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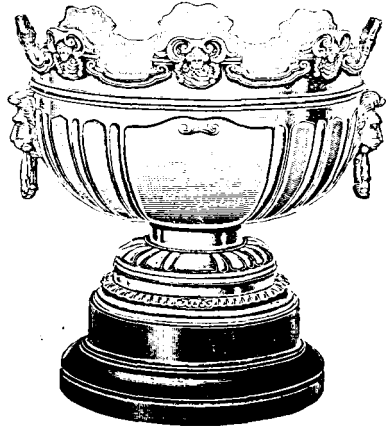
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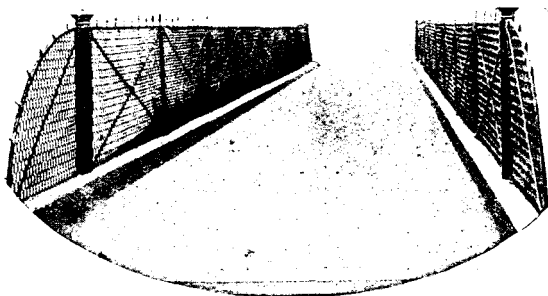
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*Authors alone are responsible for the statements made and the opinions expressed in their papers.*

THE MISHMI MISSION SURVEY DETACHMENT.

By CAPT. C. P. GUNTER, R.E.

REPORT FOR 1911-12.

*Reproduced by the kind permission of COLONEL SIR S. G. BURRARD, K.C.S.I., F.R.S., R.E., Surveyor-General of India, from the "Records of the Survey of India," Vol. IV., 1914.*

ORDERS were issued for a Survey Detachment to accompany the Mishmi Political Mission which had been sanctioned by the Secretary of State to form part of a general scheme of operations along the North-East Frontier in connection with the Abor Expedition. The portion of the frontier allotted to the Mishmi Mission extended from the Yamne-Sesseri watershed on the west to the Luhit-Namkiu Divide on the east, containing the whole of the Mishmi Hills.

The detachment (Capt. C. P. Gunter, R.E., in charge, Lieut. H. T. Morshead, R.E., Mr. Abdul Hakk, K.S., Surveyor Alla Ditta, Sub-Assistant Surgeon Ishwari Persad Sharma, Ward Orderly Chamman Singh and 32 khalasis,—in January Surveyor Amar Singh with 4 khalasis joined the Nizamghat Column) was formed on September 20th and the various members joined in Calcutta or Gauhāti arriving in Kobo on the 8th October where the detachment had been ordered to proceed.

After spending 10 days at Kobo in pouring rain the detachment proceeded to Sadiyā, the headquarters of the mission. Here a halt of a fortnight was utilized in surveying the plains round Sadiyā, and on the 1st November the march to the hills *viā* Tamei Mukh was commenced; but it was not until the 25th November that actual plane-tabling was started, by which time rations had been collected for the advance of the main column into the hills. Survey work was carried on independently of the movements of the main column, each plane-table being given a small escort so as to enable him to be free to move when he wished.

The main column returned to Sadiyā by the third week of February, 1912, and survey operations closed by the 5th of March.

The main column followed the old Mishmi path from Sadiyā to Tamei Mukh through the villages of Tashianliang and Salamgam and thence up the right bank of the Luhit as far as the Yepak River. The Chinese had planted a wooden boundary post at Menil Krai close to the Yepak River; beyond this the Mission did not go, but the survey was carried on as far as Samā Village about 20 miles further up the Luhit Valley.

A small detachment had been left at Nizamghat and it was the intention of the Political Officer to try and find a way back to the Dibāng River from the Yepak across the mountains to the north and west, and join the Nizamghat column up the Dibāng ; but the nature of the country made this impossible and the column returned to Sadiyā by the same road as it had come. A small detachment with a surveyor explored the Delei and Dou Valleys and separate escorts enabled the Ghalum, Lati, Lang, Tawa and Kharem Valleys to be surveyed. The surveyor with the Nizamghat column surveyed up the Dibāng as far as Idipo Village, some few miles beyond the point reached by Capt. Robertson in 1899—1900.

The country surveyed was of a most inhospitable and mountainous character ; the main ranges, varying from 15,000 to 17,000 ft. in height, drop in a distance of 4 or 5 miles to the level of the main valley (about 4,000 ft.) at Samā. The slopes of the gorge through which the Luhit cuts its way are often nearly 40 degrees and the general fall of this river is over 40 ft. a mile in the distance of 90 miles from Samā Village to Tamei, where it debouches into the plains ; it is practically a torrent for the whole of this distance.

North of Dong Village, the Dati falls a distance of 3,000 ft. in three cascades into the main river.

It is almost impossible to climb out of the Luhit Valley except up large streams such as the Ghalum, Lati, Delei, etc. ; small streams such as the Namti, Yepak, Shet-ti, etc., are mountain torrents and quite impassable.

The mountain tops are a series of rock pillars, sometimes 200 or 300 ft. high, joined together by snow-covered ridges. The shape of the main ridges prevented any view being obtained of the Tibet highlands supposed to exist to the north. The greatest difficulty experienced by the Survey was caused by the rainy climate and continual mists and clouds which were prevalent even on the finest days. During the four months only 38 days were experienced without rain.

The plains between Sadiyā and the hills, and the first range of hills up to the Tiding River, are covered with dense forest, as are also the hills between the Kharem River and the Luhit River as far as the Hali River ; from here eastwards the forest grows thinner and from Minzong onwards consists almost entirely of fir and rhododendron. Above 10,000 ft. there is very little forest growth, and the mountain tops appear to be entirely rock and precipice.

In January the snow line often came as low as 7,000 ft. for a few days at a time, but 10,000 ft. was usually the limit of snow.

A Miju Mishmi village consists usually of one or two long wooden houses built on piles ; several families live in each house, they have dirty habits and are exceedingly poor. At first sight it appears wonderful that human beings can find a living at all in these wild

mountains, but at the bottoms of the valleys where there is soil it is very fertile ; crops of millet are also grown on hillside clearings. Up the Delei Valley the villages of Taroān Mishmis often have 20 to 30 houses, and they appear to be more prosperous and possess cattle and pigs.

The transport was entirely Nāgā coolies who were excellent in the low hills but proved quite useless above the snow line, and were not properly clothed to stand intense cold.

Triangulated points were carried as far as the Delei River watershed but the survey of the main valley beyond Minzong was carried out by means of a subtense-bar theodolite traverse, the azimuth being checked from snow peaks to the south.

The detachment completed 3,370 square miles of detail survey on the  $\frac{1}{4}$ -in. scale, 1,010 square miles of  $\frac{1}{4}$ -in. reconnaissance survey, 384 linear miles of 1-in. plane-table traverse, 22 linear miles of subtense-theodolite traverse and 21 linear miles of time and compass traverse. The triangulation fixed three new stations of observation and 18 intersected points besides three interpolated stations with the object of testing the plane-table work near Minzong; a small area round Wālong and the Yepak Camp was surveyed and mapped on the 2-in. scale.

The area surveyed has been provisionally mapped on the same scale in one sheet which includes also the former survey by Capt. C. L. Robertson, C.M.G., R.E., in 1899—1900, a survey of the Nam Dapha Valley by Ram Prasad who accompanied Capt. Pritchard in 1912, and the Sesseri Valley with new information as regards villages and streams compiled from the Nizamghat column report, 1912, the whole comprising 22 1-in. sheets falling in degree sheets 82P, 83M, 91D&H, 92A&E.

The map produced included 690 place names of which 370 were villages.

The principal places of interest fixed by the Survey were :—

- (a). Tibetan villages of Samā, Kahao and Rimā.
- (b). The Talok Dakhru 11,000 ft., the pass on the Luhit-Nam Tamai Divide over which an easy track leads from the Luhit Valley to the Nam Tamai.
- (c). The Kong Dzong Pass leading from the Ghalum Valley to Hkamti Long.
- (d). The G'lei Dakhru 12,820 ft. over which a road leads from the Delei Valley into the Rong Thod Chu.
- (e). The Kue Dakhru about 14,000 ft. through which a road connects the Delei Valley with the Ithun Valley.
- (f). The trade route used by the Mijus leading from Wadong in the Luhit Valley across the Lang Valley joining up with the pilgrim road from Paras Ram Kund to Chongkham in Hkamti.



Other places of interest were :—

- (g). The Dati Falls where a stream falls 3,000 ft. in three cascades into the Luhit River.
- (h). Tilam opposite Dong Village where there is a spring of clear hot water.
- (i). Twin peaks Kakro and Chhichhadia Heights 17,150 ft. and 17,172 ft., two huge rock pinnacles between which a track is said to lead connecting the Dou Valley with the Luhit down the Tho Chu.
- (j). Glo Hawei, a small lake about  $\frac{1}{2}$  mile long and  $\frac{1}{4}$  mile wide in the Kharem Valley at an altitude of 3,890 ft.

The general health of the detachment was good but the weak ones amongst the khalasis soon felt the strain of hill climbing and remained behind at various intermediate posts.

#### REPORT FOR 1912-13.

On the 12th September, 1912, the Surveyor-General issued orders for me to proceed to Calcutta and take charge of the detachment (Capt. C. P. Gunter, R.E., in charge, Lieut. H. T. Morshead, R.E., Mr. Abdul Hakk, K.S., Surveyor Shaikh Muhammad Salik, Surveyor Sheo Lal, 28 khalasis (Hazaribagh). Sub-Assistant Surgeon Zulfikar Hyder and a Ward orderly joined later in Sadiyā) which would be detailed to carry on survey operations in continuation of last year's work in the Mishmi Hills : all arrangements for the field season to be made pending final sanction from the Government of India. Telegraphic orders were issued on the 6th October to proceed without delay with the detachment to Assam. On the 10th October the whole detachment as detailed above left Calcutta with all the necessary equipment, instruments, and data. On the 13th October we arrived in Sadiyā ; it took the whole of the 14th to get the kit across the Brahmaputra, and on the 15th the camp was pitched and instruments, etc., distributed.

The programme of work formulated by the Government of India for the detachment was as follows :—

- (a). Surveys to be made of the Dibāng Valley in continuation of the work done last season : of the Dri River to its source : of all the inhabited valleys leading into either the Dri or Dibāng Rivers : and of the Sesseri Valley to connect with the Mishmi and Abor surveys of last season.
- (b). In order to give the Survey officers a clear appreciation of the points regarding which the acquisition of geographical knowledge is of the first importance, the following detailed instructions were communicated :—

To discover the course of the Dibāng River, and whether the Nagong Chu is one of its tributaries. To fix the main

range of the Himālayas, north of the Dibāng River basin and the subsidiary ranges in the basin, particularly with reference to their junction with the range bordering the Taroān and Miju Mishmi country on the north-east (*i.e.*, the watershed between the Rong Thod Chu and the Delei).

As the extent of the Dibāng Valley was entirely unknown and the whole country unexplored, it was impossible to know what area we might be called upon to survey. The Government of India had sanctioned a party of two Imperial officers and two surveyors, but in order to be in a better position to complete an area of larger extent than expected and knowing that one surveyor can only deal with one valley at a time in the Mishmi Hills I asked for the services of a third surveyor and this was granted.

On arrival at Sadiyā we found that no orders had yet been issued by the civil authorities for the formation of the exploration party and that Mr. Dundas, who was to have control of the two exploration parties in the Abor and Mishmi country, had not yet received sanction to proceed with his arrangements. This was a severe blow to us as we realized that at the earliest the expedition could not be ready to leave Nizamghat, the advanced base, until the end of November. So in spite of the experience gained last year and the reports of all officers, in which it was urged that any operations in the Mishmi country should commence as early as possible in October, we were actually going to start at least a month later this year than we did last.

The work was distributed as follows :—

- (a). Lieut. Morshead to undertake all the triangulation of as much of the area as was possible for one man to do.  
 Capt. Gunter to do the plane-tabling of the main valley and other valleys if necessary to the north.  
 Mr. Abdul Hakk the plane-tabling of the Sessleri Valley, foothills west of the Dibāng River and the Ahui River.  
 Surveyor Shaikh Muhammad Salik to accompany Lieut. Morshead and help in clearing, etc., the first three hill stations, and then do the plane-tabling of the side valleys west of the Dibāng River. Surveyor Sheo Lal to carry out a large scale plan survey of Sadiyā itself, which was specially asked for by the Political Officer, and then the plane-tabling of the side valleys east of the Dibāng River. Both Capt. Gunter and Mr. Abdul Hakk were to carry 3-in. theodolites in case they might be in a position to help with triangulation.
- (b). It was determined to make use of the present fine weather to push on at once with triangulation from the nearer range of hills, north of Sadiyā, using local labour. On

October 18th Lieut. Morshead, Mr. Abdul Hakk and Surveyor Shaikh Muhammad Salik left Sadiyā with bullock carts, accompanied by Mr. Ballantine, the Assistant Political Officer, *en route* for Nizamghat. The political authorities had issued orders for local labour from the nearer villages to be collected and be ready to go into the foothills. We foresaw that the success of the operations would depend almost entirely on the triangulation which Lieut. Morshead would be able to accomplish during the fine weather in October and November from three stations on the first high range, so that every endeavour was made to enlist the sympathy of the political officers to help us in getting local labour to enable us to start work at once. The political officers were most anxious to push on our work and did everything they could; but unfortunately Mr. Ballantine, the Assistant Political Officer, was called away from Nizamghat at a most critical moment and in consequence the Mishmi coolies did not turn up to take Lieut. Morshead and party into the hills.

The road to Nizamghat was found to be very much overgrown with jungle and the party did not arrive there until the 23rd October, taking six instead of three days. On October 26th Abor coolies from Dambuk Village arrived to accompany Mr. Abdul Hakk and enable him to survey the foothills round Dambuk.

- (c). *Dambuk Party*.—This party, consisting of Mr. Abdul Hakk and 25 Military Police sepoy under a Subadar, crossed the Dibāng in boats; during this operation one sepoy was drowned and several rifles lost owing to the upsetting of a boat, so it was decided not to continue the march but return to Nizamghat. On November 1st the same party again crossed the Dibāng and marched to Dambuk, 40 Abor coolies meeting them at the river opposite Nizamghat. Mr. Abdul Hakk continued plane-tabling along the foothills, on the 3rd he reached the Sesseri River, on the 4th Memosipo Village, and returned to Nizamghat on the 7th November. During this week he completed 300 square miles of new country and fixed the position of several large Abor villages which had not been visited by any Government official for many years. Dambuk proved to be a very large and prosperous village of 400 houses, and the other Abor villages were, Memosipo 100 houses and Siluk 200 houses. Although these Abors were friendly and did not actually interfere with the work, they did not put themselves out in any

way to help Mr. Abdul Hakk, and it was only the presence of a strong escort which persuaded them to work for very high wages. Plane-tabling of the valley and lower hills was completed up to the Siku-Sibya watershed and a junction made with the Abor Survey.

It had been settled that the triangulation should be started from Sajuba Hill (Sita h. s. height 11,649 ft.) east of the Mahu Pass and a lower hill called Breliangun (9,809 ft.) west of the pass. A few Mishmis having turned up on the 28th October Shaikh Muhammad Salik started clearing the road to the Mahu Pass but it was not until November 6th that sufficient Mishmis arrived to take on Lieut. Morshead who started observing from Breliangun h. s. on the 10th and from Sita h. s. on the 13th. Bad weather had now commenced, and on the 19th snowstorms necessitated a retirement from the bivouac at 10,250 ft. below Sita h. s., causing the death of one Mishmi by being frozen and the abandonment of further observations. This was a very unfortunate beginning for the triangulation and was brought about entirely through the Mishmis not coming into Nizamghat when ordered on the 25th October. On the death of the man at Sita h. s. every Mishmi bolted and left Lieut. Morshead and party to get back to Nizamghat as best they could; this was accomplished after much difficulty by short marches and continually returning for kit left behind at each stage. The result of the observations from these two stations was of great interest as not only were many points fixed on the northern watershed of the Dibāng Basin but also Pemakoi Mountain and some new peaks on the same range; and we now had a rough idea as to how far the Dibāng Basin extended northwards.

At the beginning of November a company of Sappers and Miners and Pioneers arrived in Sadiyā and at once went off to Nizamghat to cut a road over the Maya Cliff, an obstacle which blocked the approach up the Dibāng Gorge some 4 miles north of Nizamghat. After making 10 miles of mule road and bridging the Ahun and Ahsun Rivers the Sappers and Pioneers were sent up the Luhit Valley. On the 20th the first batch of coolies, 50 in number, arrived in Sadiyā, but it was not until the first week of December that the coolie transport was complete and the whole force consisting of Major C. Bliss, Commanding Escort, Capt. G. A. Nevill, Political Officer, Capt. F. M. Bailey, Intelligence Officer, Capt. Kennedy, Medical Officer, 4 British Officers, 350 Military Police and about 1,100 coolies assembled at Nizamghat. On November 28th, after completing and handing over to the Political Officer the 6-in. plan survey of Sadiyā, I left Sadiyā with Surveyor Sheo Lal for Nizamghat, moving with bullock-cart transport. On December 2nd, Lieut. Morshead left Nizamghat for Ede h. s. (6,340 ft.), on the west bank of the Dibāng, and after completing his observations returned to Nizamghat on the 8th.

On December 4th Mr. Abdul Hakk accompanied the Sesseri Column which left Nizamghat for the survey of the Sesseri Valley under Capt. F. M. Bailey, Political Department. About 100 Abor coolies came to Nizamghat to carry the rations of the party as far as Angatsi Village, and this was a great help as it enabled the party to advance by full marches for three days. On the 5th the camp on the Sesseri, east of Dibāng, was reached; on the 6th camp was pitched on an island in the middle of the river bed just above the junction of the Egadi stream, the next day Angatsi was reached after marching along the right bank of the river and crossing over a couple of miles south of Angatsi; beyond Angatsi the meeting daily convoy was established and the Abor coolies returned to their homes. On the 9th Ihili was reached. On the 10th the march was continued up the Siku River, the last fixing up the Siku being made on the 12th in some fields belonging to the Damro Abors, at a height of 3,840 ft. From here a track leads over the Baisha Pass to Damro which can be reached in one march. Returning on the 13th Ihili was reached and on the 14th the party marched up the Sesseri to Ewalin, reaching Ardai Village on the 15th; here a halt of one day was made to enable Mr. Abdul Hakk to climb a hill 8,643 ft. and sketch in the head-waters. From Ardai Village two tracks lead over the Sesseri-Ahui watershed into the Ahui Valley at an elevation of 9,480 ft. and 8,200 ft. and Capt. Bailey was anxious to continue the advance over one of these passes into the Ahui, but as it was rumoured that the Ahui Mishmis were not friendly and as they had never been visited before, the force at Capt. Bailey's disposal at the head of his line was deemed not sufficiently strong, especially as the main column could not possibly reach the Ahui River in time to act as a containing force and cover his advance down that valley. On the 19th December therefore the party commenced the retirement, reaching Angatsi on the 19th. On the 20th Capt. Bailey followed the main valley route *viâ* Dambuk to Nizamghat while Mr. Abdul Hakk followed the high level track to Katopu reaching there on the 20th; here he remained one day owing to bad weather in order to complete his work, and on the 22nd returned to Nizamghat *viâ* Simi Village, thus bringing to a close a very successful little expedition. The Mishmis up the Sesseri were very friendly and anxious to help in every way; they appeared to be quite overawed by the Abors of Dambuk and could do nothing without their permission.

Shaikh Muhammad Salik who had already cut in points on distant ranges on my board from Sita h. s., Breliangun h. s., and Ede h. s. left Nizamghat on December 4th and resurveyed the main Dibāng Valley as far as Kronli Village. On December 9th Lieut. Morshead accompanied by Capt. Nicolay with an escort proceeded up the Dibāng River and crossing it at Kronli on the 12th climbed to Arundi h. s. (6,283 ft.) completing his observations by the 16th.

On December 17th I left Nizamghat with Surveyor Sheo Lal

and marched up the Dibāng taking over my board from Shaikh Muhammad Salik at Kronli on the 21st and started plane-tabling up the main valley. By December 27th the whole detachment was at Imbolin Village ready to carry on work ahead. We had now got to the furthest point reached by the party that explored this valley last year and there was much speculation as to what the country was like on ahead, whether Mishmis would be friendly, etc., as no European had as yet seen the country north of the Ichi River and the Mishmis south of this river professed absolute ignorance of what there was north of it. In the meanwhile the supply of rations had completely broken down and it was decided that no forward movement of the main column could be undertaken for some time to come. Major Bliss, commanding the force, however, was able to arrange for the feeding of small advanced parties, if they moved slowly, so as to enable the triangulation to be carried on without interruption. All coolies except those necessary for Capt. Morshead and a few to enable my own party with two other British officers and some 30 sepoy to advance, were sent back with Mr. Abdul Hakk and the two surveyors to Nizamghat. By using Mishmi labour it was found possible to advance with this small party.

Capt. Nevill, Political Officer, with Capt. Nicolay and some 30 sepoy, crossed the Ichi River on December 30th and established an advance post at Angolin Village. After completing his observations at Ehundi Hills (7,364 ft.) just above Imbolin, Capt. Morshead moved forward on the 3rd January and reached his 9,000-ft. camp on Achi Hill on the 7th; seven days were spent clearing the station. On the 5th January I managed to collect some Mishmi coolies and by their help and by using the small meeting convoy which had been established, I left Imbolin and reached Angolin on the 7th. On the 10th I moved up Achi Hill and with Capt. Morshead got a good view of the Matun, Dri and Tangon Valleys on ahead of us.

The days spent on Achi Hill were full of interest as we were fixing on the map of the world rivers, peaks and valleys which had not been seen or even heard of by Europeans; the views too were very fine and impressed on us the utter wildness of the country. Returning to Angolin on the 14th, I joined the advanced party with Capt. Nicolay, and by the help of Mishmi coolies reached Etalin Village, at the junction of the Dri and Tangon Rivers, on the 17th. Capt. Morshead completed his observations at both the Achi stations (10,433 ft. and 9,560 ft.) by the 18th and joined us at Etalin on the 20th of January. In order to allow of rations being collected at Etalin, it was necessary for the advanced party to make a halt here of a fortnight. Capt. Morshead was seedy and required a rest and also had a week's computation work to do, so I took his coolies and started up the Tangon River on the 21st. The wet weather had now commenced in earnest and from this time onwards there were very few days on which one could set up the plane-table without

having to protect it by means of a waterproof sheet stretched tent-wise on poles. I went three marches up the Tangon and returned to Etalin on the 26th. All the Mishmis up this river appeared very friendly and anxious to please, but the curiosity of some of the ladies anxious to get their first view of a European was rather trying, especially when one was struggling to bathe and dress in a 30-lb. tent. On January 30th, Major Bliss and the other officers having arrived at Etalin, a conference was held to settle the future programme. The conclusions come to were:—

“Continue the main advance up the Dri Valley as far as the Matun confluence and thence follow the Matun Valley; the main column under Major Bliss to complete this valley and its tributaries whilst another column under Capt. Nicolay was to go up the Emra Valley. It was found that there were not enough coolies to maintain more than two survey parties and a triangulation party working simultaneously. I was to continue the plane-tabling up the Dri and Matun whilst Mr. Abdul Hakk accompanied the Emra column; Surveyor Sheo Lal to accompany me in case it might be found possible to survey some side valleys during the advance, while Shaikh Muhammad Salik remained at Nizamghat until it would be possible to free coolies from the main line and enable another side valley to be explored.”

During January a regular meeting system of convoys had been arranged from Nizamghat onward and rations were now being rapidly collected at Etalin for the main advance and at Angolin for the Emra party. On February 1st Capt. Morshead left Etalin for Iliyi Hills (9,928 ft.) and completing observations on the 5th went by a short cut to Yuron Village on the 6th.

On the 5th I accompanied the advanced party of the main column up the Dri; the going was slow as the road was very bad, progress being only some 5 or 6 miles a day, and we arrived at Yuron on the 9th, having established a meeting convoy system with Etalin. On the 11th Capt. Morshead left Yuron for Tondondi Hills (9,627 ft.) and on the 14th I accompanied the advanced party to Ilupu Village near the junction of the Dri and Matun; on the 15th the Emra party having collected sufficient supplies started up the Emra Valley crossing the Dri River by a Mishmi suspension bridge at Aprunyi Village. At Ilupu it was necessary to halt a week to enable supplies to come up and also to await the main body of the escort which had now been ordered up from Nizamghat. As no information about the country up the Dri could be obtained except that there were Tibetan villages there, peopled by Pohs, who were very fierce and went for every one on sight with a drawn sword, the Officer Commanding the Force did not consider it safe to proceed without a large escort; during the halt I moved about with a small escort and managed to survey a large tract of country and cut in many useful points on ahead. The country here was mostly cleared of jungle

up to 7,000 ft. elevation along main spurs which greatly simplified plane-tableing. On Tondondi Hills Capt. Morshead had a bad time as it snowed almost continuously, but one fine day enabled him to complete a large portion of the observations he wished to take and so, as the main advance had commenced, he thought it best not to waste any more time on this hill, and so left it on the 26th February, following up the main column which he joined at Mipi Post on the 1st of March.

On February 19th the main body of the escort arrived, and an advance was commenced on the 20th and continued by short marches up the Matun Valley; I joined the main column on the 23rd and moved with it. On the 26th we reached the Imu Stream and from a high spur obtained a view of the Tibetan village of Mipi, a very small insignificant hamlet, it appeared, and so it was arranged to cross the Matun next day and visit the village. The main column crossed the Matun on the 27th by means of a temporary footbridge (made by the Mishmis who had accompanied us) and on the 28th Mipi Village was reconnoitred and found to contain only harmless Kambars and not the fierce Pohs that the Mishmis had given us to understand were there; on March 1st a post was established at the junction of the Matun and Andra Rivers, just beyond Mipi Village. Here a week's halt was necessary to collect rations for a further advance; a few fine days here enabled me to do a lot of plane-tableing from several high fixings, and Capt. Morshead cleared and observed from a station in the vicinity, but unfortunately the weather did not allow him to see any new snow peaks, nor could he get a view of the main range to the north up the Adzon River nor up the Andra. During the halt at Mipi Capt. Bailey, who is a good Tibetan scholar, managed to extract a good deal of useful information from the Tibetans about the Tsan-po and country north of the Andra and Adzon watershed, and it was here that the plan took shape of his crossing over into the Chimdru Valley with Capt. Morshead to unravel the mystery of the "falls" and course of the Tsan-po between Chamkar and Rinchengpung. It was interesting to discover that the name Pemakoi (Tibetan for promised land) which has been entered haphazard over different areas of the old maps of this part of the world, really refers to this valley of the Matun. Seven years ago some thousand Tibetans from Chimdru, on the strength of a prophecy that this was their promised land, came over the Andra and Yonggyap Passes into Mipi and turned out the few Mishmis whom they found in the Matun Valley. It did not take them long however to discover that this was not the land flowing with milk and honey that they expected and that the country could not maintain them. They had already left many dead along both the Andra and Yonggyap routes. Apparently all who could soon made up their minds to quit and return to Tibet, which they did by way of the Yonggyap, Dri and Jairu Passes, leaving many



hundred dead along the various routes. A small party of 80 souls who were either too old or too feeble to travel, remained behind and with them a few able-bodied men; these now form the community of 60 who live in Mipi. The weather now was quite hopeless and the snow line had descended to 6,000 ft. so that further triangulation was abandoned; fortunately I had managed, during the advance up the Matun, to fix a few points up the Andra Valley, sufficient to enable plane-tabling to be continued up that river. A conference was now held and it was settled that as the Tibetans were found to be such a small community and so friendly it was deemed safe to diminish the escort with the main column and so enable a party to proceed up the Tangon Valley earlier than was expected. News from the Emra party had also reached us that they would be back at Etalin by the middle of March, it was therefore arranged that this same party should on completing the Emra work proceed up the Tangon Valley; in the meanwhile rations were to be collected at Etalin for this trip. The main column was to split up into two parties, one to go up the Andra and one up the Adzon and continue roadmaking simultaneously. The points of importance to be fixed in this neighbourhood were the Andra and Yonggyap Passes and the survey of the Andra, Yonggyap and Adzon Rivers; Surveyor Shaikh Muhammad Salik was therefore called up to help me, and Surveyor Sheo Lal was to go down the line to Etalin and undertake the survey of the Tangon Valley, while Mr. Abdul Hakk with a 3-in. theodolite would accompany the Tangon party and extend the triangulation in that direction.

On the 5th March Capt. Hensley started up the Andra Valley with his party roadmaking and a few days later the Adzon (Matun) party left Mipi roadmaking and laying out posts up the Adzon Valley. On the 7th I proceeded up the Andra plane-tabling and was followed a few days later by Capt. Morshead and Capt. Bailey, as soon as the former had done all he could from Mipi h. s. (7,056 ft.). The advance up the Andra was very slow and difficult owing to incessant rain and snow and bad ground, only 3 or 4 miles a day being the progress made. On the 10th we got as far as it was possible for the Nāgā coolies to go and were snowed up in this camp at 7,000 ft. altitude for five days. The last fixing up this valley was made at an elevation of about 9,000 ft. at a distance of about 130 miles from Nizamghat. It was intended that Capts. Bailey and Morshead should make a dash for the Andra Pass from the last post and fix it by means of a time and compass traverse, but the snowfall was so heavy that it was impossible for them to move. On the 16th the return journey was commenced in snow and sleet. Capt. Bailey, however, instead of returning, moved up the Andra a few miles and found shelter in a cave where he remained several days waiting for the snow to stop; he eventually managed to get in another few miles of the track to the Andra Pass and this proved most useful as it

dispelled all doubt as to which valley the path actually followed. This trip up the Andra was the most mournful of the whole expedition, for, in addition to the disgusting weather conditions, we were continually coming across the remnants of the cooking pots, clothes and dried bones of the Tibetans who had died in this valley from exhaustion and starvation on their way from Chimdru to Mipi. On the 19th March we found that the road up the Adzon had been made for some 20 miles and that all was ready for our immediate move up there.

Surveyor Shaikh Muhammad Salik was ready here, and on the 21st March the party under Major Bliss proceeded up the Adzon while Capt. Hensley went down the line to the Dri-Matun junction to make arrangements for the rations and escort necessary for the trip up the Dri River.

Owing to the excellent road made by Lieut. Lane the marching up the Adzon was very easy and a great relief after the Andra experience. Shaikh Muhammad Salik went up the Yonggyap Valley to try and locate the Yonggyap Pass, but in this he failed as he was driven back, after reaching an altitude of 8,000 ft., by heavy snow. Capt. Morshead accompanied me with the idea of running a theodolite traverse up the narrow gorge of the Adzon; fixings were not to be expected as it was absolutely impossible to climb any of the hills on either side. The dense jungle however made such a traverse quite out of the question and so I had to have recourse to a range-finder traverse instead. Capt. Morshead returned to Mipi on the 27th on his way to Agidzu h. s. (10,426 ft.) with a view to fixing more points up the Dri Valley. By the 29th of March I had continued traversing as far as the deep snow and precipitous nature of the river bed would allow me to go, and after making a last fixing at 8,850 ft. in the stream at a distance of 141 miles from Nizamghat started the return journey. Luckily when at the lake on the way back we had a fine day, all the snow peaks showed up and enabled me to cut in a lot of important details. On March 29th Shaikh Muhammad Salik returned to Mipi on his way to the Elon Valley to put in a portion of the Mipi-Emra Road not seen by me. On the 2nd April the whole party had returned to Mipi and on the 4th the retirement commenced.

It is now convenient to turn to the Emra party and their fortunes. Leaving Aprunyi on the 16th February the party under Capt. Nicolay moved slowly up the valley by short marches, cutting their way through the jungle along the Mishmi path and roadmaking as they went. They reached as far as one march beyond Asonli, the furthest village up the valley and returned to Etalin post on the 18th March. Continuous rain and snow made progress very difficult and Mr. Abdul Hakk was able to survey only the actual valley itself as far as he had gone; the sketching in of the snow ranges at its head was impossible owing to continuous bad weather. On account

of continuous rain survey work was impossible until the 18th, so that Capt. Nicolay was able to get ahead of Mr. Abdul Hakk and establish two posts. On the 20th of February Mr. Abdul Hakk after completing the work in the valley as far as Aihini climbed to 6,500 ft. to try and cut in the distant main ranges; he then continued plane-tabling under very unfavourable weather conditions until the 28th, catching up the roadmaking party on the 21st. On February 28th a 9,000-ft. hill was ascended and a view of the watershed west of the Emra was obtained. The last fixing up this valley in the river bed was at 4,459 ft. at the Eken River on the 4th of March at a distance of about 100 miles from Nizamghat. The snow line now descended to 5,000 ft. and it was snowing so continuously that it was decided to abandon any further advance up the valley and, if necessary, sketch in the head-waters of the Emra from the high range at Deshindi h. s. and Ayandi Peak after the snow had diminished in May.

The Mishmis up this valley proved to be friendly but all the usual military precautions had to be taken throughout. The village of Ahalin was formerly in the Matun Valley, but the Tibetans on their arrival at Mipi some seven years previously drove them out. The inhabitants of the Emra Valley appear to be the only Mishmis who have established trading relations with the Mipi Tibetans. They had no communication with the Dihāng people over the pass at the head of their valley, the last attempt made by them in this direction resulting in the annihilation of the whole party except one man.

On March 21st a party under Capt. Nicolay with Capt. Nevill, Political Officer, left Etalin Post to explore the Tangon River. Mr. Abdul Hakk and Surveyor Sheo Lal accompanied it, the former to extend the triangulation and give points to the latter to carry on plane-tabling as far up the valley as possible, both up the Tangon and Edza Rivers. The important points to be fixed were the Kaya Pass, the main watershed of the two rivers, and to ascertain whether the Trem River, the head-waters of which were seen by Mr. Abdul Hakk last year, flowed into the Edza River or eastwards into the Rong Thod Chu. On the 23rd March, Mr. Abdul Hakk went up Anoya h. s. (6,240-ft.) completing his observations on the 24th, and Surveyor Sheo Lal started plane-tabling. On the 26th March they started the climb to Ahongon h. s. (8,006 ft.) completing observations on the 28th. On the 1st April both men went up Apongong h. s. (8,625 ft.) and finished observations on the following day. On the 4th Chiyangon h. s. (10,284 ft.) was cleared and observations completed on the 5th; the camp was pitched at 10,000-ft. altitude in rhododendron and bamboo jungle, and melted snow was the only water available; two nights were spent in this camp. Continuing plane-tabling up the valley both officers worked together and visited all stations at the same time so that the theodolite observations could be utilized at once by the plane-tabler. On April 9th Ekingon h. s.

(11,532 ft.) was visited and observations completed; the camp on this hill where two nights were spent was at 10,500 ft. and water was obtained by melting snow in cooking pots. The pine and spruce forest reached as far as 8,500 ft., and above this to the very tops of the ranges bamboo and rhododendron were met with. On the 16th Marungon h. s. (9,926 ft.) was reached, the observations being completed in one day. The 19th April found them on Atuniyangon h.s. (11,354 ft.) where observations were again completed in one day; this was the furthest station up the Tangon River, the snow line all this time being at about 9,000-ft. altitude; the camp on this hill was at 10,000 ft. in spruce and rhododendron forest and again the only water available was from melted snow. In spite of all the climbing done no view had yet been obtained of the main watershed nor had the end of the valley been seen. The weather all this time was very bad and continued rain and mist made survey operations almost impossible. On account of the bad weather Mr. Abdul Hakk decided to turn back and complete the Edza Valley, with the idea of returning to the Tangon in May when there would be more chance of getting fine weather and the snow line would have receded, making the ascent of higher peaks possible. On the 20th April the last fixing up the Tangon was made at 9,000 ft. in river bed at a distance of about 130 miles from Nizamghat; here the party was turned back by heavy snow and the return journey commenced on the 21st. On April 27th Tangon Hill was ascended and observations taken at the lower station (9,482 ft.). On the 29th the upper station (12,913 ft.) was visited and observations completed on the 30th; the camp here was maintained at 12,500 ft. in thick spruce and small bamboo forest, this forest continuing right up to the top of the peak where large trees were found; the only water available was from melted snow and altogether four nights were spent in this camp. From this hill a good view of the Edza main watershed and headwaters was obtained and also the whole of the Ithun-Edza Divide was seen; the Makhri and Ipi headwaters were also seen from this station, but it was very disappointing to find that no view could be got of the Tangon headwaters or of the Kaya Pass. Leaving here on the 1st May, Kado, the last post up the Edza, was reached on the 2nd at an altitude of 7,800 ft. On the 3rd the climb up Kelingon h. s. (13,773 ft.) was commenced and camp was pitched at 10,200 ft., on the 4th camp was moved up to 12,500 ft. and from here work was carried on. From this station the main watershed of the Tangon was visible and one ray was also obtained to the Kaya Pass. Wishing to get another ray to the Kaya Pass and a still better view of the main ranges it was determined to climb another higher hill to the north. On the 8th this higher peak was climbed and proved to be 15,073 ft. Unfortunately Sheo Lal had a bad fall on the summit of this peak and dislocated his thumb, he was obliged therefore to return to the 12,500-ft. camp. Mr. Abdul Hakk nothing daunted

pitched his camp on a convenient piece of ground just 100 ft. below the summit and remained there one night. In spite of the exposed situation in deep snow and the intense cold the Ghurka coolies were prevailed upon, mostly through Mr. Abdul Hakk's good example, to remain at that high altitude and enable the necessary observations to be made. Mr. Abdul Hakk had taken over Sheo Lal's plane-table and cut in the main range at the head of the Tangon and confirmed the position of the Kaya Pass. Unfortunately the peaks to which rays had been taken from Kelington h. s. (13,773 ft.) were never seen from the 15,073-ft. station owing to clouds which most annoyingly clung to them. On the second day so many coolies and khalasis were suffering from snow-blindness and frostbite that it was found absolutely necessary to go down the hill as fast as possible to have the sick men attended to. There was no water or wood at the top camp, the snow was melted and wood had to be brought up from the 12,500-ft. camp both for cooking purposes and for building shelters. Most unfortunately, owing to the main bridge over the Ithun River having been washed away, all men were on short rations and this exposure to cold and damp at such high elevations must have been most trying, and the greatest credit is due to Mr. Abdul Hakk and the surveyor for their courage and determination to complete their work in spite of the greatest hardships. On returning to Kado Camp on the 11th May the whole party commenced the retirement to Nizamghat, a distance of 110 miles, where they arrived on the 23rd May. Here a halt of six days was necessitated by a lack of transport. On the 29th they started for Sadiyā where they arrived on the 31st May.

We now return to the main column which had left Mipi on the 4th April and was retiring down the Matun. On the 7th I left the column at Maron Camp and cut across the downs to Akolin Village on the left bank of the Dri where Capt. Hensley had collected his force and rations ready for the exploration of the Dri River, which was crossed by a Mishmi cane suspension bridge. The rest of the column retired to Angolin Post and here under Major Bliss made arrangements for the exploration of the Ahui River. On the 9th April the Dri party under Capt. Hensley commenced the march up this valley. Surveyor Shaikh Muhammad Salik accompanied us as far as the Ange River where he left us on the 10th April for the survey of its valley and tributaries. He had with him a small escort of 3 sepoy and 18 coolies and managed to penetrate two marches up the gorge of this very wild and precipitous valley; continual bad weather hampered plane-tabling and it was not until the 21st April that he completed his work, comprising 200 square miles of precipitous mountain sides and snow ranges, and started down the line to Etalin Post with a view to joining the Ahui party.

We continued our march up the Dri Valley, crossing the Ange River by a Mishmi suspension bridge, and by moving half marches established a meeting convoy system as we advanced, large enough

to carry one day's supplies for the whole party. On April 11th we passed Dembuen, the last village up this valley, and from here managed to obtain a couple of Mishmi guides to show us the way to the Aguia Pass reported to be at the head of the valley. The important work to be accomplished was the fixing of this Aguia Pass and the main watershed at the head of the Dri and its tributaries. Up to Dembuen the marching had been quite easy along flat ground close to the river bank, but from here onwards the jungle became very thick and necessitated much labour in clearing even a 2-ft. track. The valley contracted to a gorge with a few hundred yards of flat ground on each side of the river flanked by precipices rising straight up to a height of 2,000 ft. to 4,000 ft. At the commencement of the march on the 11th I made my last reliable fixing (by resection from triangulated points) close to the village of Acheshon at a height of about 5,500 ft., and from here onwards the survey of the valley was carried on by means of a range-finder plane-table traverse, checked at intervals by resection from previously fixed points. The gorge for 40 miles was so restricted and shut in by precipices on both sides that it was found impossible to climb out of the valley anywhere until the river bed had attained an altitude of nearly 10,000 ft. ; the several side streams flowing into the main gorge were a very fine sight as they were in full flood and leapt the 3,000-ft. wall of rock in three or four magnificent cascades, falling on to the narrow flats on the river bank with a tremendous noise. The last camp up the valley at the junction of the Jairu Stream, nearly 8,000-ft. altitude, was reached on 19th April in pouring rain ; the weather throughout had been hopeless, continuous rain day after day, but luckily it cleared on the 21st and so I followed up the river bed for about 4 miles and made a last fixing at a height of just under 10,000 ft. near the river bank, on the snout of a snow avalanche and at a distance of 142 miles from Nizamghat. In a distance of 1½ miles the river had risen from 7,500 ft. to 9,500 ft. in a series of cascades and falls. A very fine view was obtained of the Aguia Pass and head-waters of the Dri, and as deep soft snow made further progress impossible, after sketching as much as was visible, I returned to camp. The next day the rain came down again and it was decided to retire from this inhospitable spot and leave it free for the " Takin " to wander about in at their leisure. The Mishmi guide informed us that there was a track leading to Chimdru up the Jairu Stream, but we found no signs of it. On the track up the Dri just opposite the junction of the Jairu we found a palisade of pine logs with loopholes carefully cut ; the Mishmi told us that this was constructed a few years back to protect Mishmis, going along the Aguia Pass track, from the attacks of Tibetans who used to frequent the Jairu Valley. Capt. Morshead who had reached Agidzu h. s. (10,425 ft.) on the 15th April took five days to clear the hilltop, being continually interrupted

by snowstorms. The view from this station was very disappointing as none of the peaks at the head of the Dri, which he was specially anxious to fix, were visible. He left Agidzu on the 12th and marched to Acolin Post, meeting us at a camp beyond Dembuen Village on the 15th. Here we arranged that the best thing for him to do was to return to Yuron Post and from there take rations, etc., for a prolonged stay on the range where he made the stations of Deshindi and Karundi; this we thought would be favourably situated for a view not only up the Emra Valley but also to the head-waters of the Andra, Adzon and Dri Rivers. We also settled that after completing observations at Deshindi h. s. he would proceed to Mipi where Capt. Bailey would be waiting for him prior to their starting for their exploration into Tibet over the Andra or Yonggyap Pass and ultimate visit to the Tsan-po Falls and return to Sudia *via* Tawang. On the 18th he camped with Capt. Bailey on the right bank of the Dri at Epalin Village, having crossed by a Mishmi suspension bridge, and on the 21st camped at 8,400 ft. close to the hill where he was going to make Karundi h. s., while Capt. Bailey marched up the Matun Valley to Mipi Village. On the 22nd April he cleared Karundi h. s. (11,267 ft.) and on the 23rd cleared and erected a pole on Deshindi h. s. (12,027 ft.). Continual and heavy snowstorms interfered with work and it was not until the 7th May that he managed to take a round of angles from Karundi h. s. In the meanwhile I had come down the line with Capt. Hensley's party to Yuron Post which we reached on the 27th April. Here Capt. Hensley halted in order to make arrangements for the supply of rations up at our Karundi hill camp. On the 28th I crossed the Dri by the Epalin Bridge and reached Capt. Morshead's 9,000-ft. camp on the 29th and did some work from Karundi h. s. Both Deshindi and Karundi were clear hilltops of pure snow some 12 ft. deep and it was impossible to camp higher than 9,000 ft. owing to the continuous snowstorms and violent wind. Heavy rain and snow kept us imprisoned in our tents for six days when it cleared a little on the 6th enabling me to do some useful work in the lower portions of the Emra Valley not visited or seen by Mr. Abdul Hakk. On the 7th snowpeaks were visible up to 7 a.m. and a few theodolite observations were taken from Karundi. The 8th was a fine clear morning and we went up Deshindi h. s., but clouds hid all snow peaks by 8 a.m. and as it was a 3,000-ft. climb over snow the whole way, there was not much time for observations as one could not start before daylight. On the way up we had a fine view of Pemakoi and neighbouring peaks, but by the time we reached the station the whole Pemakoi Range was hidden in cloud. We had very bad luck in that the peaks that were visible from Karundi were just the ones that were in cloud when we visited Deshindi and *vice versa*, and in consequence we failed to fix the few magnificent snow peaks of which

we had glimpses at the head of the Dri Valley. On the 28th April I received urgent appeals from Major Bliss to close down work and return to Sadiyā owing to the hopelessness of the weather and shortage of rations, and again on the 5th May a letter from him reached me reporting that the Ithun Bridge had been carried away by floods, that all persons were to be put on short rations, and that he could not send up any more rations until the Mishmis had constructed one of their suspension bridges across the Ithun. This I knew to be probably a long job and as we had rations sufficient to carry us on to the 16th May only, that must be the date on which we must reach Echindon where more rations could be obtained. We agreed therefore that the 10th May was the very latest date for us to remain at this camp as Echindon was six marches away. The 9th and 10th were cloudy and occupied in doing triangulation computations, and by combining my plane-table rays with several theodolite single rays we managed to fix a few more distant peaks on the main ranges. The 11th was a fine morning and I went up Karundi Hill and completed as far as was possible the survey of the main watershed north of the Andra and Adzon Rivers and as much as was visible of the head-waters of the Emra. By 10 a.m. three of Capt. Bailey's coolies reached us from Mipi and with the help of three more of our coolies (it had taken several days of persuasion and promises of "bakshish" to induce these men to consent to go) Capt. Morshead equipped with a 3-in. theodolite and small plane-table left Karundi for Mipi on his adventurous journey to unfold the secrets of the Tsan-pogorges. It was his intention to carry on triangulation as he went and keep up a plane-table survey on the 8-mile scale. On the 12th I marched down to Yurou Post and with Capt. Hensley reached Echindon Post on the 17th May. Leaving him there to join the proposed one-day raid up the Ithun Valley, I continued the march down to Sadiyā where I arrived on the 22nd May. The march back from Mipi to the Ahsun River, one march short of Nizamghat, was a revelation in showing what can be done in the way of roadmaking by a few sepoy and coolies under the guidance of efficient and keen British officers. With the aid of only a very few iron picks and shovels, with kukries, daos and picks made of hard wood, an excellent 2-ft. coolie track, with a good gradient and good surface, had been constructed for 90 miles, down into deep gorges and then climbing over high spurs, which often necessitated twice in one march an ascent and descent of 3,000 ft. through dense jungle. The track ran along the precipitous rocky hillsides with galleries crossing the vertical face of a cliff and ladders up slippery rock faces 20 or 30 ft. in height; so that instead of crawling along hanging on by one's hands to roots of trees, as was often necessary when advancing up the valley in December and January at a rate of 4 and 5 miles a day, now in May we returned jauntily by marches of 10 to 12 miles



in length along a comparatively easy road which would be no disgrace to a civilized hill station. It was undoubtedly due to this good road that the supply of rations and communications was kept up intact for so many months without interruption in spite of the continuous heavy rain which was experienced from February to May.

We may now turn to the operations of the Ahui River Party. Owing to the rise in the Dibāng River it was found that the only means of crossing it was by a Mishmi suspension bridge ; the nearest footbridge to the Ahui River of this description over the Dibāng is the one opposite Aprunyi Village. It was therefore decided to cross by this bridge and going one march up the Emra Valley strike across the Ahui-Emra Watershed from Aihini Village and enter the Ahui Valley, returning by the same route. On the 24th April, the party under Major Bliss with Capt. Nevill, Political Officer, left Etalin and crossing the Dibāng at Aprunyi marched up the Emra to Epini Post and crossing the Emra at Aihini climbed the watershed and crossed it at 7,000-ft. elevation, establishing a post at Dupo Village in the Bhui Valley on the 1st May. Surveyor Shaikh Muhammad Salik, who had reached Etalin on the 25th April after the Ange River had been completed, left again on the 26th and joined the party on the 29th at Etalin Village in the Ahui Valley. On the 29th news had reached Major Bliss that the bridge over the Ithun River had been washed away by high floods and that rations could not be got across ; he therefore with the Political Officer left at once for the scene of the disaster and handed over the charge of the party to Lieut. Lane. The advance up the valley was continued by half marches, at the same time establishing a meeting convoy system capable of carrying a day's rations for the whole party ; the surveyor kept up with the party the whole way as far as Chepwe, the furthest post up the valley, which was reached on the 8th May ; here he left the main party and with an escort of five sepoy continued planctabling up the valley for two marches and getting several fixings on a long spur from 8,700 ft. up to 10,980 ft. elevation, the headwaters, main watershed, and Abroka Pass were successfully cut in ; his highest fixing in the river bed was at about 6,500 ft. at a distance of nearly 120 miles from Nizamghat. Returning to Chepwe on the 13th the whole party retired on the 14th and reached Aokan. From Aokan Lieut. Lane with the surveyor and a small escort climbed to Chunmunli Hill (12,243 ft.) reaching the top on the 14th after a long day's march. Unfortunately continuous rain and snow prevailed the whole time they were up this hill from the 15th to 18th and they were unable to get even a glimpse of the Emra headwaters and main watershed which they had gone up to see. On the 18th Lieut. Lane received a letter from me in which I told him that I had managed to sketch in the main watershed at the head of the Emra and

so on the 19th they left the hilltop and returned to Dupo. The camp was pitched at a height of about 12,000 ft. near the summit of the hill; a thin small bamboo, sticking out through the snow, was the only jungle growth at the camp site, wood was brought up from a spot about 500 ft. lower down where there was rhododendron and oak forest, water was obtained by melting snow.

Leaving Aokan on the 20th the party reached Etalin on the 23rd and marching straight through reached Sadiyā on June 1st. Several large villages of 60 and 80 houses were found up this valley and the Mishmis proved very friendly. The road up the Ahui as far as the village of Chepwe was found to be rather easier than most of the Mishmi paths, but from here onwards the track over the Abroka is difficult and very rocky. There are four different passes from the Ahui to the Emra Valley, two passes to the Sesseri Valley at 8,200 ft. and 9,478 ft. elevation and one pass into the Inlu Valley height 7,500 ft. The inhabitants of the Ahui Valley seldom communicate with villages on the east bank of the Dibāng due probably to the fact that there is no means of crossing the Dibāng direct from the valley except by means of a single strand rope bridge near the village of Engapo.

The full survey detachment having now arrived in Sadiyā, the equipment and instruments were packed up and sent to Calcutta, ordnance stores returned to Allahābād Arsenal, and all menials paid off by the 3rd June. On June 4th the whole detachment left Sadiyā and crossed the river Brahmaputra in the launch *Rover* and on the 5th entrained at Saikhoa Ghat for their various destinations. The superior establishment was attached to the office of the Superintendent, Eastern Circle, and arrived in Shillong on the 6th and 7th June where the mapping of the field work was to be undertaken.

*Work Done.*—The whole programme as laid down by the Government of India was completed, and the work done may be recapitulated in a concise form as follows :—

- (a). The course of the Dibāng River has been traced to the source of each of the five large rivers which constitute the main Dibāng. The Nagong Chu is not one of its tributaries but flows in a north-westerly direction from Shuiden Gom-pa and according to Tibetan information, obtained at Mipi Village, joins the Tsan-po (Dihāng) some 11 or 12 marches north of Rinchengpung.
- (b). The whole basin of the Dibāng, except the Ithun Valley, has been surveyed and the main watersheds from which all the rivers in the Dibāng emanate have been fixed; these watersheds are some 280 miles in length, of this 190 miles have been rigorously surveyed and 90 miles sketched in accurately enough for geographical purposes. The watershed forming the exterior boundary of the Mishmi

country has therefore been completely surveyed, connecting with the Abor survey on the west and the North Burma Survey on the east : this again also completes the programme of work as laid down by the Surveyor-General to be carried out by the Mishmi Mission Survey in 1911-12.

The areas completed by the party are :—

Detail survey $\frac{1}{4}$ -in. scale	..	..	..	3,523 sq. miles.
Reconnaissance survey $\frac{1}{4}$ -in. scale	..	..	..	945 „ „
				Total $\frac{1}{4}$ -in. scale
			..	4,468 sq. miles.
Plan survey 6-in. scale	..	..	..	$4\frac{1}{2}$ „ „

The number of heights including both clinometric and triangulated is 1,050, which gives an average of nearly one height to every 4 square miles of survey so that the contouring should be a good representation of the ground.

*Time Spent in Actual Survey Work.*—In order to give an idea of how much actual work may be expected from surveyors on such expeditions as these, I enumerate below the length of time spent on plane-tableing by each individual.

Duration of expedition from arrival in Sadiyā to departure from Sadiyā is eight months :—

Major Gunter	..	..	..	..	$4\frac{1}{2}$ months.
Mr. Abdul Hakk	..	..	..	..	$6\frac{1}{2}$ „
Surveyor Shaikh Muhammad Salik	..	..	..	..	$3\frac{1}{2}$ „
„ Sheo Lal	..	..	..	..	3 „

The chief reasons contributing to the inability of utilizing the services of surveyors continuously were :—

Supplies and transport were not ready until six weeks after the arrival of the survey party.

The necessarily slow progress of a large force entering a difficult and wild country due to roadmaking, etc.

The necessity of establishing a daily convoy system in touch with the base during the advance. The paucity of coolies, even after advanced ration bases had been established, did not allow of more than two plane-tableing parties and one triangulation party working simultaneously.

The whole of the area under survey was triangulated by Capt. Morshead, and he fixed peaks on the entire main watershed except those portions north and east of the Dri River and north of the Tangon River. This is a fine record for one observer without help of any sort from a recorder or computer, under such trying weather

conditions as prevailed throughout. Mr. Abdul Hakk supplemented the triangulation up the Tangon and Edza Valleys, but owing to bad weather failed to extend it to the main ranges. The total number of stations of observation is 25 and intersected points 180. Capt. Morshead completed the computations of almost every triangulated point within a few hours of the observations having been made and sent the results to plane-tablers long before the latter required them. As most of the computations were carried out while camped in snow and under very trying conditions it can be realized what a fine record Capt. Morshead has to show for his season's work.

When we found ourselves in the Luhit Valley last year we thought that we had found the wildest and most precipitous country in India, but we were yet to visit the Dibāng Gorges. The precipices and mountain slopes up the Luhit, after having seen the gorges of the Dri, Tangon and Adzon Rivers, pale to insignificance. The road up the Dibāng was one succession of dips down into deep gorges and ascents up over high spurs ; for instance the march from Angolin to Imbolin entailed a climb of 2,000 ft., a descent of 1,500 ft., another climb of 2,000 ft., a descent of 2,700 ft., and a third climb of 3,100 ft., *i.e.*, a total climb of 7,100 ft., and descent of 4,200 ft. ; and again the road from the Emra to the Ahui was a continuous climb of 5,000 ft., during the first march over the watershed. The only piece of country approaching flatness in the whole 4,500 square miles is the " Downs " at the junction of the Dri and Matun, 3 miles long by  $1\frac{1}{2}$  miles wide.

The greatest difficulty presented to the plane-tableer owing to the precipitous nature of the country was that of recognizing triangulated points ; ranges consisted of innumerable snow peaks close together and much alike in profile ; looking up at them from below one could never be sure whether the peak visible was the triangulated point on the main range itself or merely the near end of a spur jutting out from the main range. Up the gorges of the Adzon and Dri fixings by resection were impossible and survey up both these rivers was carried on by means of a range-finder traverse with quite satisfactory results. In Annexure A I have written a few notes on the use of the Barr and Stroud range-finder which was used. Throughout the country as a whole plane-table fixings could not be obtained without a climb of 2,000 ft. to 3,000 ft. from the valley road, but in the neighbourhood of the villages the main spurs and the southern side of mountain slopes were usually found to be cleared of jungle, so that fixings were always possible after a climb. Higher up the rivers beyond the villages dense forest was met with on all hillsides and spurs from the river bed right up to elevations of 12,000 ft. and sometimes 13,000 ft. and here of course fixings were difficult to obtain. Without doubt an interesting feature of the country in

the Dibāng Basin is the unusual steepness of the river gradients. From Nizamghat up the main valley to the junction of the Ahui River the rise is 300 ft. in 23 miles, a gradient of over 13 ft. a mile.

From the Ahui Junction to the Tangon Junction the main river rises 800 ft. in 13 miles or a grade of 61 ft. a mile. From the junction of the Tangon to the junction of the Dri and Matun Rivers the rise is 1,630 ft. in 14 miles or a grade of 116 ft. per mile.

The Tangon rises 2,850 ft. from its junction with the Dri to the Edza Junction, a distance of 24 miles, a grade of nearly 120 ft. per mile.

The Ahui rises 4,000 ft. from its junction with the Tangon in 30 miles or a grade of 133 ft. per mile.

The Adzon rises 3,000 ft. in 17 miles or a grade of over 180 ft. per mile.

The Dri from the Matun Junction to the Ange Junction rises 1,200 ft. in 12 miles, a grade of 100 ft. per mile while in its upper reaches the Dri drops 2,000 ft. in  $1\frac{1}{2}$  miles.

It is not surprising therefore that the Dibāng River rushes through the gorge at Nizamghat with such terrific force.

*The Weather.*—The weather, being a very important factor on the North-East Frontier in survey operations, should occupy a prominent place in every report. Up to January 15th it was very favourable and clear cloudless days were the rule; only periodical storms lasting two or three days were experienced but after this date the weather broke up and continuous rain, snow and mist predominated up to the very last day of the expedition. The record from 15th January to 15th May when all work was practically completed is as follows: Cloud and mist 38 days, continuous rain 62 days; clear fine days, when snow peaks were visible, only 21 days. To get only 21 days of fine weather in four months was rather a trying experience, especially to a triangulator. The patience, endurance and professional ingenuity of every member of the party were taxed to their utmost by the disgusting weather conditions and by the enclosed, precipitous and snowbound nature of the country. It would be difficult to imagine worse conditions for survey operations than prevailed throughout the season from January to May.

*Health of the Party.*—The health of the party was good throughout and the Hazāribāgh tindals and khalasis, with the exception of a few men in the triangulation squad, did very well. One khalasi suffered from frostbite in both feet, but he was recovering rapidly before he left and amputation will probably not be necessary. One of my khalasis fell down a precipice, but was fortunately caught up in a tree some 80 ft. down and on being rescued informed everyone that he was "dead."

A list of principal places of interest fixed during the season is shown in Annexure C.

## ANNEXURE A.

*Notes on the Use of the Barr and Stroud Range-Finder as a Traversing Instrument.*

The instrument used by me was of the F.T. type with direct image, obtained by the Mathematical Instrument Office from the makers at very short notice last year ; it unfortunately arrived too late to be used in the Mishmi Survey of 1911-12. The ordinary stand supplied with the instrument was not used ; the Mathematical Instrument Office constructed an adaptor by means of which the instrument was used on the stand supplied with my 3-in. theodolite ; this proved a very satisfactory arrangement. The image being magnified 14 times it was very necessary for accurate work to have a firm stand. The great advantage of the range-finder for traversing is that one can use objects on the far side of an impassable river as a forward point ; being on the far side of the river also makes the object easier to keep in sight while proceeding to the forward station. My usual procedure was to pick out an object with a straight vertical line, such as a tree trunk or edge of a white rock in a cliff, etc., about  $1\frac{1}{2}$  miles ahead, taking care that the object would also be visible from the forward station. Having ranged this, two other objects were also ranged, and entered in the traverse book, in case the first object might not be visible from the forward station—ranges to hilltops, etc., should also be taken—the plane-table being set up rays are drawn to each of these ranged objects, distances plotted and carefully marked and the necessary vertical angles taken with the clinometer. While moving forward it is easy to keep the object in sight, but after it has been passed it is usually found that the object disappears in the most annoying way and for this reason it should be high up and well above the tops of trees in the foreground. Having settled on the new station from which the back object is visible and a good view forward can be obtained, the same procedure of ranging, etc., as at the first station is followed. Observed distances of  $1\frac{1}{2}$  miles on the  $\frac{1}{4}$ -in. scale having an elevation of 10 degrees or more require a correction to obtain the correct horizontal distance. On the back of my Wahab's Height Indicator were pasted :—

- (a). A scale of feet. (b). Height correction up to distances of 147,000 feet. (c). Correction per 1,000 ft. for observed distances up to a slope of 35 degrees. In traversing up narrow gorges, such as

are met with in the Mishmi country, many of the forward rays may be at a slope of 30 degrees so that the ordinary survey clinometer should be supplemented by the small military pocket clinometer which is quite accurate enough (reads  $\frac{1}{4}$  degree) for short rays.

2. As regards instrumental adjustments, etc., I found that halving adjustment was necessary practically every time the instrument was taken out of its case, the jolting after being carried even for only a couple of miles upset this adjustment. For short ranges up to  $1\frac{1}{2}$  miles the mean of three observations is quite sufficient, but for longer ranges such as 6 or 7 miles, five or seven observations are necessary. It is best to range with the right eye only and then read the scale with both eyes open. Coincidence adjustment was necessary only once during the season after the instrument had been tested and set on the roof of the Mathematical Instrument Office, Calcutta. The various mirrors and lenses kept wonderfully clean throughout the season in spite of the intense damp and they were not touched by me once in the eight months.

Every survey party working on the North-East Frontier should have one of these instruments in case work has to be carried up long narrow gorges where the ordinary methods of plane-tabling and traversing are impossible. It is certainly the most rapid method of traversing that I have so far experienced.

## ANNEXURE B.

*Notes on Coolie Transport, etc., for the North-East Frontier.*

Experience of the last two years shows that the best coolies for the North-East Frontier hills are "Nepalese," the next best are "Gurkhas" and "Gurkhalis" and for work on lines of communication in low ground "Nāgas" are useful. "Bhotiās" are bad as they cannot negotiate the hill climbing, are too slow, and cannot cut jungle. All coolies accompanying a survey party must be fully clothed on the "winter" scale with boots, putties and socks, etc. A supply of green gauze for issue to coolies and khalasis while working in the snow should be taken to prevent snow-blindness.

It is useful to note that whereas up the Luhit Valley all Mishmis take opium in preference to money and for money they prefer 4-anna pieces to rupees; up the Dibāng Valley opium is useless and all money should be in rupees and not small coin. Up the Dibāng Mishmis are fond of "rum" and village headmen become quite communicative and pleasant after a few "tots" of it; they also prize a good large briar pipe, the larger the better, and warm cloth.



## ANNEXURE C.

The chief places of interest fixed by the Survey were :—

- (a). The main watershed of the Dibāng Basin separating it from the rivers to the west, north and east, about 280 miles in length, all of which was previously entirely unknown and consisting of snow ranges varying in height from 14,000 ft. to 19,000 ft.
- (b). The Tibetan Village of Mipi in the Matun Valley.
- (c). The following passes :—
- Baisha*.—Leading from the Sesseri River to Damro on the Yamne River—1 march. Height approximately 5,000 ft., always open.
- Abroka*.—Leading from the Ahui River to Simong on the Dihāng River—3 marches. Height approximately 12,900 ft., usually open except in February and March.
- Andra*.—Leading from Mipi Village on the Matun River to Rinchengpung, Dihāng Valley, and Chimdru—4 to 5 marches. Height approximately 12,500 ft., open from middle of April, but the rivers are not passable during the rains.
- Yonggyap*.—Leading from Mipi Village on the Matun to Chimdru in Tibet. Mipi to Chimdru is about ten marches. Cpts. Bailey and Morshead went over this pass to Chimdru. Height approximately 13,000 ft., open from end of May, but road not passable during the rains.
- Aguia*.—Leads from the Dri River to Ruipu on the Rong Thod Chu, pass to Ruipu is four marches, seldom used and is in permanent snow. Height approximately 17,000 ft., open during November only.
- Kaya*.—Leads from the Tangon River to Alupu on the Rong Thod Chu, reported one march. None of the passes except the Baisha are passable for troops or large bodies of men without many days' roadmaking, and then only in fine weather. Height approximately 15,700 ft., open in November only.
- (d). Many magnificent waterfalls and cascades up the Adzon and Dri Gorges and at Yuron Village, varying in height from the Yuron Fall, 1,500 ft. to the Detza Falls on the Dri over 3,500 ft.

## THE ORGANIZATION OF ENGINEERS.

By MAJOR J. E. E. CRASTER, R.E.

*War Duties.*—The duties of military engineers in war may be grouped under the following headings:—Fortification, both field and fortress; demolitions; sapping and mining; bridging; water supply; roads; railways; telegraph and telephones; searchlights; surveying, and, in addition, all civil engineering and building work within the area of operations for which civilian engineers are not immediately available.

*Peace Duties.*—Their peace duties include the construction and maintenance of fortifications, military buildings, military railways, telegraphs and telephones, searchlights, and surveys.

*Organization.*—For these duties in war and peace the engineers of civilized armies are organized on two rival systems. The first may be described as the "single corps" system.

*The Single Corps System.*—In this organization the whole of the above duties are allotted to a single corps, the officers and men of which are available for any, or all of the duties. This is the system that has been adopted in the British Army.

*The Multiple Corps System.*—The second is the "multiple corps" system. Under this organization the various duties are performed by corps of specialists, which are not available for other duties. This system has attained its extreme development in the German Army. There are companies of pioneers, whose duties are confined to field defences, siege work, demolitions, and bridging. A corps of engineers, composed entirely of officers, which is allotted to the various fortresses. A corps of fortress constructors, for the building of permanent fortifications; field searchlight units; railway troops, subdivided into construction, traffic, and works companies; telegraph troops, subdivided into telegraph and telephone companies. A Garrison communication staff for fortresses. A barrack construction department, a survey department, forming part of the General Staff.

All these various corps are on separate rosters for promotion, and no officer or man can be transferred from one to another against his wishes, nor can he be called upon to perform duties that do not appertain to his own particular branch.

*The Two Systems at Work in 1900.*—An excellent example of the working of the rival systems was afforded during the operations in

North China, in 1900 and 1901. The Army of one of the Continental Powers put in the field a large number of engineers, composed of pioneer companies, telegraph companies, railway construction and traffic companies. It happened that the telegraph company had more work than it could cope with at the time when the railway troops were unemployed, yet owing to the multiple corps system the telegraphists could get no help from the railwaymen. Later on the railway companies were overworked, while the pioneer companies were doing physical exercises to keep the men fit.

The engineers with the British force in North China consisted of three companies of Sappers & Miners, a telegraph section, a railway section, a balloon section, and various details from the Fortress Companies at Hong Kong.

Owing to the railway being at first in other hands, the British railway section had no railway work to do, and it was therefore delegated to other duties. The officer commanding the railway section, for instance, was employed in making a survey and reconnaissance at Peking, pending the arrival of the survey section.

It was found that one telegraph section was not enough to cope with the work, so another was raised at once from one of the companies of Sappers & Miners, two or three electrical experts being added from the Hong Kong fortress details. This telegraph section replaced all the field lines and cables, with permanent air lines. As soon as the work was finished, the section was broken up, and the men were returned to their own units.

When the railway was handed over to the British, the companies of Sappers & Miners were called in to help the railway section to reconstruct the line, and the officer commanding the balloon section, who had had much previous experience of railway work, was made Director of Railways.

In this way the whole of the work that fell to the engineers was performed without delay, and the British force was ready for any further field operations that might have been required, before its European allies had established trustworthy communications even with Peking. In short, the operations in North China resulted in the complete triumph of the "single corps," over the "multiple corps" organization.

*SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY  
THE BRITISH AND INDIAN ARMIES IN THE  
XIXth CENTURY.*

*(Continued).*

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF SEBASTOPOL *(continued).*

It is time to be passing to the camp of the French and the English. It has been shown what the condition of Sebastopol was during those last days of September, and it may be asked why it was that the invaders, now able to gaze at their ease on the domes of the coveted town, did not move forward to seize it.

On the 27th September, the day the French completed their flank march and the second of the days during which the deserted garrison had been left without tidings of Prince Mentschikoff's Army, both the French and the English pushed forward some troops towards Sebastopol, and from the southern side of the town effected their first reconnaissance of its defences.

Seeing the entrance of the roadstead blocked up, the Allies were not without means of inferring that the resources of the Black Sea Fleet, both in men and material, must become available for the land defences; and they were witnesses of the energy and haste which the garrison thought it needful to exert in trying to strengthen their lines, for upon the points upon which their field-glasses were directed there were thousands of men and women at work.

The cardinal question which had to be solved was whether the Allies should now follow up their hitherto victorious march, and endeavour to carry Sebastopol by a prompt and determined attack, or whether they should consent to give the enemy breathing time and begin upon a slow plan of warfare resembling a siege.

Before the 27th September closed bold counsel had been offered by Admiral Sir E. Lyons, and the fact is recorded that having made himself in a general way acquainted with the state of the defences which covered the land front of Sebastopol, and believing them to be imperfect and weak, he urged at the English headquarters the expediency of an immediate assault. Lord Raglan was of the same opinion, but the notion of an assault without first reducing the fire of the place by means of heavy artillery was not favoured by Sir John

Burgoyne, and the proposal having been submitted for consideration to the French, General Canrobert refused to adopt the measure.

So now the Allies took a step, not in itself decisive, but tending to govern their fate, by ignoring the all-vital question of time, and adopting a plan, smooth and easy enough at first sight, but which might yet lead to trouble. They requested the naval commanders to land the siege trains. Their purpose was to open the way for assault by first getting down the enemy's fire.\*

On the 28th the seamen were busily engaged in landing the siege trains, and at this time Sir George Cathcart began to urge that the attack upon Sebastopol should be of a summary kind. There was however no change of opinion in the French camp. Apparently they were all of one mind, the reason given, among several others, being "that they would have to move under the fire of the enemy's batteries for a space of some 2,000 yards. They would have to traverse ground quite unknown to them. Any attack upon the enemy's defences must be made from an extended diverging circumference; and the assailing forces would be so split by these deep intersecting ravines, as to become divided into isolated bodies of men incapable of giving one another any mutual help."

The combined arguments of Lord Raglan, Sir Edward Lyons and Sir George Cathcart in favour of an immediate assault were of a most cogent nature. They may be thus summed up: "Here, on this barren shore we stand fastened—inexorably fastened—to the duty of taking Sebastopol; and for an army in such a predicament as this, the adoption of even a very hardy measure may not only be free from the charge of rashness, but may be commanded by the strictest prudence."

Without the concurrence of Marshal Canrobert there could of course be no assault, and as he did not concur, and any endeavour to shake his decision was clearly hopeless, the question was ended. What the Allies now undertook when they resolved not to assault the place immediately was to open some trench work in which to plant their great guns, and with these to cannonade the fortress. In other words they had determined to enter upon the Siege of Sebastopol. It was with the hope of inducing the Allies to come to this very resolve that the defenders of Sebastopol had been toiling.

The great Engineer who directed the labours of the garrison has declared that the place, at that time, could not have been held against such an attack as the Allies had the power to make; and this is the judgment of one who, compared with all other men, had the fullest understanding and knowledge of the question on which he was writing.

\* Sir John Burgoyne's *Military Opinions*, p. 181.

The condition of things in the Crimea, after the battle of the Alma, was such as might well have contented the Allies had they looked upon the expedition as one to be carried through swiftly, in the first week after the victory. Yet it would be likely to be hard against them, from the moment, when setting themselves against the judgment of Lord Raglan, and Lyons, and Cathcart, they reasoned away their first boldness, and wilfully suffered the enterprise to degenerate into a siege.

In adapting the disposition of their troops to the undertaking now about to begin the Allies had two objects before them ; they had to provide for the duties of the intended siege, and also to secure their forces as well as they could from interruption on the part of the enemy.

With this twofold purpose in view General Canrobert divided his army into two bodies, each consisting of two French divisions. Of these two corps, one only, consisting of the 3rd and 4th Divisions, and placed under the orders of General Forey, was charged with siege duties. It encamped with its front towards the town of Sebastopol, its left resting on the sea, and its right extending to the Harbour Ravine. The French forces drew their supplies from the Bays of Karniesch and Koratch.

On the other hand Lord Raglan devoted everyone of his infantry divisions to the business of the siege,\* but his troops were so posted, that while they had thus cast upon them the duty of pursuing the siege, they were also liable to be summoned to the task of defending the Chersonese at its north-eastern angle.

The English Army had its left at the crest of the ravine which divided our lines from the French, and thence it extended eastward to ground not very far distant from the crest of the Saponné Ridge. The English Army drew its supplies from Balaklava, and at first by two routes ; for until the 25th October the Woronzoff Road, as well as by the way of the Col was open to the besiegers.

The task of covering the siege, by defending the Col, and the greater part of the Saponné Ridge, was assigned to the 1st and 2nd Divisions of the French Army under the command of General Bosquet. The Turkish battalions under the orders of the French commander took part in the same duty. General Bosquet, however, did not occupy the more northerly part of the Saponné Heights ; for there the right wing of the English, though also engaged in the siege stood charged to defend the position.

The Allied Armies were to be covered by the sea on the north-west as well as the south ; and on the more southerly portion of the

\* The infantry forces detached were only one battalion, the 93rd, and some weakly men not in a condition for hard duty, together with one field battery.

Saponné Heights they were to be defended by Bosquet's Corps ; while against any sortie from Sebastopol directed upon the French or English trenches, the besieging forces would of course be their own defenders.

So long as the English drew their supplies from Balaklava it was necessary, of course, that that harbour should be secured ; and this place was on the outside of the natural rampart that guarded the table-land. It therefore required a separate system of defence. For this so far as concerned its eastern approaches, the steep lofty hills, which soon came to be known as the " Marine Heights," were so well fitted as to be capable of being rendered formidable by even the slight works which could quickly be constructed for the purpose ; and a redoubt with a line of breastwork extending athwart the entrance to the gorge by the village of Kadikoi, was to complete the " inner line " of the Balaklava defences. It was afterwards determined that an " outer line " of defence should be constructed by throwing up a chain of small redoubts upon the low range of heights which stretches across the plain at a distance of about a mile and a-half from the gorge leading into Balaklava.

Lord Lucan with his cavalry and horse artillery was stationed in the plain to the north of Balaklava, with orders to patrol to the Tchernaya, and also in the direction of the gorges leading into the valley of Baidan. With the exception of this division of cavalry, the whole of the scant forces entrusted with the defences of Balaklava were placed under the orders of Sir Colin Campbell.

Both the English and the French headquarters were established on the Chersonese—the English in a farmhouse a little to the north of the pass which led up from Balaklava, and the French at a spot further west.

Wharves had at once to be made for the purpose, and the Allies went on in all haste with the toil of landing their siege trains. There was yet the still harder task of bringing up heavy guns from the shore to the front, great stores of ammunition and the loads of material required for the business of the siege work besides all the usual supplies which were needed for the support of their armies.

The French had spacious landing ground in the Bay of Karniesch but it was otherwise with the English, for there soon came the first stress of that want which was destined to be the cause of cruel suffering to their army. The forces, encamped on the Chersonese, were near, it is true, to their port of supply, but not in contact with it. There was a distance of 6 or 7 miles which had to be conquered. And how ? It would seem that the only means of transport available to our engineers were some light bullock carts of the country, amounting at first to forty-six, but reduced by the 20th October to twenty-one ; and the only way this scant command of draught power

could be augmented, was by pressing into the service every spare ammunition and baggage horse.

Large bodies of men were landed from the Allied fleets, and they were ordered to take part in the active operations against Sebastopol. The brigade of English seamen then placed under the orders of Capt. Lushington, and Capt. Peel\* undertook a battery with his men from the *Diamond*. Large quantities of the armament and other material resources of the fleets were also freely devoted to the same purpose. Numbers of ship's guns of heavy metal were taken from the decks of the men-of-war, and dragged up to the camp by the sailors.

The process of landing battering trains and bringing them up to the front was too difficult to be got through in the short space of time that was thought sufficient when the Allies resolved to enter upon the siege; and before they were ready to open the first trench, the enemy's field army began to show signs of changing the attitude to which its chief had condemned it since the day of the Alma. Prince Mentschikoff must have been told by his own officers, as early as the 28th or 29th September, that the Mackenzie Height was clear of the invaders, but for several days he made no movement. By the 7th October, however, the Russians had begun to appreciate the fact that, after all, they were once more the undisturbed masters of the Mackenzie Range, including every road and pathway which connected it with the valley of the Tchernaya. So now at last the Russian commander accepted this priceless dominion of territory which secured his communications with Sebastopol and the interior of Russia, but pushed his reconnoitring forces down into the plain, and even to the banks of the stream where the British Cavalry patrolled. At this time, moreover, it began to appear that the forces which constituted the garrison of Sebastopol were daily becoming more bold, for (supporting them in some instances with field guns) the enemy now kept his outposts so firmly on ground far in front of his works, as to hinder the Allies in any attempt to establish batteries at a moderate distance from the place.

The part of the enemy's defences which offered to his assailants the obvious "front for attack" was that slightly curved belt which included the Flagstaff Bastion, the Redan, and the Malakoff Tower. This last work, or rather the ground on which it stood, had been pronounced by Sir John Burgoyne upon his surveying the ground to be the key of Sebastopol. But the Malakoff was not "the key" in such sense as to imply that it was the only key of Sebastopol; and it was the opinion of General Todleben that the capture of any

\* Afterwards Sir William Peel who was in command of the Naval Brigade at the capture of Lucknow in 1858, and who died from small-pox shortly after the siege.



one of the three works—the Malakoff, the Redan, or the Flagstaff Bastion—must have carried with it the fall of the place.

Straitened in their choice of the “front for attack” the Allies determined that they would devote their first efforts to carrying the Flagstaff Bastion and the Redan, and they hoped that the mastery which might thus be attained would insure, with but little delay, the fall of the Malakoff itself, and all the other defences. It was by the eventual assault of the Flagstaff Bastion and the Redan, that the French and the English expected to be able to carry them. To prepare the way for this enterprise, they not only endeavoured to keep down the fire of these works, but of all the intermediate batteries as well on shore or ship’s decks, which helped the defence of the place on its land front. It was also their object to do all they could towards silencing, on the one side, the Central Bastion, and on the other, the Malakoff Tower. The first step towards the execution of this plan was, to draw the investment closer, and to push forward some of the infantry battalions to ground nearer the place; and this with the view to obtain for the engineers better means of reconnoitring, and also to support the working parties in their endeavour to open trenches at a moderate distance from the enemy’s works.

On the 7th October, Lord Raglan assembled the Generals of the Infantry Divisions\* and announced to them what he wished to have done; but the practical conclusion attained by the council was the rejection of Burgoyne’s proposal for a closer investment of the place. Lord Raglan seemed to ascribe to the decision of his Divisional Generals, the necessity of confining the operations of the English Army, and apprehended that for the time and until the moment for assault should be ripe, that army must confine itself to such an operation as would enable the engineers to place in battery some guns of long range.

In pursuance of their plan of attempting something against the shipping and the other defences by their long-range guns, the English on the nights of the 7th and the 8th October, began the formation of two half-sunken batteries upon spots very distant from the enemy’s line of works.†

After sunset on the same day as that on which the English generals had delivered their opinions, nine French battalions commanded by General Lourmel were pushed forward, and established in a sheltered position, beneath the commanding crest of Mount Rodolph, where the French meant to plant their batteries.

It was on the night of the 9th October that the French were to

\* Sir George Brown, the Duke of Cambridge, Sir de Lacy Evans, Sir Richard England and Sir George Cathcart.

† About 2,800 yards from the nearest of the enemy’s works.

break ground. Advancing from the ground where Lourmel had established himself, their engineers, with a large body of men told off for the work, were to fasten at once upon the crest of Mount Rodolph; and this they proposed to do by throwing up a gabionade a few yards in advance of the ground they had selected as the site of their intended batteries. This gabionade was intended as a screen for the subsequent operation of sinking the trenches in which their batteries were to be placed. The night was clear, and a fresh wind blew from the north-east, which prevented the garrison from hearing the sound of the pickaxe. Relays of working parties numbering 1,600, worked all night without being molested, so that when morning dawned, they had thrown up a work 1,100 yards in length at a distance of about 1,000 yards from the Central Bastion.

The enemy often busied himself with sallies at night, and the cannonades with which he assailed the besiegers and their works rarely ceased for any length of time, and were sometimes of much power. In the space of a single hour on the 14th October, 800 cannon shot were fired against the works of the French, resulting in a good deal of damage to the parapets, but killing only two men, and wounding three. Whilst the French, in most places, had beneath them a fair depth of earth, the ground in front of the English was almost bare rock covered with soil a few inches deep.

On the nights of the 10th and 11th October, the English succeeded in opening the trenches on Green Hill, as well as on the Woronzoff Heights; and it soon appeared that the fire they were preparing was likely to prove much more effective than they had ventured to hope for. By the evening of the 16th October the English had established their batteries and were ready, with the French, to open fire on the following morning.

The English were to be ready to storm the Redan as soon as the French operations should be ripe for a like effort against the Flagstaff Bastion.

The English were put to great straits for want of timber, owing to the platforms sent out with their siege trains being of a new and ingenious kind, which, though promising to serve its end admirably when tried upon a perfect level at Woolwich, turned out to be altogether unfitted for the rocky and uneven ground where our batteries had to be placed. So the platform of the old-fashioned pattern had to be resorted to, and, to meet the emergency most of the few buildings which stood on the Chersonese were quickly stripped of their roofs.

At this time there was a strong desire that the fleets should take part in the attack upon Sebastopol, but there was a difficulty indicating a way in which it would be prudent for their co-operation. On the 15th October a naval conference was held on board the *Mogador* and after much discussion a plan of the naval

attack was determined upon on the 16th October. As late as the 5th October, the Russian forces defending the quarter of the Malakoff Tower were judged to be deficient in military strength, and Prince Mentschikoff yielding to the advice of Admiral Korniloff, without calling a council of war, suddenly to the joy of Sebastopol made it known that some twelve battalions should at once be detached from his field army, and be allowed to take part with the garrison in the defence of the place. Two other battalions were also brought over from the north of the roadstead; and from time to time afterwards, further bodies of infantry detached from Prince Mentschikoff's Army were sent to strengthen the garrison. This resolution of Prince Mentschikoff to send reinforcements from the field army was apparently decided upon in consequence of a step taken by Admiral Korniloff which seemed to provide that in case of Sebastopol falling for want of aid from his army, the truth should be visibly extant. The latter framed and signed a remonstrance against the plan of continuing to withhold the entire field army from the defence of Sebastopol, and Korniloff apparently intended that whether he were destined to survive or to perish along with the fortress, his words should go to the Czar.

By the 6th October more than 25,000 men of the army had joined the sailors to help in the defence, the total amounting to nearly 38,000 doing duty on shore, and in the course of the ten days which followed the 6th October the garrison was yet further reinforced.

During this time Todleben with restless energy had been pressing on the defences; and it seems to have turned out that the respite of 20 days with which the Allies had been indulging Sebastopol, was just of the length that the garrison needed for bringing the works commenced since the 26th September to a state of all but completion.\*

On the evening of the 16th October, the garrison knew that the time of preparation was almost at an end, and that a great cannonade of their works was likely to begin on the morrow. At half-past six a.m. on the 17th October, three shells were to be discharged from one of the French batteries, and then forthwith the Allies were to open fire along the whole line of their works. The following are the details of the Russian guns:—

Guns opposed to the batteries of the Allies	..	118
Guns sweeping the approaches	.. ..	160
Guns for taking the besiegers when at close quarters		
in front or flank	.. ..	63
		<hr/>
Total	..	341

\* Todleben, p. 301.

The signal had not yet been given when at daybreak the Russians were able to see that the Allies during the night had cut their embrasures and that their guns were visible. A body of French tirailleurs with a support pushed forward towards the enemy's lines. Sebastopol beat to arms. The three appointed signal shells were fired. In a minute some English guns opened ; and presently along their whole line of batteries, and along all the enemy's works from the Central to the Flagstaff Bastion, and thence across to the Redan, and thence on again to the Malakoff, a heavy cannonade commenced.

So long as the conflict was one between covered batteries on one side and covered batteries on the other, there could not well be any approach to equality in point of losses between the besiegers and the besieged ; for the Russians were not only forced to keep manned the 223 guns which they had prepared against the expected assaults, but also to have close at hand near the gorges of their bastions the bodies of infantry which they designed to meet the same contingencies. Both the gunners and the infantry were imperfectly sheltered from the fire from the batteries of the Allies and the result was that the troops thus kept in expectation suffered many casualties in killed or wounded, whilst the besiegers on the other hand, were able to keep out of fire the troops with which they meant to assault till the moment for their onset had come.

The instant he heard the opening of the cannonade Korniloff galloped off to the Flagstaff Bastion. Korniloff conversed with the gunners, and to some of them he gave directions as to the pointing of the guns. "Calm and stern," says one of the staff who rode with Korniloff, "was the expression of his face, yet a slight smile played upon his lips. His eyes shone brighter than was their wont. His cheeks were flushed. He carried his head loftily. His thin and slightly bent form had become erect. He seemed to grow in size."

Gaining at length the Central Bastion, Korniloff there found Admiral Nachinoff toiling hard at his duty and seeming to be as much at home in the batteries as though he were on board his own ship. He afterwards visited the work at the Land Quarantine and seeing that the men were suffering from thirst, he gave orders for handing up casks of water to the batteries.

After changing the position of the Moscow battalion by moving it to ground where it would be sheltered from the enemy's fire Korniloff passed the dock-bridge and began to ascend the western slope of the Malakoff. When he came near the seamen on duty in that part of the field they greeted him with loud cheers ; but Korniloff forbade them. He pointed to the crest of Mount Rodolph where all was now hushed, owing to the French batteries having been silenced by the Russian fire, and said to his people, "When

the English batteries are as silent as the French yonder, then, and not till then you may cheer."

When Korniloff reached the Malakoff Tower he found that its guns had been silenced and deserted; but Admiral Istornin still answered the English by a well-sustained fire from the earthworks which covered and flanked the stone building. It occurred to Korniloff that the ground floor of the tower would be suitable for an ambulance or field hospital and he gave directions accordingly. After this Korniloff remained for some time at the foot of the tower. His aide-de-camp begged him to return home; and in answer he pointed to the ground where the Bontir and Borodino Regiments were stationed, saying, "We will just go to those battalions, and after that we will go home by the hospital road." He still loitered for a few minutes longer, but at length—it was then half-past eleven o'clock—he said "Now let us go." He moved towards the spot under shelter of the breastwork where the horses were awaiting him; but he had scarcely yet taken four steps when the uppermost part of his left thigh was shattered by a round shot. Gendre raised the head of the wounded chief, and the other officers near coming up and lifting him in their arms, they together laid their Admiral under shelter of the breastwork, between two of the guns. For a moment Korniloff was able to speak, and he said feebly "Defend Sebastopol." He then became senseless. He was carried to the hospital, suffering greatly; but at a moment when he was free from sharp pain, he laid both hands on the head of the Chief of the Staff and said, "Tell everybody how pleasant it is to die when the conscience is quiet." He sent tender words to his wife and children; and from time to time he prayed thus, "O God! bless Russia and the Emperor. Save Sebastopol and the fleet!" Shortly afterwards he became insensible. After a few minutes he ceased to breathe. An effort was made to conceal the death of the Admiral, but upon coming to know the truth, the sailors, and the soldiers too, grieved bitterly for the loss of their trusted chief and dictator. From time to time there had been posted up numbers of general orders, in which Korniloff gave directions tending to relieve the sufferings of the men, and in many ways add to their comfort. These announcements remained on the walls long after the death of the chief whose name was at the foot of them; and the grateful men as they passed, used to look up and point to the words, and bless the memory of their hero, saying often in that gentle and poetic spirit which is characteristic of the Muscovite people, "Our Admiral still watches over us!"

It had been originally determined apparently that the attack of the forts should be executed by ships which, keeping always in movement, would deliver their fire in succession and that the attack should commence at half-past six on the morning of October 17th, but at the last moment Admiral Dundas in command of the British

Fleet received a communication from the French Admiral Hamelin that he did not intend to commence his fire before 10 or 11 o'clock, as his shot would not last long, and if expended early, the enemy might think that he was beaten off. Dundas acceded to the reason which Hamelin adduced, and consented to the proposed change of time.

At 7 o'clock on the morning of the 17th Admiral Hamelin to the astonishment of Dundas came on board the *Britannia* and announced a new plan of attack. By this new plan it was laid down that instead of an operation effected by ships kept in motion, the two fleets while engaging the forts, should be anchored in line; that the array of the French fleet should begin at Chersonese Bay, proceeding thence in a north-north-easterly direction to a point opposite to the centre of the harbour; and that from thence, but in a line taking a north-easterly direction, the English fleet should be ranged. The French fleet would thus be at a distance of from 1,600 to 2,000 yards from the Quarantine Sea Fort—the nearest of the forts which it proposed to assail—and that the English fleet would have to engage Fort Constantine at ranges equally long.

This was the plan which the French had decided to carry out. Admiral Dundas was so reluctant to adopt a measure which he considered would be mortifying to the self-respect of our Navy that until Admiral Hamelin had declared that the French were determined to adopt this course he withheld his assent.

It was apparently in a spirit of devotion to a forlorn duty that Dundas chose the place in which to put his own flagship; for when in the course of a conference of admirals and captains that had been previously held, an officer whose opinion was weighty, pointed out that the ship which should be on the extreme right of the English line must of necessity be sunk in one hour, Dundas quietly answered that that post was the one he had reserved for the *Britannia*.

So large a proportion of the defensive works had been designed for the purpose of preventing an enemy's ships from entering the roadstead, that not counting the two small works, the Wasp Tower and the Telegraph Battery, three only of all the water-side forts were so placed as to be able to take part in an engagement with ships keeping clear of the entrance. These three forts were Fort Constantine, Fort Alexander, and the Quarantine Sea Fort.

This being a condensed history of the sieges in which the British and Indian Armies have been engaged, and being limited in size, it has been found necessary to exclude the account of the naval engagements of the 17th and 18th October, the details of which are fully and admirably related in Chapters XVII. and XVIII. of Kinglake's *Invasion of the Crimea*. It will be sufficient to recall that

the results of the naval actions were on the whole more favourable to the Russians than to the Allies.

In a categorical form the five results evolved by the conflict may be thus summed up.

1. At ranges of from 1,600 to 1,800 yards, a whole French fleet failed to make any useful impression upon a fort at the water's edge, though its guns were all ranged in open-air batteries, and firing from over the parapet.

2. An earthen battery mounting only five guns, but placed on a cliff at an elevation of 100 ft., inflicted grievous losses and injury on four powerful English ships of war, and actually disabled two of them, without itself having a gun dismantled, and without losing a single man.

3. At ranges of from 800 to 1,200 yards, and with the aid of steam frigates throwing shells at a range of 1,600 yards three English ships in 10 minutes brought to ruin and cleared of their gunners the whole of the open-air batteries (containing 27 guns) which were on the top of a great stone fort at the water's edge.

4. The whole Allied fleet operating in one part of it at a range of from 1,600 to 1,800 yards, and in another part of it at ranges of from 800 to 1,200 yards, failed to make any useful impression upon casemated batteries protected by a good stone wall from 5 to 6 ft. thick.

5. Under the guns of a great fort by the water's edge, which although it had lost the use of its topmost pieces of artillery, still had all its casemates entire, and the batteries within them uninjured, a great English ship lay at anchor at a distance of only 800 yards, and fought for hours without sustaining any ruinous harm.

*October 17th.*—Whilst the fleets plied their thunder in vain and the guns on Mount Rodolph were still silent, there was one part of the field where the cause of the Allies seemed to prosper. This was in the English batteries. There from break of day our gunners, sailors and landsmen, had been well fulfilling their part. Not only had they sustained with advantage their now single-handed conflict with the Flagstaff Bastion and the "Garden Batteries," but they were fast achieving almost all that could have been hoped from their efforts against that part of the enemy's lines in the Karabel Faubourg which they more especially undertook to assail. The batteries in both Gordon's and Chapman's attacks were so placed and were armed with guns of a calibre which compensated so aptly for the length of the range that after some nine hours of firing, they had established a clear ascendancy over the enemy's ordnance.

Though with somewhat less advantage in that respect, than the French, the English were still upon heights which commanded the

Russian defences, and looked over into their rear. From this cause as well as from the effect of shot bounding in by *ricochet*, our guns from the first, had begun to work a great havoc in those parts of the Russian batteries which lay towards the gorges of their bastions, as well as among the bodies of troops which were posted hard by to await the expected assault.

But this was not all; for little by little the whole front of the assailed defences in the Karabel Faubourg began to give way under the power of the English artillery. Even from the Allied lines it was easy to see that independently of the effect produced by explosions, the shell or round shot alighting upon a parapet which was no more than a heap of loose particles, wrought changes in its bulk and its form and whirling into the air at every blow a dark column of dust and small earth. Before the day was half spent, the frail ramparts most battered by our artillery had degenerated into shapeless mounds; and after the first nine hours of the cannonade there was more than one spot where they seemed to be nearly effaced. In the midst of the earth-works thus almost dissolved into dust the stone-built tower of the Malakoff still remained upstanding; but the work had undergone a fire so powerful that it no longer carried an effective armament. Of its few guns, all ranged in open-air battery at the top of the work, some had been not merely dismantled, but even hurled over the parapet. The stone parapet of the tower also was so shattered, and its splinters flew so destructively, that without incurring an unwarrantable sacrifice, the men at the top of the work could no longer be kept to their guns, and were withdrawn. A well-sustained fire from the guns still poured on the glacis of the work, but the tower itself was silent.

At an early hour in the forenoon when de Todleben surveyed the Redan its defences had fallen into a critical state. Even then several pieces had been dismantled, and numbers of the embrasures were blocked up with ruins. By about 3 o'clock p.m., one-third of the pieces which armed the work had been dismantled. The loss in men had been heavy. The gunners of several pieces had had to be replaced by fresh hands twice. Of 75 men sent to the Redan from one of the ships, 50 were killed or wounded. Yet in spite of the decisive and increasing ascendant thus established against them by the English, the gunners in the Redan stood firm. However appalling the slaughter, the men yet remaining alive and unstricken worked on with a courage which did not droop. The officers did not hesitate to give examples of devotion. They mounted the parapets, and toiled at the repairs to the embrasures.

Soon after 3 o'clock, however, there occurred a disaster which completed the ruin of the work. A shell blew up the powder



magazine established in the salient. When the smoke lifted a dire spectacle of ruin was disclosed. At the fore part of the work the parapet had been thrown over into the ditch, and so filled it. The ground was laden with fragments of platforms, with guns dismounted, with gun-carriages overthrown, and shattered. On all sides there were the blackened bodies of men and it was afterwards known that more than 100 had been killed.

The troops which had been kept near the gorge of the Redan in order to meet an assault, all at once fell back for shelter towards the Marine Hospital. "Thenceforth," says de Todleben, "there disappeared all possibility of replying to the English artillery. The defence in that part was completely paralyzed; and in the Karabelnaya men expected to see the enemy avail himself of the advantage he had gained, and at once advance to the assault.\*

But it has to be remembered that whenever the English should be assaulting the Redan, the French were to be assaulting the Flagstaff Bastion. According to the understanding between the French and the English headquarters, the one assault was not to be going on without the other; and it seems to have been not so much stated in terms, but rather taken for granted, that the silencing for the day of the batteries on Mount Rodolph carried with it a corresponding postponement of any attempt by the French to assault the Flagstaff Bastion. Thus the tender exigencies of the bond which united two mighty states forbade them the full use of their strength. A tacit compact required that their armies should act together in any great operation; and it chancing at this time, from the mere fortune of war, that the English were in a condition to assault and the French not, it resulted as a natural consequence, that the temporary impotence of the one Power carried with it the abstention of both. What benumbed the Alliance was the Alliance.

After the failure of the 17th October the Allies had determined to undertake a new plan of attack. The French were now to proceed against the Flagstaff Bastion by regular approaches. The English, it was known, with difficult ground in their front, and having but scant means of carrying on extensive siege works, would be able to do but little towards attaining the Redan by regular approaches; but it was agreed that whenever the French should be ready for the assault of the Flagstaff Bastion, the English at one point or other, should also storm the defences. On the night of the 17th October the French so prolonged their first parallel as to disclose their new plan of proceeding against the Flagstaff Bastion.

It was determined, however, that pending the time which would be occupied in proceeding by regular approaches, the cannonade

\* de Todleben, p. 329.

should go on, and on the 18th October the English still maintained the fire of their batteries as the French had not only been repairing the havoc made in their works, but establishing new and powerful batteries ; and as it was known that on the morning of the 19th, they would be in a condition to open their fire with largely increased means, the hour of trial was looked forward to with great interest by the Allies.

But the preparations of the French were under the eyes of Colonel de Todleben ; and he evidently assured himself that, so long as they might continue to assail him from a narrow point of fire, he would be able to keep his ascendant, by meeting their increase of armament with an increase yet greater than theirs. And de Todleben got the ascendancy. Two of the French batteries were visited by the calamity of explosions ; a third was silenced by fire, and at 3 in the afternoon there was no longer any French battery which continued the strife. The English fire was continued with great energy the whole of the day, and directed for the most part against the Redan. At evening the cannonade ceased. No material injury had been done to the works of defence ; but in killed and wounded this day the Russians lost 516 men. Every day from this time until the evening of the 25th October the fire of the Allies was continued, but every day it was met by de Todleben with a ceaseless energy.

The French at this time, with their magazines often exploding, and their batteries often enfiladed by new works thrown up for the purpose were undergoing a trial of such a kind as might tend to make them distrustful of their own engineers. They hardly understood at the time the true root of the evils which beset them, but that which really stood in their path was warlike genius.

Under the direction of de Todleben, the Russians, by fighting their batteries with unsparing valour, and achieving at night immense labours, were able to present to the besiegers every morning a line of defence which was not only strong and unbroken, but even augmented in strength ; and they also found means to provide themselves, as the struggle continued, with a more and more efficient protection against the missiles.

On the 18th (when only the English were firing) the Russians in killed and wounded lost no less than 543 men ; but although during the six days which followed the 19th October, a cannonade equally vigorous was maintained by both the French and the English, yet during that period the average daily loss of the Russians in killed and wounded was reduced to 254. The whole loss in killed and wounded which the Russians sustained from the siege down to the 25th October was officially stated to be 3,834. From the moment when on the morning of the 18th October, de Todleben saw how the French on Mount Rodolph had newly opened the ground along a distance of 400 or 500 yards, he had

assured himself that they had determined to assail the Flagstaff Bastion by regular approaches. As an engineer he entirely approved their decision. By means of a change in the organization of the night outposts, he was able to inflict much heavier losses than before upon the French working parties ; but he also constructed fresh batteries, so ordering his measures that the nearer they might draw their approaches the more he would be able to ply them with fire, and adhering to his favourite principle, he never ceased to take care that, whenever the moment might come for assaulting the work, any troops employed in the enterprise should be under a storm of mitrail.

*(To be continued).*

*TESTS OF REINFORCED CONCRETE BRIDGES ON THE  
GREAT CENTRAL RAILWAY.*

MR. JAMES BENJAMIN BALL, M.INST.C.E., recently read a paper at the Institute of Civil Engineers and by the kindness of the Secretary we are enabled to publish the following abstract :—

The Great Central Railway Company have completed within the last six years several considerable works in reinforced concrete, the more important of which include a bridge carrying a public road over their main lines at Ashton-under-Lyne—believed to be one of the heaviest reinforced-concrete bridges of its type yet constructed in England—a bridge carrying a new road and tramway over the Grimsby District Light Railway at Immingham Dock, and several reinforced-concrete bridges in the dock area at Immingham.

*Reinforced-Concrete Overbridge, Ashton-under-Lyne.*—This bridge consists of parallel girders of three spans. The main girders also form the parapets of the bridge. On a level with the bottom booms are formed the main deck beams or cross-girders, and between these again are the smaller deck beams parallel to the main girders, supporting the reinforced-concrete decking. The entire superstructure is reinforced with round bars on the Hennebique system.

The abutments at each end are of mass concrete, but the piers are braced and reinforced. The main girders only rest on the abutments and are not anchored down in any way ; moreover, they are not continuous, there being a space of  $1\frac{1}{2}$  in. between the girders over each of the intermediate supports for expansion : thus each span is independent, and consequently any slight settlement which may take place in the abutments or piers will not affect the stresses on the reinforcement, and in each case the full bending-moment effects due to both dead and live loads were taken into account.

Both tensile and compressive reinforcement was used in all the beams, the percentage of reinforcement in the main girders being exceptionally high, on account of the small area available in the compression flange.

The bridge was tested with a dead load of 1 cwt. per square foot and a rolling load of two 16-ton traction engines each drawing a lorry loaded with pig-iron to a weight of 32 tons, or a total moving load of 96 tons. In all cases the recovery was complete after the load was removed.

The working stresses were limited to 700 lbs. per square inch

maximum compressive stress on the concrete, and 16,000 lbs. per square inch tensile stress on the reinforcement.

The actual cost of the work as carried out in reinforced concrete amounted to £5,917. The estimated cost of a similar structure in steel and masonry was £8,390.

*Reinforced-Concrete Bridge carrying New Road and Tramway over the Grimsby District Light Railway.*—This bridge, also designed on the Hennebique system, consists of a roadway 40 ft. wide extending over two spans of 37 ft. 2 in. and 31 ft. 2 in. respectively. There are five main longitudinal beams, the two outer of which also carry a reinforced parapet. The parapets, however, are not designed to take any portion of the load stresses.

Between these main beams cross-beams are arranged, which support reinforced decking.

The percentage of reinforcement ranges from 0·60 per cent. in the cross-beams, to 4·67 per cent. in the outer main beams of the longer span.

The bridge was tested with two moving tramcars, and no appreciable deflection was recorded on any of the beams.

It was designed to allow for the passage of two 40-ton boiler trollies drawn by a 15-ton traction engine, that portion of the bridge not covered by the moving loads being loaded with 1 cwt. per square foot.

In computing the stresses, the various members were taken as being freely supported, and no allowance was made for the continuity of the beams or for the fixity of the ends, the allowable working stresses being the same as in the case of the previous bridge.

The actual cost of this bridge carried out in reinforced concrete was £2,939. The estimated cost of a similar structure in steelwork and masonry was £3,500.

*Four High-Level Railway Bridges, Immingham Dock.*—These are all skew spans of the same construction. Each bridge carrying four tracks over a siding for empty wagons, and forming practically a tunnel 86 ft. long.

The square span between the abutments is 15 ft. Both the wing walls and abutments are reinforced, and there are in addition reinforced tie-beams at the bottom of the abutments, at the same spacing as the cross-girders, embedded in a concrete raft.

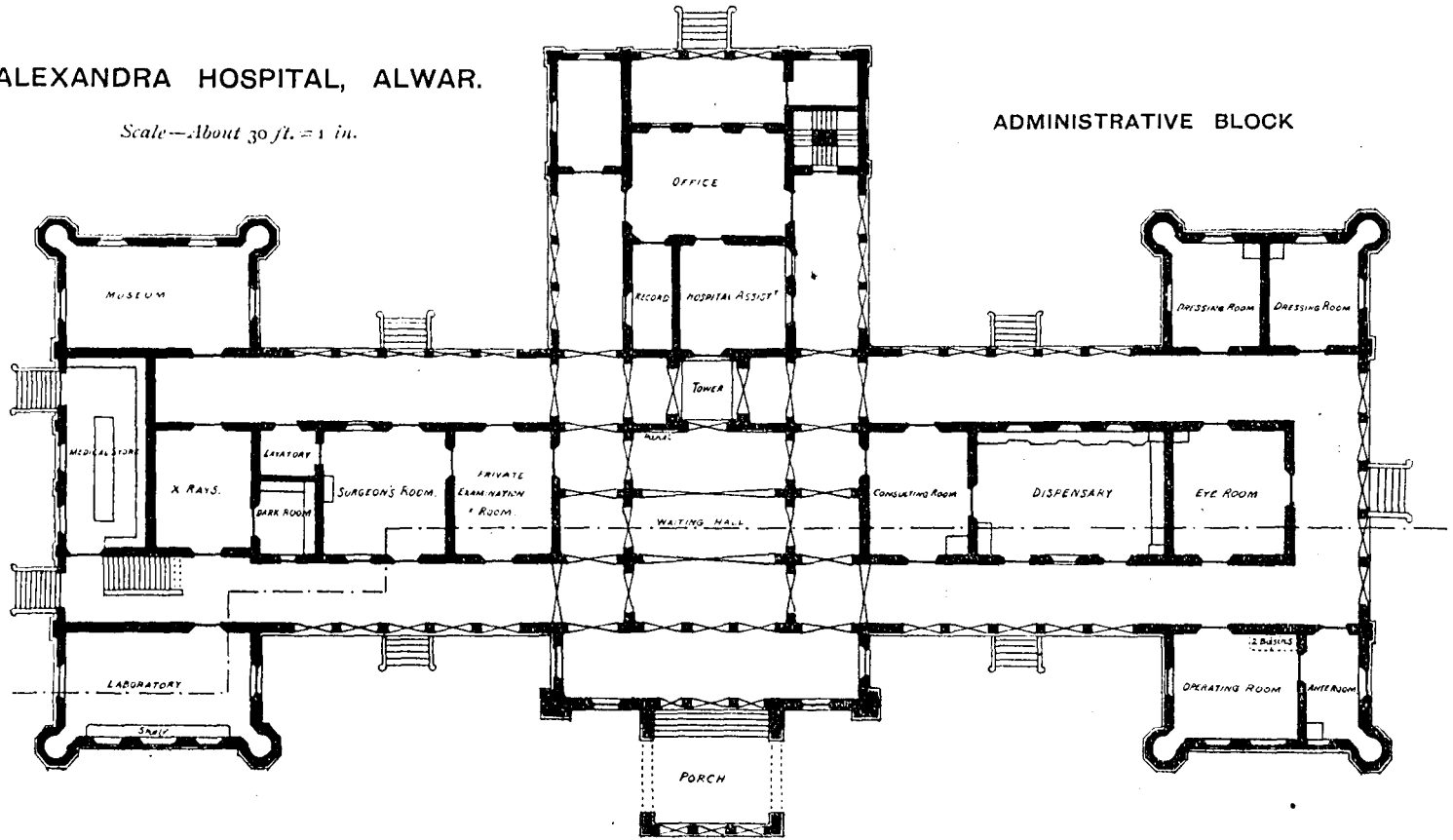
The bridges were designed to carry axle loads of 18 tons, spaced 6 ft. 6 in. apart, or 72 tons on the single-line span.

The average cost of these bridges in reinforced concrete was £3,024 each. The estimated cost of a similar structure in steelwork and masonry was £3,800 each.

# ALEXANDRA HOSPITAL, ALWAR.

Scale—About 30 ft. = 1 in.

## ADMINISTRATIVE BLOCK



*THE ALEXANDRA HOSPITAL, ALWAR.*

By MAJOR A. ff. GARRETT, R.E.

It probably does not often fall to the lot of an R.E. officer to be given a perfectly free hand practically regardless of cost as regards the architectural treatment of the buildings he erects, so possibly the following account of the new hospital in the Alwar State of Rajputana, which was built under these conditions, may be of interest to the Corps.

Early in the cold weather of 1904 there was a rumour that H.R.H. the Prince of Wales would visit India during the next year, and it at once occurred to the young Maharaja of Alwar, who had only a few months ago entered on his powers as ruling chief, to invite the Prince to Alwar and request him to open a new hospital, which he proposed to call the Alexandra Hospital after the Queen. Accordingly in my then capacity of State Engineer, I was asked to erect a wonderful and magnificent structure of pure white marble, and to have it ready within nine months, so that there might be a big opening ceremony in the winter of 1905, which would give the young Maharaja an opportunity of welcoming His Royal Highness to his capital. On representing to him that it would be absolutely impossible to complete the construction in so short a time, and that the cost would also be prohibitive, the Maharaja asked me to get out the design of a less pretentious, but more useful edifice, as quickly as I could, and press on with the construction with all speed. The matter was discussed with Capt. Smith, I.M.S., the Civil Surgeon, and finally the plan shown in the plan was adopted for the Administrative Block, the main operating room, and wards being arranged in separate buildings behind the main building. In designing the plan of the Administrative Block, the main idea was to enable out-patients to be dealt with rapidly, to prevent them from wandering all over the buildings, and to arrange the communications as conveniently as possible. Thus the out-patients enter through the front porch into the waiting hall—pass one by one into the consulting room to the right, and then along the back verandah past the dispensary windows, where they get their medicines, and any cases which require surgical dressing are treated in the two dressing rooms on the extreme right of the building. Similarly eye cases are examined in the eye room, and cases which require small and

unimportant operations are dealt with in the operating room. The out-patients pass right away out of the building from the verandah on the right wing. On the left of the building are situated the surgeon's room and X-ray room, laboratory with large windows facing north so that direct sunlight is excluded, and a museum for surgical specimens, etc. Under the whole of the left wing are arranged cellars communicating with the front verandah by a flight of stone steps. These cellars serve as a supplementary medical store, and are very useful for storing packing cases and other such articles which would block up the medical store room and look very unsightly. These cellars are lit by small windows placed between the plinth and the ground. These can be seen on the elevation. Immediately behind the waiting hall are placed the hospital assistants' rooms, the offices and record rooms.

The Maharaja naturally desired an Indian style of architecture, and I accordingly took the plan to Sir Swinton Jacob's head draftsman, who supplied a small scale drawing of the front elevation. This with a few small alterations was adhered to, and the wards and other buildings were designed in the same style. In working out the details, Sir Swinton Jacob's *Portfolio of Architectural Details* was found extremely useful, though a considerable number of the details and carvings were worked out on the spot during construction. The hospital is built of a light grey stone, with facings of the well-known Agra and Delhi red sandstone. This forms a very pleasing colour contrast, and the pillars, cornices and brackets show up to the best advantage. The domes are of white marble with red sandstone bases. The balustrades in the verandahs, and the perforated tracery in the verandah arches, are carved from large slabs of the red sandstone. For this tracery work a large number of different designs were obtained, as also for the carving on the bases and caps of the verandah pillars. Competitions were held amongst the workmen, and small prizes given for the best designs. When a design was selected, a full size model was usually made in mud plaster, which enabled one to judge very well of the general effect. The model was altered until the result was found to be satisfactory, and the stone cutters were then put to work to carve the stone direct from the model. I was fortunate in obtaining a gang of 60 or 70 expert stone cutters from the neighbourhood of Delhi and Agra. These men took the keenest interest in the work, and displayed considerable originality in many of the designs which they proposed. Occasionally they made absurd mistakes, as in the case when one of them designed a bit of elaborate carving of vine leaves and grapes, in which the grapes were supported by the stalk instead of hanging freely. But such errors were easily eliminated in the mud modelling.

The roof is supported on ordinary rolled steel beams spaced 3 to 5 ft. apart. On the lower flanges of these were placed sandstone



slabs, readily obtainable in the neighbourhood. Over these a 5-in. layer of "Kharanja" masonry and on top of this again 4-in. lime concrete. The "Kharanja" masonry is, I believe, a device peculiar to Rajputana. It consists of 4 or 5-in. flattish chips of stone laid in lime mortar directly over the slabs in a circular formation, so as to make a kind of flat dome. It serves to strengthen the slabs and to prevent their being broken by the subsequent ramming of the concrete. Over the concrete is a layer of "Kara" plaster, made of stone lime and crushed quartz. This is a pure white plaster, which when well laid, is found to be very durable and waterproof. There is always a risk of leakage in these flat roofs unless great care is taken with the concrete and plaster. The concrete must be rich in mortar, and well beaten until the mortar rises to the top. It is then finished off by gentle beating with wooden "Thapis" and the kara laid on. It is necessary to give a slope to the roof so that rain water may run off quickly.

A somewhat peculiar feature of the roof of the Administrative Block is the entire absence of the usual clerestory windows. In place of these, skylights were arranged. They are shown in rectangular dotted lines on the plan. There are two in the dispensary. They are made so as to open and are provided with long projecting eaves of sandstone slabs, so as to keep out direct sunshine and rain.

The floor of the waiting room is made of slabs of red, white and black marble, highly polished and arranged in geometrical patterns, while the pillars are of white marble with elaborately carved caps and bases. The floors of the operating and dressing rooms are made of large slabs of polished white marble with a slope draining off into drains and sumps arranged outside the building. All this marble was obtained from local quarries in the Alwar State. The floors of the other rooms are of lime concrete covered with white chunam plaster. This latter is really kara plaster highly polished by a somewhat technical and laborious process more or less peculiar to Rajputana. It gives a very hard durable surface almost like marble. The verandah floors are paved. All corners and edges are rounded off throughout the whole hospital, so as to avoid cracks in which dust could lodge, and the walls are all covered with a washable sanitary distemper. In the operating rooms, the walls are of polished marble up to a height of 6 ft.

The main operating room is in a separate building behind the Administrative Block. It has a large window of plate glass facing north, so as always to exclude sunlight. The operating room is connected with the surgical ward by a covered passage, so that after an operation, a patient may be wheeled directly into the ward.

There are separate wards for women's cases, fever cases and miscellaneous, each ward containing 11 beds.

The latrines are outside and at the back and connected with the wards by covered passages. There is also a ward for infectious cases in a separate and isolated part of the hospital compound. There are also various staff quarters for assistant surgeons, hospital assistant, dressers and menials.

It is intended to eventually add an electric light installation and to lay out all the spaces between the wards as gardens.

Work was begun towards the end of 1904 and vigorously pushed, but when it was heard that the Prince of Wales was not actually going to visit India at all the allotments were considerably reduced, and the work consequently dragged considerably, and it was only opened by the Viceroy, Lord Minto, in 1909. The construction thus occupied nearly five years.



Front Elevation.

## **ALEXANDRA HOSPITAL ALWAR**



Right Wing.

**ALEXANDRA HOSPITAL, ALWAR**

*REVIEW.*

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## A TEXT BOOK OF MILITARY HYGIENE AND SANITATION.

By LIEUT.-COLONEL F. R. KEEFER, M.D., Medical Corps, U.S.A.

THIS small book of some 250 pages surveys in a brief compass the whole range of military hygiene, including such questions as physical training, clothing, equipment, food, water supply, accommodation both on land and sea, diseases and their prevention, etc., etc.

The subjects dealt with are treated in a simple manner, suited to the general reader or regimental officer, and is not intended for experts. A great mass of useful information is condensed in a small space, and among items of interest is the following extract from p. 101:—

“Only two armies other than our own issue socks to their soldiers. These are Great Britain and Japan. The great military nations of the European Continent expect their men to provide themselves somehow with these articles, which by us are deemed of such importance. From motives of economy many German soldiers wrap oil-soaked cloths about their feet in lieu of socks.”

It would be of interest to know what our enemies and allies on the Continent of Europe are doing at this time about the provision of socks!

The price of the book is not stated, it is worth perusal by all interested in the subject.

H.B.

## NOTICE OF MAGAZINE.

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RIVISTA DI ARTIGLIERIA E GENIO.

*July—August, 1914.*

### OPERATIONS FOR THE PASSAGE OF UNFORDABLE RIVERS.

During the course of operations in war it frequently becomes necessary for large masses of men to force a passage across unfordable rivers, the passage being contested by the enemy. Such a crossing may happen under very different conditions, depending essentially on the characteristics of the rivers, on the formation of the ground near the river banks, on the strength of the detachments which are required to cross, as well as on the opposition that is likely to be made to the passage.

The considerations for selecting the points for forcing a passage across a river may be summed up under the following headings:—

- (a). To select in the first place the position for the principal passage, and also for secondary crossings at other points so as to distract the attention and the forces of the defender, and so to facilitate the main passage.
- (b). To pass across to the opposite bank, by means of rafts, boats, or pontoons a certain force of infantry required to hold the bridgehead.
- (c). To construct the bridges in the positions before selected.
- (d). To effect the crossing of the great columns by these bridges.

With the assistance of maps the ground on the banks of the rivers which it is intended to cross by force should be thoroughly studied, and the positions fixed for the construction of the bridge.

It is advisable to select positions for the bridges where the river is at its least width, and flows in a concave direction to the defence because the positions on the flanks of the attack are not so exposed to the enfilading fire of the defenders, and where the ground does not offer obstacles, such as marshes, watercourses, or canals, which would serve to impede the movements of the troops after crossing.

The secondary operations for the passage should be carried out on places where it is known or assumed that the defence is weak or absent, and these are then favourable to the success of the principal crossing because offensive action can be taken on the flanks of the defenders.

It is necessary however to bear in mind that secondary operations are frequently the cause of complications in the main operations of the crossing, and grave crises may occur when small detachments remain

isolated for a time on the same bank as the defenders. The principal objects for exploration and reconnaissance are

- (a). The width of the rivers at the spots proposed for the crossing.
- (b). The particulars of the defensive occupation near the banks ; the position of the artillery and mitrailleuses, the eventual commencement of a movement in retreat or the movements of reinforcements.
- (c). The location of searchlights or means of nocturnal illumination.
- (d). Watching those parts of the river that by their situation and by the nature of the banks would aid counter-offensive crossings by the defenders ; great vigilance should also be shown in watching the fortresses or bridgeheads situated in the vicinity.

#### *Operations for the Passage.*

For these it is especially necessary to transport to near the principal point of crossing not only the floating material strictly necessary, but also a sufficient reserve to replace any of the boats or pontoons that the enemy may be able to sink. These reserve materials should be placed at a little distance from the points of crossing in such a way that they can be easily utilized. It is a good rule to divide the material uniformly on the various selected points ; and especially to have at each point bodies of infantry equally strong, and to avoid losses or damage from the defenders' artillery fire to large masses of materials which have a tendency to be collected on favourable spots on the river bank. It is also necessary to avoid as much as possible the noise caused by the approach of the carts and materials to the river bank, and the throwing of the spars, chesses, etc., into the water.

The execution of the bridging operations requires promptness and punctuality by all the troops engaged, especially on the part of the engineers who with their proper equipment should be able to overcome difficulties and prevent friction. The commander should calculate the time, allowing ample time, so that the more delicate operations of loading and placing the boats in position in the water may proceed without undue haste, and on the other hand that the operations should not be too prolonged, so that the energies of the troops may be saved, and that there may be fewer risks of being discovered.

Night-time is preferable in some ways for the actual construction of the bridges, notwithstanding the difficulties that have to be overcome, because the defenders are not so active with their fire and counter-attacks as in the day. Misty weather is also favourable for all bridging operations without having the inconveniences of the night.

The opening of fire during the bridging operations at the opportune moment is of particular importance for the artillery. The guns of the attack which have not yet entered into action tend definitely to veil the intentions of the attack and the localities of the bridging and on opening fire disclose the secrecy of the operations. The opening of the artillery fire is a delicate question which can be left to the commander of the troops who will commence the fire accordingly as the formation of the bridgehead will meet serious opposition from the defenders on the opposite bank, or the reverse.

*Compilation of Orders.*

Another important question of the operations is the compilation of orders.

The commander, during the course of the reconnaissances after having disposed the troops, the technical detachments, and the materials provisionally, by aid of the map should be able to compile a draft of the various necessary orders. These should be definite and framed from the results of the explorations and reconnaissances.

The orders once given, it is not advisable to communicate them to the executive commands too long before their execution, as a sudden change of the situation may require alteration.

As regards the secondary crossings or feints of crossing, and the actual construction of the bridges, it is advisable that the superior commander should limit his instructions as far as possible, assigning the necessary material to the officers charged with the construction of the bridges.

The engineer troops required for the bridge construction should be drawn from the great unit of which they form part and from which they are assigned to the charge of the operations just for the time. It is also advisable to assign to the executive officers of the various operations, as guides, the heads of the patrols who have completed the most interesting and valuable reconnaissances in the direction of each operation.

The orders should be as brief as possible and should comprise (after explaining the preliminary indications and the general character of the work) all the instructions necessary for the completion of the work by the executive officer.

If there is time, it may be as well to add a sketch showing the indications contained in the writing in order to make the orders and instructions more clear. This is of importance in regard to the lines of communication and for the references to the network of roads, and for the various dispositions relating to the passage of the river in question.

*September, 1914.*

## MILITARY OPERATIONS FOR THE CROSSING OF UNFORDABLE RIVERS.

The article on the above heading which appeared in the *Rivista* for July—August is continued in the number for September with an historic example of the passage of the Limmat, by the French under Massena in 1799, which among numerous examples offered by military history appears to be one of the most instructive.

*Passage of the Limmat to Dietikon (25th September, 1799).*

The Archduke Charles evacuated Switzerland at the end of August, leaving Hotze with 17,000 Austrians, and Korsakow with about 31,000 Russians, altogether 48,000 Allies against 60,000 French under Massena. Suwarow, not being able to rejoin the new theatre of operations until the latter half of September, sent orders to Hotze and Korsakow to wait in their respective positions until his arrival (announced for the 26th September in Altdorf) in order then to commence a concentric movement against Massena. Massena had however decided to attack Korsakow and Hotze before Suwarow's arrival, with the greater part of



his force, and with the divisions Mortier, Lorges, Mesnard (37,000 men) crossed the Limmat and defeated Korsakow, and with Soult's Division and Moliton's Brigade (about 13,000 men) at the same time attacked Hotze in the valley of the Linth, in order to prevent him from hastening to Korsakow's assistance.

The Limmat from the Lake of Zurich up to its junction with the Aar formed a considerable obstacle, not so much for its width (from 100 to 150 m.) as for the great velocity of the current, the depth of the channel, and its rocky bed. Massena had taken two points of crossing into his consideration; one near Dietikon, the other near Höngg. Massena decided on the first, distant only 10 to 12 k.m. from Zurich, since it offered the possibility of breaking the enemy's lines and marching on Zurich, so as to fight with Korsakow.

The Limmat, near Dietikon, forms a loop convex towards the west, dominated by the left bank. The level ground near Urdorf stretches widely to the river, offering a good position for artillery, and covered from the view of the enemy's troops posted to the south of it. The width of the river is from 90 to 100 m., the velocity of the current is considerably less than in the mountains. The depth, also, offers a better anchorage than in other places. The left bank is covered with vegetation, and the village of Dietikon which rises in the immediate vicinity of the bank permits of the crossing being undertaken outside the view of the enemy. The right bank was also woody, and without communications leading to the river, was occupied by the Russian advanced posts. At the distance of 6—8 k.m., a hilly tract offered a good defensive position to the Russians (Markow's detachment, 1,800 men, 400 cavalry and 7 guns). On the left bank good roads coming from Baden, Bremgarten, and Zurich lead to Dietikon. The roads from Zurich it may be noted ran near to the point of crossing, at about 40 or 50 m. from the left bank of the river. On the right bank only a footpath intersected the roads, Zurich-Oetwil-Baden.

Massena, with the Lorges Division and half of Mesnard's Division (15,000 men), crossed the Limmat near Dietikon, driving back towards Zurich the Russian troops that he found on the right bank of the river, and marched on that town. The remaining half of Mesnard's Division (4,000 men) at the same time effected the passage of the Aar near Stilli (at its confluence with the Limmat) to deal with the Russian forces. Mortier's Division attacked in the direction of Wiedikon, the Russian forces of Korsakow, so as to deal with them with the assistance of Klein's Cavalry Division. The corps of General Humbert was in reserve at Albierieden to assist Mortier at Lorges.

The direction of all the technical preparations was entrusted to General Dedon, who had at his disposal 5 companies of pontooneers. From these one was sent to Soult for the passage of the Linth, and one to Mesnard for a demonstration near Stilli; there remained 3 companies for the crossing at Dietikon. A bridging detachment was at this time at work on the Reuss near Rottenswil. A *dépôt* of boats was formed near Brugg, on the Aar. Detachments of sappers were added to each unit of the troops.

The principal difficulty consisted in placing the bridging material

(near Dietikon) for the bridge at that point. The larger embarkations, too heavy for the transport wagons, were sent by water to Stilli, for the pretended passage. The smaller embarkations (sufficient for 900 men) were sent to Dietikon not by the road Brugg-Baden-Dietikon, which was too much exposed to the enemy's view, but by the ordinary road to Bremgarten whence they proceeded in company with the detachments coming from Rottenswil. These last to avoid suspicion were located along the Reuss only 24 hours before the crossing. The passage was effected partly by day and partly by night, and the convoy without the knowledge of the Russians was able to go to Dietikon at 1,500 paces from the bank, and to be united under cover. From this position, on the night of the crossing, the material was carried and escorted by infantry up to the river, it not being thought advisable to employ quadrupeds at such a short distance from the lines of observation of the Russians. In order further to deceive the enemy several demonstrations were made towards the confluence of the Reuss with the Aar.

Whilst on the 19th September, Massena in Bremgarten communicated to his generals the order to effect the crossing on the 26th, the Allies decided on the same day a general attack on the French positions. Massena becoming aware of this intention ordered the arrangements to be put into action at dawn on the 25th. Mesnard commenced the feigned crossing at 5 o'clock on the 25th, opening a heavy artillery fire against the enemy's positions on the opposite side of the Limmat, and ordering some companies to cross the Aar at the valley at its confluence with the Limmat. These after crossing, quickly constructed a small bridgehead near Vogelsang, under the protection of which they threw across a flying bridge. The three battalions at Mesnard's disposal were spread at wide intervals south of Stilli on the left banks of the Aar and the Limmat from whence they opened a sharp fire against the enemy's positions. This demonstration deceived Durasow who abandoned to itself Markow's Detachment at Dietikon and although within hearing of the guns took himself towards Frendenau. Becoming aware in the afternoon that he had been deceived he re-ascended the river with the greater part of his forces, but without result.

On the night of the 24th—25th September the 15,000 men of Lorges were assembled near Urdorf. General Dedon who assumed the direction of the crossing at first placed in battery 32 pieces of various calibre at the loop of the river, so as to bring a crushing fire on all the ground that they overlooked, dominating at the same time the right bank and so preventing the arrival of reinforcements. He systematized the crossing by sending 900 men who were ordered to approach on three different points, and with three groups of boats or pontoons. All the boats were transported at night by the pontooneers and infantry to the river bank.

Detachments of sappers stationed at each of the points of crossing executed the necessary works for facilitating the embarkation and disembarkation. All the preparations were made by midnight, the Cossacks who usually kept an active watch had seen nothing. At 4.40 Dedon gave the signal to throw the boats into the water. The operation proceeded very carefully, but the noise of the oars gave the alarm to the Russian advanced posts who opened fire. The operations were then

accelerated, and 300 men were able to approach the island in front of Dietikon and 600 on the opposite bank. The Russian advanced posts were badly placed for the defence, and the troops advanced assailing the Russian encampment while the French artillery rendered the defence on the enemy's bank unsustainable.

The Russian artillery at the first alarm had opened fire in the direction of the point of crossing, but with slight effect. After that the first orders for the crossing had been carried out without notable resistance Dedon ordered the artillery fire to be suspended, so that the crossing might be continued expeditiously.

The time for completing the embarkation for the passage of the river, for the disembarkation, and the return of the empty boats was not more than 10 minutes.

After the order for the second disembarkation, Dedon considered the success as assured, and gave orders to throw the bridge across the river. The crews and the equipment for the bridge were advanced from Dietikon and at 5 o'clock they commenced the work of constructing the bridge, whilst at the same time detachments of sappers prepared a passage through the woods to enable the artillery to advance to Kloster Fahr, after crossing the bridge.

The pontooneers had to contend against a strong current and difficult anchorage. The bridge, 100 metres in length, was finished by 7.30. At this time 8,000 French had crossed to the right bank; the remaining detachments of the divisions of Lorges and Mesnard (about 7,000 men) the greater part artillery and cavalry passed by the bridge. At about 9 o'clock the entire French corps had completed the passage.

E. T. THACKERAY.

## RECENT PUBLICATIONS OF MILITARY INTEREST.

## REVIEW OF BOOKS.

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## LAW.

AIRCRAFT IN WAR. By J. M. Spaight, LL.D. 172 pp. 8vo. London, 1914. Macmillan & Co. 6s.

In the opening part of this book the war right of aerial bombardment is treated at some length. The author takes as his text the very interesting lecture delivered at the Royal United Services Institution last April by Colonel L. Jackson, R.E., who raised the question of London's liability to attack by a hostile airship fleet. The author's conclusion is that the terms of the Hague *Réglement* for war on land, which exempts *undefended* cities from bombardment "by any means whatever," is not a sufficient international guarantee of London's security, and he quotes authorities, including German and British official manuals, to support his view.

To some extent the book is simply an expansion of the article entitled "War Law for Aircraft," which appeared in *The Army Review* for April, 1914. Some of the questions which were briefly dealt with in that article are treated in the book at greater length. An example is the question of attacks on raiding enemy aircraft by non-military populations. In the article, only the case of aircraft detached from an army which has invaded some portion of the opposed country was discussed. The equally conceivable case of raids carried out by airmen whose army has not yet set foot in the raided country is dealt with in the book. In the book many questions are more fully discussed than in the article and several new ones besides. Among the former is the question of neutral atmosphere. This is of especial interest to England for a foe coming to attack her from middle Europe would find his shortest air route lying over Belgium and Holland. The former is a neutralized country. The latter would probably be neutral in a war of the Great Powers. One assumes, of course, for this purpose that England's enemy is a State which respects treaties and has some regard for its honour and its bond; not always a safe assumption, as recent events have proved, but the world is being cleansed as these words are being written.

In one case the author has discarded in the book a view which he adopted in the article. He no longer thinks the *Alabama* rule can be applied to aircraft. The practical difficulties in the way seem to him, on reconsideration, too great.

Other questions are more fully discussed than in the article; for instance, that of the treatment of private enemy airmen who are captured. Dr. Spaight disagrees on this point with continental writers who hold that they should not be considered prisoners of war.

The question of contraband of war with regard to aircraft and their parts, and that of private enemy aircraft in enemy's territory on the outbreak of war, are also discussed.

The appendices contain codes proposed by MM. Fauchille, D'Hooghe, Le Moyne, v on Bar, and the author.

The author's code contains some new features not hitherto suggested. These are :—

- (1) an insistence on the necessity for uniform for pilots ;
- (2) recognition of military necessity as justifying the shelling of civilian aircraft in practically any circumstances ;
- (3) a simpler and yet more comprehensive view of what constitutes aerial espionage ;
- (4) a provision that air bombardment must in all cases be authorized by the general or admiral in command ;
- (5) a proposal that, though, for belligerent aircraft passage through neutral atmosphere and entry of neutral ports are strictly forbidden, an exception should be made in the latter case in favour of seaplanes attached to a fleet so long as they remain in actual contact therewith.

These and other new suggestions are discussed at some length. Dr. Spaight has supplied a basis from which any discussion of international law as applied to aircraft must proceed. Many points demand some definite ruling. Fighting aircraft has beyond all question come to stay—as the author points out ordinary rules cannot govern them since land and maritime law differ and yet the same type of aeroplane might be attached either to an army or a fleet.

### STRATEGY, TACTICS AND TRAINING.

THE OPERATIONS OF SMALL FORMATIONS IN THE OFFENSIVE. (*Étude sur la conduite des petites unités dans l'offensive*). By Capt. C. Barberot. Part I., Evolutions, Approach Marches, Combat. 104 pp. Plates. Paris, 1913. Lavauzelle. 1s.

In a preface the author justifies the publication of his work. From a *régime* of stereotyped company and battalion evolutions "lightened up at times by a little guerilla warfare" the French Army has since 1904—according to him—gone to the opposite extreme. The preaching of "initiative" and of "reason as opposed to rote" brought "liberty too suddenly to slaves." The development of higher studies caused many to despise the details of handling small units. "Ideas" for all evolutions prevented "step by step" instruction. Application of knowledge preceded the acquiring of it. Russian and Japanese officers fresh from Manchuria who saw the French Army said : "You are too apt to consider small bodies as acting independently." The author assures his younger comrades that close attention to details of leading small units will call for talents and judgment quite equal to that which they may be required to display in the course of larger manœuvres.

The author treats separately :—

*Evolutions* whilst troops are in the hands of their commanders and can manœuvre.

*Approach Marches* when they are committed to a definite task, and retain only limited manœuvring powers.

The *Combat*—when they use their arms.

Treating of evolutions the author regrets that the French regulations do not draw a clearer distinction between parade movements (designated merely to inculcate passive obedience) and evolutions properly so called. For the practice of the former he thinks a definite time limit should be laid down, but correct commands, etc., should be strictly insisted on. For the directing of evolutions he considers absence of noise and use of signals to be essential. He emphasizes the importance of commanders not remaining glued to their units.

Approach marches are dealt with at considerable length. The author considers them to be profoundly modified by the offensive strategy (marching quickly towards enemy on a broad front) recently adopted in France, and by the advent of aeroplanes. They largely concern regimental officers and are much more difficult than is generally supposed, offensive movements signifying a narrower frontage for units, will limit opportunities for utilizing covered approaches. Later on (p. 51 *et seq.*) he points out that no well-defined line separates "evolutions" and "approach marches," even units of a battalion may change from one to the other according to the exposure

of the ground over which they pass. Considering formations from the point of view of avoiding losses, he points out that in approach marches, formations—even in the case of sub-units of the smaller commands—will vary according to the intensity and nature of the fire directed at them, *e.g.*, the head of a semi-deployed unit may form columns smaller than the rear portion. Hence the great importance of the platoon commander's rôle. Sketches on p. 39 show various formations which a battalion might adopt during an approach march. Proceeding to consider the question from the point of view of the facility for manœuvring he lays down certain principles:—

*Direction.*—Normally, every commander should, until prevented by hostile fire, keep near to a directing unit by which all subordinate units should march. Further, a commander should place himself so as to make his influence felt quickly at a critical moment, which generally means well to the front.

*Pace.*—The pace must depend upon the nature of the task to be carried out, and also upon the ground.

*Intercommunication.*—Communication must be kept from top to bottom, *vice versa*, and laterally. Means for ensuring it, says the author, are insufficient. Six mounted scouts per battalion are required, he thinks, (a French regiment actually has twelve per regiment) one to each company, and two at battalion headquarters.

*Reconnaissance.*—All commanders must constantly get well to the front to ensure this. When thus leaving their units they must place points to guide these latter. For this purpose, and for showing to the artillery the positions of the infantry units, the author recommends the use of battalion flags (formerly carried in the French Army). For efficient reconnaissance he considers that infantry officers should remain mounted as long as possible, and deplors the haste to dismount shown at peace exercises, "an isolated horseman is not easy to hit even at 900 yards; our men will begin to think that we value our skins unduly."

*Security.*—All units near the head of a formation should cover themselves by patrols pushed to points within rifle range: this signifies a distance varying according to the ground, but 600 to 800 yards will generally constitute the limit to which these protective patrols could go.

Coming to the combat he emphasizes the importance of putting into the firing line the smallest possible number of rifles, since fire impedes movement, except in cases where the situation demands a vigorous initial effort. He discusses also the advisability of limiting the number of rounds to be fired at each burst, and thinks that this should, generally speaking, be done when covering short movements. For fire control he recommends numbering certain "description points," a system which appears less practical than the designation of such points contemplated in our regulations. He discusses the size of units by which advances should be made and the formations to be adopted. By a sketch map on p. 68 he illustrates his view that this is entirely a question of ground.

MILITARY EDUCATION IN THE UNITED STATES. By Capt. Ira L. Reeves, U.S. Army. 431 pp. 8vo. Burlington, U.S.A., 1914. Free Press Printing Co. 7s. 11d.

This is a book which undoubtedly will fill a gap in the library of anyone interested in military education. In addition to chapters on West Point and the various Army Service Schools (which range from the Army War College to the School for Bakers and Cooks) there are sections on military education in civil institutions of learning and in Land Grant Colleges and Universities. Not the least interesting part of the book is to be found in the pages devoted to specimen examination questions for entrance to the Military Academy: it is gratifying to find in the question "what are the most important facts about the life and works of anyone of the following authors" that, of the six authors given, five are English, Burns, Milton, Keats, Tennyson and Dickens; the many admirers in this country of the author of *Tales of Mystery and Imagination* (who was by the way a student at West Point) will be delighted to find that he is the remaining writer in the list.

RUSSIAN REGULATIONS FOR THE INFANTRY COMBAT. Official. 77 pp. 8vo. St. Petersburg, 1914.

This manual, issued for the first time, forms a counterpart to Part IV. of our Infantry Training. The latest Russian *Field Service Regulations*, which appeared in 1912, are being supplemented with brief manuals for each arm. That under review is the second to appear, *Regulations for the Action of Artillery in the Combat* having been issued in 1912.

Manuals of tactics issued by an army which has had late experience of a great war, and which is making a great effort to remedy the defects discovered by that war, have naturally a special interest. The chief defects of the Russian infantry in Manchuria may be said to have been dense and antiquated formations unsuited to modern warfare, bayonet attacks with insufficient fire preparation, and lack of individual initiative and offensive spirit. The formations now laid down are in accordance with the general principles in practice in our own armies, but the impression given by a study of these regulations in comparison with our own Infantry Training is that, in their desire to cultivate the offensive spirit at all costs, the Russians have neglected to emphasize the necessity for preparation by fire before an assault. The words "superiority of fire" do not occur in the manual at all, and there is no indication of a systematic building up of the firing line to the requisite strength in order to obtain it.

A few quotations may serve to show the general tendencies of the manual :—

"The strength of infantry in battle lies in rifle and machine-gun fire combined with a resolute advance and bayonet charge." (Paragraph 2).

"Independently of the distance separating the two forces, the assault should commence at the moment when, according to the object in view, the situation, and the results already obtained, the time has come for the bayonet charge; or when it is noticed that the enemy's *moral* is wavering." (Paragraph 82).

"The assault should be made not only on a weakened adversary, but on an adversary who still retains readiness to beat off the assault, if the situation demands it and if it is necessary to help some other portion of one's own force." (Paragraph 83).

"Infantry carries out the assault firing on the run from close distances; before the bayonet attack hand grenades are thrown. If the enemy is surprised he should at once be attacked with the bayonet, without waiting to open fire." (Paragraph 87).

"If the assault fails, it should be repeated till the object in view is obtained." (Paragraph 92).

The signal for the assault will usually come by the action of some part of the firing line and should be supported by the remainder. Very considerable individual initiative in this respect is encouraged thus in the section on the counter-attack in defence :—

"The attack of a company should be supported by neighbouring units without awaiting special orders from the higher commander." (Paragraph 127).

"On occasions the general counter-attack of the battalion may take place by the necessity to support one of its companies which has attacked on its own initiative." (Paragraph 163).

Generally, in the defence, no clear line is laid down between the local and general counter-attack.

A few other points of interest may be briefly noted :—

(a). Position of commanders—"Every commander should be in the position from which he can best direct the units under him and if possible personally watch their action. . . . At critical moments he should be in such a position as directly to control the troops and inspire them by his personal example." It has been remarked on peace manœuvres that Russian battalion and regimental commanders are apt to be too far forward in action.

- (b). Very great stress is laid on detailing special parties or individuals for observation over the field of battle. It is laid down that every unit down to the company must always arrange for this.
- (c). Volley firing may be used at long ranges at large and important targets to pursue a retreating enemy; to repulse a night attack; for ranging. In the firing line volleys should not be used by a larger body than a section.
- (d). The length of a rush in the advance over open ground should average about 100 paces.
- (e). The firing line entrenches, by order of the commanders in the firing line, when it is necessary to remain long on one fire position, or to secure a position won from the enemy.

The last three sections of the manual deal with the meeting of an attack by cavalry, night operations, and the use of searchlights. The principal injunction with regard to the former is that a cavalry attack should be met by fire in the formation in which infantry are at the time; any attempt to carry out complicated changes of formation will usually result in confusion. The section on night operations is brief but contains all the usually accepted principles. Searchlights are being widely adopted in the Russian Army and every infantry regiment will eventually be equipped with them. General principles only are laid down here.

Taken on the whole, these regulations are much briefer and more general than our own, which fact makes them a little difficult to criticize. No exception can be taken to any of the general principles laid down, but, as indicated above, the tendency seems to be to encourage offensive action to an extent that may possibly cause the neglect of fire preparation. Perhaps the Russian General Staff have embodied in this manual the ideas derived from a study of the tactics of their fellow Slavs in the Balkans. The present rank and file of the Russian Army have not, perhaps, reached such a high pitch of civilization as their neighbours. They should, therefore, be able to endure a heavier percentage of loss in order to get home with the bayonet. It is possible that the Russians in the desire to cultivate the offensive spirit, which is apparent in all their training manuals recently issued, are deliberately prepared to face the losses which may be incurred by premature assaults.

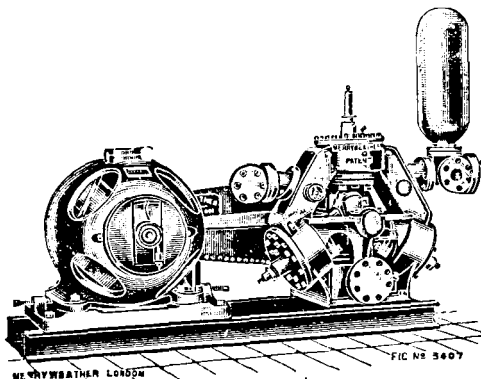


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