for the sake of protecting that town. The permanent defences enable the garrison to be reduced to a minimum, leaving the great bulk of the troops free to undertake the far more important duty of meeting the enemy in the field. This leading principle of fortification, economy of men enabling the strength of the field army to be increased, is too often lost sight of nowadays. This is shewn by the author's use of the phrase "a battlefield permanently equipped with war *matériel*." Certainly the ground within and around the girdle is a battlefield; but not for an army. It is intended for a minimum garrison, far inferior in numbers to the besieger, but placed on an equality with him by the permanent means of defence.

The essential difference between the tactics of the field army and those of the garrison is this:—The field army can oppose large reserves to an attack on any point, and can, by their skilful employment, render nugatory the enemy's success if he breaks through the line. The garrison has no such reserves of men; it has to use instead a reserve of fortified works in the shape of an inner line, which can be held by a relatively small number of men. This is the true function of the walled enceinte.

This power of defending inner lines is more important to the fortress than to the field army. For the central kernel of the defence contains the stores of provisions, ammunition and *matériel*, which are indispensable to the defence; it contains the men's barracks and the headquarters of the besieged force. But for the enceinte it would be necessary to keep a large reserve of troops to protect this centre, which would reduce the numbers available for the fighting line. The "assault-proof" enceinte may be slenderly garrisoned, in view of the serious hazards to which the besieger would be exposed if he ventured to attack it. Its principal use — and that a most important one—is to strengthen the fighting line during the attack on the girdle, both by its material and moral support, and not merely as a place where the defenders can make a last stand when the girdle has been captured by the enemy.

If, in the case of Port Arthur, we assume a girdle 14 miles long and a complete walled enceinte, then the proper garrison would be 10,000 infantry and 5,000 artillery for the 500 guns. (This is on the supposition that 46 guns were taken from the ships and manned by the sailors). Add a mobile reserve of 10,000 men, and we have a grand total of about 25,000. But the actual garrison on the 26th May was 37,000, or a whole division in excess of the number required under the above supposition; and to this total we must add the 13,000 men borrowed from the navy, who finally increased the strength of the garrison to 50,000 men.

The first attack in force, on August 21st to 24th, shewed that the garrison could not afford to dispense with strong reserves kept in constant readiness. For, although General Stoessel had not omitted to provide successive lines of defence by constructing subsidiary advanced works, the Japanese penetrated to the main fort of Wantai and established themselves there; it was only by the vigorous counter-attack of a strong reserve that they were dislodged and that this attack was repulsed.

Although the besiegers were then constrained to adopt the method of steady advance by sap and parallel, they shewed a disposition to attempt the capture of isolated works by assault in mass. The defender need not have expended so many lives on holding unimportant advanced works, had not *the absence of an enciente* kept him in a state of anxiety lest all should be lost if the besieger succeeded in penetrating the girdle. He was therefore forced to keep masses of troops in reserve behind all the outer forts, which extended from the north-west angle of the defences to the east front. These troops were exposed to severe fatigues and heavy losses. As at Sebastopol, it was impossible to provide them with proper protection either against the weather or against the enemy's fire, so that they filled the hospitals with sick and wounded. As a result, the defending forces were used up more quickly than if a walled enceinte had existed. An enceinte would certainly have enabled Port Arthur to hold out longer.

Moreover, according to all accounts, the forts at Port Arthur were by no means proof against assault. This defect could only be supplemented by keeping both the fort garrisons and the reserves behind them constantly under arms. The experience of this Siege will do much to rehabilitate the value of assault-proof defences, which had sunk in military estimation since the introduction of modern firearms. In the future construction of defensive works it will no doubt be recognized that not only the salients of the walled enceinte but *all isolated works* must be made assault-proof.

The detailed history of the Siege shews that the fighting there partook more of the nature of a struggle between two armies on a prepared battle-field than between a large force and a small force strengthened by permanent defences.

Moreover, the fact that the besieger had to have recourse to turning movements wherever he encountered assault-proof works shews that only such works can be accepted as satisfactory portions of permanent defences. It is not sufficient to mark the line of the enceinte by an iron railing; we must have an insurmountable obstacle, properly flanked.

If we mean our fortresses to be not battlefields for our armies but strongholds for minimum garrisons, we cannot dispense with walled enceintes. Otherwise we shall be liable to make the same mistaken use of our fortresses as the French did in 1870.

# ORGANISATION OF MILITARY TELEGRAPHS IN AUSTRIA-HUNGARY.*

*By* FIRST LIEUTENANT OTHMAR KOVARIK *in the* KRIEGSTECHNISCHE ZEITSCHRIFT, *No.* 7, *Year VII.*

In 1869 the organization of Engineer troops for the first time included field telegraphs. The experiences of 1870–71 necessitated a more complete re-organization, which was completed in 1877 and put to a practical test in Bosnia in 1878. Even at that period there were heavy and light detachments; the former (with air line and bamboo poles) for lines of communications, the latter (with $\frac{2}{3}$ air line, $\frac{1}{3}$ cable) for the front. In spite of adverse conditions the field telegraphs were found most efficient.

Austria led the way in more respects than one. In 1872 a signalling school was established at Bruck. In 1875 an excellent field telegraph cable was introduced (0·234-in. diameter, weight per mile 170½ lbs., breaking strain 271 lbs., resistance per mile 29 ohms). About 1890 the cavalry patrol equipment was introduced; this consisted of a small portable case, containing microphone, vibrator and telephone; the 550 yards of light conductor is abandoned after it has been laid, as the thin wire can easily be replaced. The telegraph school, introduced in 1889, forms a good basis for the training of all branches of the service (although only 52 men per year are trained, whilst war requirements are 2,000 men). The interests of military telegraphs are looked after by a branch of the General Staff, as well as by a branch of the War Ministry.

Visual signalling has always received special attention in Austria. A well-managed system existed in 1848–49 with Radezki's army. In 1859 excellent results were obtained in the quadrilateral Verona-Peschiera-Mantua-Legnano, and in 1866 between Josephsstadt and Königgrätz. Dots were shewn by a circular white disc in daytime and by a light at night, and dashes by a square or by two lights. At present the signallers are organised in 23 detachments, and each signalling station consists of five men, three of whom send and two receive messages.

A telephone detachment with 100 miles of line accompanies each Army Corps.

The 7th Section of the General Staff controls the whole of the military telegraphs and signalling. At the head is a specially selected senior officer, who is in wartime called "Director of Field Telegraphs" and is on the Line of Communication Staff.

Contrary to the practice in other states the Austrian telegraph and railway troops are amalgamated in a Railway and Telegraph Regiment.

* By permission of the editor of the *Kriegstechnische Zeitschrift.*

This is admittedly unsound, but is excused by want of funds. Two battalions were formed in 1883, and in 1900 a third was added.

PEACE FORMATIONS.

The following regimental formations exist in peace time:—

The Telegraph School.
A Telegraph Reserve Cadre.
The Committee on Telegraph *Matériel.*
A Cadre for Fortress Telegraph Detachments.

*The Telegraph School** forms part of the regimental staff, and trains field telegraphists for their duties in wartime. The training is quite distinct from that of the railway companies. On mobilisation the school is closed.

The establishment comprises:—1 captain, 2 field telegraphists as instructors, 1 officers' servant. Only those who pass well and show signs of permanent aptitude are promoted to "field telegraphists" (ranking as sergeant-major). All other candidates who have been successful are classed as "telegraph assistants" or "manipulators," and are appointed as N.C.O.'s to the various telegraph detachments. Training begins on the 1st May and finishes in August. Two exercises under service conditions take place each month.

There are also, at Tulln and Budapest, cavalry telegraph courses from the 1st November till June, concluding with a large telegraph exercise under service conditions. These courses are in military respects under cavalry brigade commanders, and for technical purposes under the telegraph branch of the General Staff. They are intended to provide and train the telegraph patrols attached to each cavalry regiment; each patrol consists of 8 mounted men, 4 N.C.O.'s as telegraphists and 4 troopers as orderlies, and has equipment for two offices (which can in cases of emergency be made into four) and 8¼ miles of cable carried on 8 pack horses.

*The Telegraph Reserve Cadre* forms a reserve for all the detachments necessary in wartime; it keeps the roster of and trains Reserve telegraphists and assistants. The Commandant is a technical adviser in field telegraph matters to the Regimental Commander. The establishment is:—1 captain, 1 subaltern, 3 N.C.O.'s for administration, 1 section leader, 2 pioneers, 2 officers' servants.

*The Committee on Telegraph "Matériel"* is responsible for the efficiency of all stores.

*The Cadre for Fortress Telegraph Detachments* forms a nucleus for certain arrangements in fortified places, particulars of which are kept secret.

ORGANIZATION IN THE FIELD.

The advantages of electrical transmission of messages are pointed out in the Austrian Field Service Regulations. To provide communication for an army in the field there are telephone detachments as well as field

* At Korneuburg, near Vienna.

telegraphs. Telephones replace telegraphs in connecting Army Corps headquarters with its train and with Divisional headquarters; they supplement telegraphy on the field of battle (medical, ammunition supply, captive balloons, etc.), and also along field railway sections, each of which has a telephone detachment providing 6 offices and 18¾ miles of line. Whilst cavalry telegraph patrols connect the advanced reconnoitring bodies with the cavalry commander, cavalry telegraph detachments connect the cavalry commander with Army headquarters. Army and Corps telegraph detachments provide for communication between columns of an army, whose advanced troops also get into touch by means of the cavalry telegraph detachments. Reserve telegraphs provide for the more permanent lines, extend the existing system of the country, and connect it with the field telegraphs.

Reserve telegraph detachments can erect 3½ to 4¾ miles a day. 1,100 yards of cavalry telegraph line can be laid or reeled up in 18 minutes, and 1,100 yards of field cable in 24 minutes.

Field lines are protected:—(1). By making communal districts responsible for lines within their zones. (2). By patrols. (3). By a strict observance of the regulations, which lay down that troops are not to damage lines, and are to repair any damage they see or report it to the nearest telegraph office.

All commanders to whom field telegraphs are allotted, as well as their superiors, use the lines for orders and reports. Lesser commanders, such as those of units, reconnoitring bodies and patrols, only use them for transmitting reports. All other official messages have to be submitted to the commander to whom the telegraph office is allotted, who may permit their transmission if he considers them urgent. Important messages must be wholly or partly in cypher; and care must be taken that no opportunity is given to the enemy of gaining information. A supreme commander, or a commander of an independent army, may sanction the periodical transmission of private telegrams, but official messages must never be delayed for this purpose. Private telegrams, whether sent by inhabitants or by members of the army, are always carefully censored before transmission by the Chief of the General Staff or by an officer deputed by him. The Line of Communication Staff may only *visé* messages when no higher staff is present. Further details are given in the *Regulations and Instructions for Field Telegraphs.*

The vehicles comprise:—

1. Field telegraph store wagon, pattern 1890, for Corps and Cavalry telegraph detachments; carrying only cable; drawn by 4 horses and weighing loaded 2,463 lbs.; track 3 ft. 10 in.

2. Field telegraph wagon, pattern 1897, similar to the above, and for the same purpose.

3. Field telegraph office wagon, equipped with 2 offices complete and with room for 1 office on the wagon; drawn by 4 horses, weight loaded 2,017 lbs., track 3 ft. 10 in., used by all field telegraph detachments.

4. Submarine cable wagon, with 1,100 yards of cable on drums; drawn by 4 horses, weight loaded 1,800 lbs., track 4 ft. 5 in., for Army detachments.

The following are formed on mobilisation:—

| | | |
|---|---|---|
| 3 Army | Telegraph | Detachments. |
| 14 Corps | " | " |
| 8 Cavalry | " | " |
| 2 Independent | " | " |
| 3 Mountain | " | " |

The *Director of Field Telegraphs* is on the staff of the Lines of Communications, and has under him 1 staff captain, 1 civilian telegraph official, 1 N.C.O. as clerk, 1 field telegraphist, 1 travelling office horsed by the transport corps, and 1 wagon for the civilian official.

*Field Telegraph Sections.*—One with each army. Establishment:—1 senior officer as Commandant (with 3 horses), 2 civilian officials (one in charge of the Reserve telegraphists), 1 mounted subaltern (as adjutant), 1 paymaster (with clerks), 1 telegraphist, 4 officers' servants and drivers for the 4 horses with the office wagon, and a requisitioned carriage for the 2 civilian officials and the paymaster.

*Field Telegraph Detachments.*—Each is divided into construction and transport detachments, and is commanded by a captain or subaltern of the Railway and Telegraph Regiment (with cavalry troops a cavalry officer). Except with cavalry, each detachment is independent for administrative purposes.

These Detachments are allotted as follows:—

(*a*). One with the supreme Commander, consisting of:—Construction, 1 officer, 4 telegraphists, 25 men, 1 officer's horse; Transport, 10 men, 17 horses, 2 office and 2 store wagons, each 4 horsed; 6 offices, 5 miles air line, 2½ miles cable.

(*b*). One with each Army, consisting of:—Construction, 3 officers, 18 telegraphists, 172 men, 3 horses; Transport, 1 officer, 89 men, 150 horses, 6 office and 24 store wagons, 1 wagon for submarine cable, 1 baggage wagon and 1 supply wagon; 12 offices, 60 miles air line, 30 miles field cable, 1,100 yards submarine cable.

(*c*). One with each Army Corps, consisting of:—Construction, 2 officers, 9 telegraphists, 54 men, 2 horses; Transport, 26 men, 42 horses, 3 office and 6 store wagons, and a 2-horse cart for supplies; 6 offices, 30 miles cable.

(*d*). One with each Cavalry Division, consisting of:—Construction, 1 officer, 6 telegraphists, 34 men; Transport, 16 men, 26 horses, 2 office and 4 store wagons; 6 offices, 47 miles cable.

(*e*). Independent (as also fortress) detachments are also formed in accordance with special instructions. These consist of:—Construction, 2 officers, 4 telegraphists, 48 men, 2 horses; Transport, 16 men, 26 horses, 2 office and 4 store wagons; 4 offices, 10 miles air line, 5 miles cable.

(*a*) forms one and (*b*) six working parties of 3 N.C.O.'s and 20 men each; (*c*) forms three and (*d*) two working parties of 2 N.C.O.'s and 10 men each. The remainder of the men march with the staff details; they form a reserve for the working parties, provide the linemen for maintenance, and occasionally act as orderlies for the office. Field telegraphists and working parties ride on the telegraph wagons.

*Mountain Telegraph Detachment.*—Stores are carried on pack animals. Establishment:—1 officer, 31 men, 2 horses, for construction; 34 men, 7 horses, 30 pack animals, for transport; 4 offices, 15 miles field cable.

*Signalling Detachments* are under the chief staff officer of the particular body of troops they are with. Establishment: — 2 mounted officers, 9 N.C.O.'s and 16 men of infantry. Two country wagons or 7 pack animals carry equipment for 5 stations, *i.e.*, for Nos. 1 to 4 (station No. 5 only being used in case of necessity). Their training lasts two months; it is carried out by Army Corps, and supervised by an officer of the General Staff.

It is under consideration to replace the signalling detachments by allotting infantry telegraph patrols, with 3 offices, 44½ miles of conductor and modern visual signalling apparatus, to each infantry division, independent brigade or body of troops operating in mountainous country. These patrols would be under the General Staff, and would be subdivided into 3 sections, each with 1 store wagon.

*Reserves.*—Besides a telegraph reserve company there would be reserve telegraph detachments in accordance with requirements. Establishment:—1 official, 1 superintendent, 50 labourers and reserve operators, all provided by the civil telegraph administration of the State; *matériel* carried on requisitioned country wagons. In an extensive theatre of operations such reserve detachments might be under their own field telegraph directors.

Although the Austro-Hungarian organisation of military telegraphs appears to meet all demands of a future war, the existing peace establishment is quite inadequate and has to be made up to war strength with 80 per cent. of reservists and 30 officers not on the active list.

G. B. ROBERTS.

# *REVIEWS.*

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## THE LIFE AND TIMES OF MAJOR-GENERAL SIR JAMES BROWNE ("BUSTER BROWNE").

*By* GENERAL J. J. MCLEOD INNES, V.C., R.E.

Among the many distinguished men who left Addiscombe to join the Indian Engineers, amalgamated in 1861 with the Corps of Royal Engineers, probably there has been none of such varied attainments as the subject of this memoir. There have been great soldiers like Lord Napier of Magdala, great engineers like Sir Arthur Cotton, and great administrators like Sir Henry Durand; but Sir James Browne was distinguished in all three branches. He was, moreover, a man of marked scientific attainments, a linguist of wide range, a mathematician of no ordinary calibre, a wise and far-seeing statesman. When we add to the above that nature had endowed him with a herculean frame, a rich and sonorous voice and good ear for music, and a peculiar power of attracting the regard and affection of his fellow men, it will be admitted that his biographer has indeed a difficult task to perform in presenting an adequate picture of so varied a character from the *embarras de richesse* of the subject.

General Innes, whose own brilliant military career, in so far as active service was concerned, had ended before Browne had even arrived in India, has taken a somewhat new and most interesting method of treating his subject. Instead of writing, after the fashion of most biographers, a detailed account, interspersed with letters and diaries, of the life of the man whom he desired to depict, and alluding to public events only in so far as they touched the career of the individual, he has chosen to trace the public events themselves as regarded from the standpoint of an official high in the Indian service, and to show how Sir James Browne was an executive agent in carrying out the orders of the rulers of the land. In this way he has most successfully described the *service* of the subject of his memoir, a service which was rendered in the highest and most honourable manner, free from self-seeking and individual ambition, but at the same time with a clear perception of what was of lasting importance as distinguished from mere transitory expediency. This perception of essentials at times led Browne to take upon himself heavy individual responsibility, and even to violate regulations, but this was always done in the true interests of the State which he served throughout with unswerving loyalty.

James Browne reached India just at the period after the Mutiny when the old *régime* had necessarily to be replaced by other measures. General Innes has most clearly shown how the paying off of old scores on the frontier and Browne's employment thereon gave the latter the foundation for the important work which he subsequently carried out in that part of the world, and with which his name is now chiefly associated. The Mahsud Waziri Campaign of 1860 and the Umbela Campaign of 1863, in both of which he did admirable service and had much hard fighting, brought him into touch with some of the best soldiers of the day, and taught him much about the nature of the tribes and the lessons of war.

In the intervals of these campaigns he had engineering work to do, the scope of which is most astonishing. The Kohat division, of which he was made executive engineer, appears to have been in those days of enormous size. In fact the extent of his charge would appear to have been almost as large as that of the C.R.E. of the N.W Frontier to-day—a task of no little magnitude for a Lieutenant! It must be remembered too that there were then no such means of communication as exist now, when roads and railways cover the face of the country.

After Kohat he had the executive charge of Kangra, where he speedily made his mark as a great mountain road maker and bridge builder.

The bridges he designed and built were of every variety, and some indeed are among the finest specimens of the art of the *pontifex maximus* that are to be seen anywhere. Stone bridges of a greater span than 140 ft. are, indeed, to be found in other parts of the world; but Browne is, so far as we know, the only engineer who has built bridges of that span with bricks burnt in his own kilns,—a bold feat for a sapper subaltern! It was no mere guess work. Every step he took was founded on thorough mathematical investigation coupled with careful practical experiment, and, as he often told the writer, each successful step he thus took gave him fresh confidence for other and further designs. He delighted in scientific engineering, it was to him a charming combination of mind and matter, a conquest of nature by study of her laws, a subject of infinite variety and infinite expansion. And in this his great mathematical powers were of incalculable value. He had not the mere bowing acquaintance with the calculus that some of us have; he grasped it as a valuable tool, and used it with the skill of a master.

It may be interesting to officers in the Corps to know that after his death Lady Browne sent the writer several of his bridge plans. These are now in the office of the C.R.E., N.W. Frontier at Peshawar.

The Institution of Civil Engineers awarded him the Telford Medal and Premium in 1871 for a paper on Mountain Roads.

On reading the account of the engineering works open to the Corps in the sixties and early seventies, it is curious to notice how times have changed. Then the chief engineering works entrusted to the military engineer were in connection with irrigation—a branch in which Browne never was employed. Railways were mostly in the hands of the special men sent from home by the guaranteed companies. Barracks and roads were, as now, largely in the hands of military engineers, but water supply projects and other sanitary schemes were almost unknown. Nowadays irrigation has passed out of our hands, but our officers find their work on railways, roads and barracks, on water supply projects and drainage schemes, a wider field in many respects than that which was open to them in the early days.

Browne very soon made his mark as a railway engineer when that class of work was thrown open to the Corps. He studied the subject both theoretically and practically while on furlough; and, his fame as a bridge builder in Kangra having paved the way to further distinction, he was employed to design the Indus bridge at Sukkur. His design, it is true, was not accepted, but the details and calculations elicited the highest praise from the Consulting Engineer at the India Office, who said that they evinced "a rare combination of theoretical skill and practical talent."

From this employment he was sent by Lord Lytton to survey the country between Sukkur and Sibi in Beluchistan. How this led to his employment in a semi-political capacity, by utilising his linguistic powers and well-known influence over the wild frontier tribesmen; how this further led him to be selected as political officer in the Southern Column in the Afghan War; how that column, unlike those in Northern Afghanistan, was entirely unmolested by the tribes; and how he eventually led part of it back to India through an unknown route, has all been fully and graphically narrated by his biographer.

To revert to military employment was quite congenial. He was not one of that class of officers who look upon the engineering arts of peace as their sole, or even principal, duty. He was essentially a leader of men; and whether he led them—as he did in sublime audacity—to the capture of a stronghold like Khelat-i-Ghilzai or charging a battery at Tel-el-Kebir, or to the tussle with nature in a big bridge or a stiff bit of tunnel work, his leading characteristic differed only in degree not in kind. He was probably never happier in his life than in the early days of Umbela, in daily danger. It was all like a big game of football to him and he dearly loved the rough-and-tumble.

But the greatest work he ever accomplished was the making of the Harnai—or, as it is more correctly called, the Sind-Peshin—railway. In connection with this, however, his biographer has made one or two mistakes. As the writer of this review was Sir J. Browne's personal assistant during the greater part of the period in question, he considers he is in a position to point them out; and in justice to others it is desirable that they should be mentioned. The route of the railway was, it is true, originally reconnoitred by Sir R. Temple in 1879; but it is incorrect to say that "between that date and 1883 more detailed, but still only preliminary, surveys and proposals for the route and the work were sent in to Government . . . they were quite worthless and misleading," etc. This is hardly fair to the officers who were employed on what was in 1880 called the Kandahar State Railway. As a matter of fact the whole of the line was laid out and properly surveyed as far as Khanai (33 miles from Quetta); and with the exception of the Chappar Rift, Mud Gorge, and "The Summit Portion," it was executed under Browne in accordance with the original plans. These surveys were of the greatest possible use to him. The work had not merely been surveyed but had been begun in 1880, some staff quarters built, and a considerable amount of plant collected. Unfortunately the guillotine stoppage of the works by order of Mr. Gladstone had a most disastrous effect both on the people of the country and on the actual work, so that three years afterwards it was in some places more dangerous than if it had never been touched, but that was not the fault of the early engineers.

Again, the rival route, O'Callaghan's Bolan line, has been incorrectly described. General Innes says that this "line runs for the first forty miles with a fairly good gradient, and, although liable to be flooded, . . . is in ordinary seasons an excellent working railway. The steep gradient in the higher part of the Pass prohibits the construction of a broad gauge line and the last part is on the mètre gauge up a very steep incline. . . . It is now proposed to substitute for this narrow gauge portion a broad gauge line on another system, and when this is carried out there will be two broad gauge lines from India to Beloochistan." As a matter of fact the Bolan line was absolutely wiped out a few years after its completion. The remains of the road can still be seen in places, but to all intents and purposes the money spent on it was thrown away. Another broad gauge road, a double track moreover, called the Mushkaf Bolan, begun in 1891 and finished in 1897 by one of Browne's men, Mr. James Ramsay, now connects India with Quetta, in addition to Browne's own line which is just as good to-day as ever.

The story of the construction of the Harnai line has already been told in the *Royal Engineers Professional Papers*, in the columns of *Engineering* and in the *History of the Royal Engineers*, but no words can describe it adequately. Such a record of difficulties from pestering interference from above and pestilence, cholera, scurvy and fever from below, strikes of workmen, unusual floods and landslips, insufficiency of food and transport—, added to the stupendous task of pushing through in 3 years 165 miles of a railway which combined every natural obstacle with the most trying of climates—such an undertaking few men have had to face and fewer have carried through with success.

Towards the close of the work, when physical and mental energies had been taxed almost beyond endurance, Browne was further worried by carping criticisms in the Press. There was about that time a flood of misrepresentation concerning the officers of the Royal Engineers, and some of the Indian papers took up this question with peculiar virulence.

Invidious comparisons were made between the Harnai and Bolan railways, and some of Browne's brother-officers urged him to take notice of these attacks; and although he systematically kept silence, there is no doubt that they annoyed him. Time has vindicated his action with overwhelming force, for, as has already been stated, his work remains as sound as ever.

To-day the traveller whirls in a comfortable first-class carriage over the great bridges and plunges into the tunnels which were then built, and perhaps there is astonishment at the boldness which designed and the skill which executed these works; but only those who took part in the struggle can have any conception of the toil and pains involved, of the courage necessary to persevere, when cholera and scurvy were raging, when nature seemed to gather all her forces against man's puny efforts, and each day seemed to bring forth some new and unexpected difficulty. As one looks back on those times after the lapse of twenty years, one sees in the midst of it all the splendid personality of the Engineer-in-Chief, always cheery, always plucky, always full of resource, a man among ten thousand, towering above his fellows.

Browne then came home for much-needed rest, and thoroughly enjoyed home life, but alas, for the last time. His subsequent tenure of office as Quartermaster-General in India was much occupied with many important little wars, as well as with important memoranda on frontier defence questions and schemes of mobilisation. It was an anxious and busy time as his private letters to the writer evinced.

From this he was taken to succeed Sir R. Sandeman in the responsible position of Agent to the Governor-General in Beluchistan. There he at once made his mark, going to the root of difficulties as he always did. He deposed the savage Khan of Khelat and restored order in a district where much trouble was brewing, and introduced many wholesome and necessary reforms into the administration. There he died in harness, like his two predecessors, at the comparatively early age of 56.

There are a few minor inaccuracies in his biography, which are worthy of notice. The picture at p. 262 is not the "Louise Margaret" bridge, but what used to be known as "Whiteford's High Level Bridge" near Kach. The titles of the pictures at pp. 324 and 348 should be reversed. The epitaph in Rochester Cathedral was not written by the late Dean Hole (though, of course, as Dean he had to approve of it) but by General H. A. Brownlow and the writer, both of whom were the deceased's very intimate friends.

It may interest officers in the Corps to know that although Browne's service, with the exception of the Egyptian Campaign of 1882, was spent wholly in India, he took the keenest interest in the development of Corps work at home. In connection with the course of construction at the School of Military Engineering he sent to the writer most valuable advice, and was delighted to be consulted.

The picture in the Chatham mess is only moderately good. It was painted from a photograph after his death.

G. K. SCOTT-MONCRIEFF.

## HISTORY OF THE RAILWAYS DURING THE WAR IN SOUTH AFRICA, 1899—1902.

*By* LIEUT.-COLONEL SIR E. P. C. GIROUARD, K.C.M.G., D.S.O., R.E. (Printed for H.M. Stationery Office. Price 4s.).

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

(Two vols.;—I. Letterpress, II. Illustrations. Chatham: R.E. Institute. Price £2 2s. net.).

*The Times Literary Supplement* of the 28th April contained a very able review of the above two publications.

The writer forcibly propounds the principle "that the supreme need for our Army is a system of carefully considered plans which shall lay down the general outline of any war in which we are likely to find ourselves involved," and refers to the necessity of considering the part to be played by special services such as the railway staff.

The importance of a properly thought-out railway system in time of war is illustrated by the Franco-German War; and our own Sudan Expedition and the present war in the East are quoted as instances of the effect of railways on military operations. "In South Africa, partly perhaps because the railways were on the whole so well managed and contributed so largely to our final success in the war, very little has been heard about their management except the obvious stories about a few ill-mannered railway staff officers. But the problems which presented themselves are certainly worth record and study. The original staff to cope with these problems consisted of fifteen special officers and two railway companies of Engineers; and the only plans or arrangements made were subsequent to the declaration of hostilities."

The two publications show that "the most difficult task which the Director had was not so much to educate his own staff as to educate the rest of the Army with regard to the proper functions of the railway and the railway staff in war. When this had been done the rest was comparatively easy."

"Another point clearly brought out is the way in which officers and men were improvised for the railway duties required of them and how well on the whole they accommodated themselves to their new duties. There is a great tendency just now for specialization of functions, both in the Army and elsewhere; but good as this tendency is in some respects, the advantage of the general training in self-reliance and willingness to undertake any responsibility, which our public school and former Army training gave, is one not to be overlooked. The specialist is naturally best for his particular job; but if the particular specialist required is not on the spot, as must often be the case, the best substitute for him is not another specialist but the man trained to act for himself in all circumstances, as it has been the glory of our nation to produce both in the Army and elsewhere."

After stating the circumstances under which the *Detailed History* was published by the R.E. Institute instead of by the Government, and expressing regret that the latter did not undertake the task, the reviewer says:—"As it is, the earnest enquirer is seriously handicapped by having to get his material from two different publications, and, no doubt owing to the want of uniform system, the editing is not all that could be desired; thus the second part repeats a good deal of what is stated quite clearly in the first part.* The work would have been improved if it had been carefully edited as a whole by somebody not concerned in the operations described, who, while giving full effect to the evidence of the real workers, could clearly bring out the lessons to be drawn from it. There are some important omissions, such as the absence of any allusion to General Plumer's very important operations on the railway north of Mafeking and the general working of the Rhodesian railway, or to the deplorable failure of the Beira railway, the causes of which are well worth consideration by the student of railways in wartime. Lastly, the book suffers greatly from the want of a good index. But it would be ungracious to insist on these defects and forget to pay a warm tribute to the enlightened patriotism of the R.E. Institute in stepping into the breach when the Government seemed to have failed to realize its responsibilities. Their part of the work is admirably printed, and the illustrations, which entirely fill up the second volume, seem to be most carefully reproduced and are of obvious value."

## THE DESTRUCTION OF MOSQUITOS.

BEING AN ACCOUNT OF THE DRAINAGE AND OTHER WORKS CARRIED OUT WITH THIS OBJECT DURING 1902 AND 1903 AT ST. LUCIA, WEST INDIES.

*By* MAJOR W. M. HODDER, R.E.—(Royal Engineers Institute, 1904).

In a pamphlet entitled *The Destruction of Mosquitos*, Major Hodder, R.E., gives an account of the drainage and other works carried out in St. Lucia, West Indies, in 1902 and 1903. An epidemic of yellow fever which occurred amongst the troops in that island in 1901 was primarily responsible for this work being undertaken. Acting under expert evidence, the military authorities decided to adopt means for destroying

* The *Times* reviewer is under some misapprehensions which it is necessary to correct. The official *History* is a general report, the *Detailed History* is what its name implies. The two publications of course cover the same ground; but this was not only unavoidable, it was advisable, one being for the general reader, the other for the technical student. The *Detailed History* is a record, not a study; it does not, therefore, profess to draw conclusions from the work that was carried out; this is left to the reader to do, with the aid of the preface in which attention is invited to some of the lessons to be learnt. It *was* edited by somebody not concerned in the operations described, one who was qualified too by technical knowledge of railway work. The Rhodesia Railways did not come under the control of the Director of Railways of the South African Field Force until after the relief of Mafeking; the Portugese Beira Railway was, of course, never under his jurisdiction. The contrast between the unsatisfactory working of these lines and the comparatively smooth working of those in the rest of the theatre of war no doubt exemplifies the necessity of adopting the principles laid down in the books under review, but the records naturally deal only with the lines under the Director's control. The *Detailed History* was advisedly published without an index, it being decided that a really good one was impossible and that a good summary is better than a bad index; the work is intended for careful and particular reading and not as a book for intermittent reference.—EDR., *R.E.J.*

the mosquitos, which were very prevalent on the island, and it is this work and other operations carried out later that Major Hodder now describes. The main part of the pamphlet deals with a description of how yellow fever was stamped out in Havana and the habits of mosquitos. The rest of the text deals with the various drainage improvements that were carried out. The results were satisfactory, and it is interesting to note that the malarial returns for 1903 were enormously lower than those of 1901 and 1902.

The pamphlet will be valuable to those, whether lay or medical men, who may find themselves in tropical countries where there are many mosquitos. In view of the importance of this experiment from a sanitary point of view, it is unfortunate that some competent officer of the Royal Army Medical Corps did not take part in the report, as it would have lent it greater weight with the sceptics who believe that mosquito destruction is impossible.—(*British Medical Journal*).

# NOTICES OF MAGAZINES.

## Bulletin de la Presse et de la Bibliographie Militaires.

*Nos. 499—500.—28th February and 15th March, 1905.*

Statistic Tables of the Armies of Europe.—This double number consists of 180 closely printed pages, containing tabulated statistics in parallel columns, for comparison with each other, of the military organisation, administration, armament, equipment, area, population and Army finance of 18 different countries of Europe as they stood on 1st February, 1905. It is a marvellous and most valuable compendium of military statistical information; but it seems a pity that 3 more columns, for Belgium herself and for the United States and Japan, could not have been added or substituted for three of those devoted to the smaller European states.

*No. 502.—15th April, 1905.*

Battalion-Surgeon Lefèvre contributes an article on the Psycho-Physiological Study of Musketry. This alarming title covers an attempt to shew by a sort of analysis of the human nature, by separating the animal mechanism of the man from his will power, sensibility and emotional attributes, that the soldier is really (if he only knew it) but a creature of impulse, a victim of circumstance and the sport of passing impressions. The writer argues that it is the want of the chemical combination of his bodily and mental components, which are by nature only mechanically grafted to each other, which is the chief obstacle to the soldier's success as a marksman. The good that he would do, he does not, and the evil that he would not, that he does.

Twenty-five pages of philosophical argument lead to the deduction that the only way to make a man a good shot is to put him through such a strenuous and grinding course of progressive physical rifle exercise during his 2 years' service that the mental intelligence will be crushed out of him and he will become a simple mechanical automaton; that he requires really no aiming over sights to shoot straight, but will automatically snap-shoot correctly at any range just as Buffalo Bill used to break his glass balls with his scatter gun. Some doubt however seems to have arisen whether 2 years' service is long enough for the soldier to attain the desired brain vacuity (probably his life would be all too short); and it is recommended that he should begin his rifle practice very early in his youth.

We may I think congratulate ourselves that our R.A.M.C. officers have not yet taken to setting us right about the psychology of marksmanship. It might perhaps bewilder some of our recruits, and retard the development of that intelligence in the soldier of which we have been hearing so much lately.

G. H. Sim.

## ENGINEERING NEWS.

*February 2nd*, 1905.

IMPURE SAND IN CONCRETE.—It is somewhat a novelty to hear that the presence of clay or organic matter in sand intended for making concrete is no disadvantage, and further that certain soft fine sand will make good concrete; but such has been the experience of Mr. J. C. Hain of the Chicago, Milwaukee and St. Paul Railway, who has been employed on concrete work of bridges and culverts for some time past. The conclusion drawn is that the usual specification "clean, sharp sand" is not always necessary.

It is true that all sands which contained impurities did not behave alike, but tests extending over three years were generally favourable to those containing foreign matter. Again, Mr. Hain remarks "Washed sand may be less desirable than unwashed. Washing removes the fine particles as well as the foreign matters. The fine grains, if not in excess, are needed to fill the voids of the larger. The only way to decide whether sand should be washed would be to test it under both conditions." In fact, the acceptance or rejection of the sand should depend on briquette tests.

It is interesting to note that some progressive engineers are altering their specifications so as to allow a certain percentage of foreign matters in sand, *e.g.*, "The sand must be free from organic matter, and must not contain more than 10 per cent. of clayey matter. All the sand must be of such a size as will pass through a sieve of $\frac{1}{4}$-inch square mesh, and shall be of a mixture of sizes satisfactory to the engineer."

It causes one to reflect, perhaps not for the first time, that our specifications are often more rigid than we can really enforce with satisfaction.

C. E. VICKERS.

## NATURE.

*March and April*, 1905.

RADIAL VELOCITY OF THE POLE STAR.—Spectrograms have been obtained at Lick with the large photographic spectroscope during the last eight years to ascertain the "Motion in the line of sight" of Polaris and other (so called) "Fixed" stars.

When a star is bright enough to give an observable spectrum we can ascertain the rate of its approach or recession by comparing the spectrum of the star with that of some substance (say hydrogen or iron) whose lines are present in the star spectrum. Then, if its distance is increasing, its lines will be shifted towards the red, and towards the blue if it is coming nearer. Visual observations of this kind are extremely difficult, the star spectra are faint at best, and the lines themselves often broad and hazy. Photography, by prolonged exposure, gets over the difficulty of the faintness of the star spectra and produces negatives which can be satisfactorily examined at leisure, by clamping the star negative to that of the solar spectrum so as to make the lines correspond and thus facilitate the identification of the star lines. By this process the probable error of a star seldom exceeds a mile a second, and is usually less.

In the case of Polaris, the measurements of groups of plates indicated that the velocity of the centre of mass of the rapid pair in this triple system is changing regularly with a period of at least twelve years.

Alpha Tauri has been found by Vogel to be *receding* at a velocity of 30·1 miles a second and $\gamma$ Leonis *approaching* at 24·1 miles, though the whole distance travelled by these stars in a human lifetime makes no appreciable difference in their direction or appearance.

JUPITER'S SIXTH SATELLITE.—Photographs were taken of Jupiter with the Crossley reflector on December 3rd, 8th, 9th and 10th, 1904; a comparison of them showed that the planet, which was slowly retrograding at the time, was accompanied by an object of the 14th magnitude. Photographs taken on January 2nd, 3rd and 4th showed that the newly discovered object was following Jupiter in such a manner as to suggest its dependence on that body. The above was further confirmed on January 28th by using the 36-inch refractor, the hourly motion of 20″ in R.A. agreeing with the photographic result. The direction of the satellite's motion, although apparently retrograde, cannot be determined until further observations have been made.

SALMON FISHING.—Mr. W. G. Hodgson, discussing certain problems connected with this sport, points out the inaccuracy of the common opinion that the north of Scotland in spring is necessarily colder than the south of England, and then proceeds to discuss the reason why loch-fishing for salmon is carried on with a minnow instead of with a fly. One reason seems to be that salmon lie deeper in the water than trout, and will, consequently, owing to the set of their eyes, see the approach of a boat at a greater distance. A minnow trolled behind a boat is probably, therefore, the best lure for *salmo salar;* but whether the boatmen are right in giving a sinuous course to the boat is questionable. In the first place a boat may be rowed right over a deep-lying salmon without being seen by the fish; secondly, there is reason to believe that disturbed water is conducive to the salmon biting; and thirdly, the fish which takes the trailing lure may not have been lying in the wake of the boat, but may have made a dash from the side. Mr. Hodgson is not convinced that salmon fast during their sojourn in fresh water, and thinks that they take the minnow for a wounded fish, and dash at it owing to the impulse which makes most animals attack a cripple.

THE INDIAN EARTHQUAKE OF APRIL 4TH was clearly registered in the seismograph at the Royal Observatory of Edinburgh. The record began with some minute tremors at 1 a.m., while the larger waves followed about eight minutes later. The maximum disturbance was recorded at 1.30, and was followed by one of almost equal severity a minute and a-half later. From that point the tremors were gradually reduced until 4.43 a.m. The difference of time between Edinburgh and Dharmsala is about five hours. Slight tremors have been recorded at Calcutta and Bombay, but no decided disturbance was felt.

ELECTRICAL EFFECTS.—Professor Buller describes some striking electrical effects due to the dryness of the atmosphere at Winnipeg. The air during the winter months contains so little water-vapour that bodies charged with electricity lose their charges very slowly. For a week or more at a time the temperature ranges from 0° to −40F.; very little friction, such for instance as that produced by a person walking on a carpet, will charge him with sufficient electricity to produce a visible and audible spark on touching the gas tap or any other conductor. It is quite easy to light the gas with a spark from the finger by merely shuffling a few paces over the carpet and then holding a finger to the burner! On February 6th, at 1 p.m., when the outside thermometer stood at −5°F. and that indoors at 62°F., Professor Buller found that a spark half an inch long could be obtained between his finger and an earth-connected iron pipe, after sliding his feet smartly for twenty paces along the maple wood floor of the laboratory. In the chemical laboratory *calcium chloride* may be exposed to the air for some weeks without showing the least signs of deliquescence. To demonstrate the deliquescence of this substance he was obliged to use a damp chamber.

W. E. WARRAND.

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## NEUE MILITÄRISCHE BLÄTTER.

*March and April*, 1905.

LESSONS OF THE BATTLE OF MUKDEN.—The writer ascribes the Russian misfortunes as being largely due to their original faulty strategic concentration, "a mistake in which pervades the whole conduct of a campaign." This principle is clearly laid down in Blumé's excellent *Treatise on Strategy*, as well as another to which the Japanese success is to be ascribed, viz., "The best chance of success of the Attack over the Defence lies in the simultaneous advance of all available forces against the front flanks of the enemy." Indeed this principle was applied by the Japanese at Lao Yang; but a necessary condition, a superiority of force was not available and the blow, as far as securing a decisive success, was a failure. The battle shows clearly that the Japanese are no longer to be reproached with want of strategic conception, for Nogi's and Kuroki's operations on both flanks were finely conceived, and the former's came quite as a surprise to Kouropatkin and entailed the loss of the campaign. This is all the more remarkable as there were two divisions of Russian Cavalry on this flank under the command of General Mutcheuski, who had hitherto shown himself an active and reliable leader; the movement was known in Europe days before the *dénouement* and was freely commented on in the press. It will remain, with our present knowledge, a lasting reproach against the Russian Cavalry, largely composed, by the way, of Cossacks, and justifies the predictions of a well-known authority at the beginning of the war,—that no matter what was the upshot, two popular fallacies would be exposed, viz., Kouropatkin's generalship and Cossack uselessness; that great battles are not to be decided in a day; that the attack of an army in position is an operation in many respects analogous to that of a siege, and that a thorough preparation by heavy Artillery is absolutely necessary if any result is to be obtained by the frontal attack; and that "Le bon Dieu est du côté des gros bataillons" as of yore. Japanese tactics have shown themselves superior on every occasion to Russian. Perhaps Japanese success may be chiefly ascribed to moral superiority—made up of patriotism, contempt of death, order, obedience, frugality and endurance, all of which qualities they have shown in a high degree; indeed in regard to their power of enduring losses it is very questionable whether any army is their equal in this respect.

NIGHT OPERATIONS.—Have always been a feature of war in as far as *la petite guerre* is concerned, and instances are not wanting of its use on a larger scale, of which we have examples in the Seven Years' War and in 1814, not to mention the English operations at Tel-el-Kebir. In the present war many instances can be adduced of the advance of large bodies over extreme and middle ranges during the night, so as to be ready by break of day to undertake the attack over the decisive fire zone. This procedure saves the troops from the losses to which they would be exposed in advancing over these ranges against a well-chosen position, and allows of the attack being commenced by daybreak with comparatively fresh troops, if one can so designate troops who have had but little repose during the night. No doubt the German regulations which prescribe this mode of procedure have been not alone well studied by the Japanese but also well practised, for order, silence, right direction, etc.—indispensable in night operations—are only to be acquired after troops have been trained in a gradually progressive manner, commencing with the company.

PORT ARTHUR.—Major Schroetter, the well-known writer on fortification, has just published an interesting work on this subject, which will be read by soldiers of all Arms, being not merely a dry recital of engineering operations but a work in which many questions of general interest concerning the operations of the war are discussed; he is of opinion, against that of many distinguished strategists, that the Japanese were justified in proceeding as they did, instead of merely blockading the fortress and trusting to famine to do its work. Their great losses he ascribes to over-confidence, owing to their easy capture of the fortress by assault in their China Campaign, and to their want of experience in fortress war, involving imperfect appreciation of the effect of their at first insufficiently powerful Artillery. The long and skilful step-by-step defence before the complete investment reflects the greatest credit on the Russian Army. The surrender was a consequence of physical and nervous depression, brought about principally by the loss of Hill (203) and the death of the Commanding Engineer Kondratensko, whom all admit to have been the Todleben of the siege; under the circumstances the continuation of the defence became impossible although considerable material resources were still available.

THE COST OF WAR.—According to the Statistical Department of the Credit Lyonnais the Russian expenses of the war for the 10½ months up to end of 1904 amounted to £88,000,000, the Japanese expenses for the same period being about £72,000,000; in these figures no account is taken of the loss of *matériel* sustained by either belligerent, the Russian fleet destroyed being worth on a low estimate £10,000,000. Some interesting figures are given showing costs of previous wars. The Crimean War, lasting 2½ years, cost Russia £140,000,000; the war of 1877-78, lasting 10 months, cost the same power £128,000,000. The Transvaal War cost £200,000,000, lasting 2½ years. The Franco-German War, lasting 7 months, cost France £88,000,000 and Germany £60,000,000, these sums including only pay of troops and *matériel de guerre.* Indemnity, compensations, etc., have swelled these amounts by many times, as for instance the famous 5 milliards and 2 provinces which unfortunate France had to hand over to the victors—*Va Victis.*

BATTLESHIPS *v.* ARMOURED CRUISERS.—According to a reliable formula adopted by Chief Constructor Kretchner, of the German Navy, the relative fighting values of the following ships are as under :—

| | | Tons. | Co-efficient or fighting value. |
|---|---|---|---|
| Armoured Cruiser | *Washington* (U.S.) ... | 14,700 | 12·4 |
| " | *Drake* (E.) ... ... | 14,320 | 10·3 |
| " | *Maryland* (U.S.) ... | 14,020 | 9·6 |
| " | *Furst Bismark* (G.) ... | 10,700 | 7·4 |
| Line-of-Battleship | *Duncan* (E.) ... ... | 13,780 | 22 |
| " | *Borodino* (R.) ... ... | 13,730 | 30 |
| " | *Suffren* (F.) ... ... | 12,730 | 27 |
| " | *Kaiser Friedrich III.* (G.) | 10,700 | 13·6 |

Comparing these figures of fighting value with cost and tonnage, it appears that an Armoured Cruiser costs about ⅘ that of a Battleship of the same tonnage, which has a fighting value of between 2 and 3 times that of the Cruiser; and the writer laments that Germany should be spending so much on Armoured Cruisers, when—according to Herr Kretchner's formula—the command of the sea depends on Ironclads.

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There are interesting articles on Béton and its application to military purposes, but they contain nothing that is not well known on the subject.

The strategic value of Mukden, the *rôle* of fortresses, field fortification applied to the field of battle, are interesting *résumés* of what is already known on these subjects.

It will interest many students of war to learn that a new Edition (the 5th) of Clausewitz's immortal work *Von Kriege* has just been published with an appreciative introduction by the Chief of the German General Staff, General Von Schleiffen, who says "The teachings contained in it guided the German Army to Koniggratz and Sedan."

R. A. LIVESAY.

## RAILWAY AND LOCOMOTIVE ENGINEERING.

*February*, 1905.

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

We have here an account of certain mechanical devices for exchanging Staffs without stopping. Such apparatus, adapted for the Webb & Thompson Staff is in use on some British lines; but the pattern of staff here* used is smaller and lighter. It is suspended in a rubber staff case hung from a delivering arm (in much the same way as mail bags are), and is caught by a "catcher" projecting from the engine. The exhibition of the Train Order Signal indicates that Staffs have to be exchanged.

The Santa Fé line uses the Train Staff on some of its sections, and we have here a description of a *Permissive* Staff system, *i.e.*, electric staff combined with tickets. The reason for this arrangement is that, on the section where employed, the balance of traffic, owing to a heavy grade, is all in one direction. Either the *Absolute* Staff or the *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 quite contrary to our rules, as in this country, where 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" system is or used to be employed on the Midland Railway between Little Eaton and Ripley (if I remember right). In this case the Tablet had to be put into a certain drawer to unlock the Ticket box, after having been withdrawn from the machine in the usual manner.

C. E. VICKERS

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## REVUE D'HISTOIRE.

*April*, 1905.

THE CAMPAIGNS OF MARSHAL SAXE.—The account of the battle of Fontenoy is completed. It is very full and fair, and is supported by a large number of letters and reports, mainly French, but including also those of Marshal Königsegg, the Prince of Waldeck (who commanded the Dutch) and General Ligonier. The writer states the French loss at 7,500, about the same as that of the Allies. The loss of the English infantry was 3,600, while the French infantry opposed to it had 4,500

* Cincinnati, New Orleans and Texas Pacific.

killed and wounded, and the French cavalry 2,300. Hence he reckons that the English column inflicted twice as many wounds as it received. He ought, however, to have taken the Hanoverians into account, for they formed part of the column, and lost 1,400 men, 44 per cent. of their strength. While declining to follow the French writers, who say that the column was shattered and put to flight, he will not admit that it retired in good order and of its own accord. But Königsegg, a fairly impartial witness, says:—"Seeing at length that the affair was becoming a butchery, and that there was no hope of success owing to the pusillanimity of the Dutch, I advised a retreat, which was made in good order, without the enemy . . . venturing to pursue us." The number of unwounded prisoners taken by the French was very small.

THE CAMPAIGN OF 1800 IN GERMANY.—This chapter is devoted to the generals and the troops of the two opposed armies. The conclusion is that, except in the matter of cavalry and supplies, the Austrian army was inferior in every respect. In describing the antecedents of the French generals, Gouvion-Saint-Cyr seems to be mixed up with his cousin, Jean Baptiste Gouvion, who was born twelve years earlier and was an artillery officer before the Revolution. Gouvion-Saint-Cyr had been an artist, and was one of the most notable instances of men who showed the highest military capacity without previous military training in the regular army.

THE WAR OF 1870–1871.—*Retreat of the Army of Alsace on the Camp of Chalons.*—The appearance of the Germans at Lunéville and Nancy caused Macmahon to renounce his direct line of retreat, by Bar-le-Duc, and move in a south-westerly direction. The infantry of the 1st and 5th Corps took train at Neufchâteau and Chaumont for Chalons, but there was great anxiety lest the Germans, following a straighter course, should cut the line. The cavalry and artillery went by road. The movements are followed day by day from 13th to 20th August; and though there was no fighting, the orders and counter-orders issued are instructive.

E. M. LLOYD.

## REVUE DU GENIE MILITAIRE.

*February and March*, 1905.

THE RÔLES OF INFANTRY AND ENGINEERS AS REGARDS FIELD WORKS.—This article refers to the intrenching equipment of the Infantry and Engineers of the French Army, and enunciates certain principles with regard to their respective *rôles* in executing field works. The writer aims at removing certain erroneous impressions as to what work the Engineers are expected to carry out, and what should be left to the Infantry to undertake.

*Tools, Infantry.*—Portable intrenching tools, carried by the soldier, are so few and so widely distributed that practically no effective intrenching work is possible with them alone.

The heavier tools carried in each company cart, together with the portable tools of the company, would suffice for one section to throw up light cover for itself in about an hour, so that an independent company could intrench itself in about 4 hours.

Similarly all the tools in the company carts of a battalion, if collected, would suffice to equip one company, which could obtain effective cover in about an hour and a-half; but this method of working would not be so convenient as that by sections, as the company carts also carry ammunition and their separation from their company is inadvisable. It is calculated that one tool suffices for two men, and that this is the best way for infantry, not trained to digging, to work, one man resting while the other digs.

The Engineer Park of an Army Corps contains tool wagons, each carrying sufficient intrenching tools to provide two companies on the above scale. A battalion could therefore, with its own tools and those of one Park tool wagon, equip three of its companies for intrenching; the fourth company would probably be employed on protection or other duties. Each "section" of the Army Corps Park has three tool wagons, enough to provide a regiment of 3 battalions; and there are 3 sections, 9 wagons in all, in the Park.

The above arrangements do not seem to satisfy modern requirements for hasty intrenching, for only a battalion which can procure a tool wagon from the Engineer Park of the Army Corps can provide cover for itself in less than 4 or 5 hours; and this points to the superiority of an arrangement of portable tools at the immediate disposal of the rank and file in proportion of at least one tool to two men.

*Tools, Engineers.*—The Engineer company carries enough intrenching tools, mostly heavy but a few portable, to equip each sapper with a pick and shovel. It is laid down in the regulations that the Engineer tools are not available for Infantry use. The Infantry Regulations, 1904, specify that the Infantry must rely on themselves for all ordinary intrenchments, and the preparation of these is in no sense the duty of the Engineers. These will be required for more technical work of overhead cover, abattis, entanglements and communications, or for clearing the field of fire. It follows that for field works the Engineers should be considered as attached to the Infantry, to assist them, and not the Infantry as providing working parties for the Engineers. The latter idea has been hitherto generally prevalent.

The splitting up of the Engineer company by order of the Commander of a mixed force is deprecated. The Officer Commanding the Engineer Company should always have his unit intact and apportion his men to different works and duties as he thinks fit; otherwise he cannot be responsible for the administration and effective work of his company. It is considered that a Brigade is the largest unit that can be served at one time by a company of Engineers. Regret is expressed that the "Chef de Bataillon" (Lieutenant-Colonel, C.R.E.) has been abolished from the staff of a Division; the same arguments are adduced as those we have so often heard in our own service in this matter, but they have apparently had as little effect.

*Execution of Defensive Field Works.*—When the General-in-Chief makes his preliminary reconnaissance of ground to be occupied for defence, he should be accompanied by the senior Engineer officers available, in order that they may be thoroughly in touch with his ideas.

After reconnaissance the General issues his orders as to the positions to be prepared for defence, allots the groups or units of Infantry to their sections, apportions the Engineer Park tool wagons (if available) to the Infantry units, and details the Engineer companies at his disposal, some to assist the Infantry in certain sections of the position, and others to execute special technical works, with, possibly, working parties of Infantry to assist them. Beyond this all details are left to the Commanders of sections of defence. The Section Commanders then make their detailed reconnaissances accompanied by the captains of any Engineer companies allotted to them. They should avail themselves of the latter's technical advice in allocating and designing the defensive works and in tracing them where necessary. But the responsibility of the scheme of defence rests solely with the Infantry Commanders; and the works are executed by the Infantry who are to garrison them, aided in technical matters by the Engineers.

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CAMP OF INSTRUCTION AT MAILLY.—The description of the arrangements of the Camp of Instruction at Mailly is given in considerable detail with plans. The site is to comprise a manœuvre ground, rifle ranges and barrack accommodation for

16 Battalions Infantry (4 companies each),
6 Batteries Field Artillery,
1 Company Engineers,
1 Regiment of Cavalry (4 squadrons of 100),

in all 354 officers, 10,700 men, 690 horses.

Later on 24 Batteries Field Artillery and 2 of Horse will be added.

The area of the ground taken up is 28,000 acres, of which one-fourth is covered with pine woods. The ground is diversified with hills and ravines and a river so that variety may be obtained for manœuvre purposes. Eleven farms and a small hamlet had to be acquired, and 2,345 land-owners had to be bought out, of whom 92 per cent. came to terms by private treaty. The cost of the land, including existing buildings, was £282,500 or about £10 an acre.

The site was occupied as a camp for some years, and the plan for the barracks (single-storied buildings to hold one company each) was arranged so that they should cover the same ground as the tents. This enabled the accessory buildings, kitchens, latrines and lavatories for the canvas camp to be erected permanently, and the pipelines and drains to be laid down, so as to be suitable for the permanent barracks when they should be built. The disadvantage of this arrangement as compared with double-storied buildings for 2 companies is that the length of pipes and drains is increased.

The buildings face N. and S. and are 40 ft. apart, so as to admit plenty of sunlight between them.

Water supply is calculated at the rate of 10 gallons per man per day and 11 gallons per horse.

Five wells, about 150 feet deep, were sunk near the stream. The first 30 feet were formed by concentric steel tubes, 12" and 16" diameter, with cement grouting filled in between them, by which means the surface water could be kept from filtering into the well. The rest of the well depth was a steel tube 10" diameter.

The water is pumped into 2 reservoir towers, one at each end of the camp, by 3 pumps worked by turbines in the stream close by. Two petrol motors are arranged in reserve in case of the failure of water for the turbines.

Sewers are arranged to carry off all liquids except rain water. The sewage is collected in septic tanks, and the liquid pumped up to a sewage farm situated about 1,000 yards from the camp. The pumping arrangements are very similar to those for the water supply.

The sewage farm contains about 20 acres, divided into seven almost equal sections. The liquid sewage is distributed over a different section each day, so that there are 6 days given for soakage. Each acre is calculated to deal with about 624,000 gallons per year. The farm is let for about £10 a year for each section, about £3 10s. per acre, for a term of 3 years, the chief condition of the lease being that no vegetable is to be grown that can be eaten by man uncooked.

One latrine for each Battalion is provided, containing 10 seats, 2 for N.C.O.'s and 8 for men, with washout closets and up-to-date fittings.

One kitchen serves for a Battalion, and comprises a scullery, 4 company provision stores, and 2 double-company lavatories of 15 basins each. It has a verandah where potatoes can be peeled and vegetables prepared under shelter. The grease traps and surface gullies connected with cooking and washing arrangements are a source of constant complaint, as it is found impossible to get the troops to keep them properly cleaned daily, but the writer has no practical alternative to suggest.

An open double washing trough, 33 ft. long, suffices for a whole Regiment of 4 Battalions. It has a corrugated iron roof, and a drying ground on each side.

Quarters for officers of all ranks have been built, of a very simple pattern apparently, and Brigade mess houses erected, each of which contains the messes of 2 Regiments, with accommodation for over 100 officers. The cost of the quarters and messes is being recouped by a daily contribution from each officer attending the camp.

Barracks for the troops have not yet been commenced; it is intended that they shall be single-storied buildings, measuring 136 ft. × 45 ft., each to accommodate one company of 150 men.

Magazines, stables, stores, and administrative buildings of all kinds have been erected; also a hospital for each Brigade.

G. H. SIM.

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