

GÉNÉRAL REPORT
SURVEY OF INDIA

1900-1901.

employed as the river was far too wide to cross by the ordinary method of levelling. The agreement of the three methods was satisfactory. The outturn amounted to 211 miles of double levelling.

45. The Magnetic party which was formed in December 1900 was employed for the rest of the year in making preparations for the work. Base stations at which continuous magnetic records will be made are required at Bombay, Calcutta, Kodaikánal, Dehra Dún and Rangoon. At Bombay and Calcutta such observatories already exist, but unfortunately the introduction of Electric tramways in these two cities will vitiate their magnetic records and it has become necessary to arrange for other observatories which will be free from the effects of the electric current. It is hoped that these arrangements will be made in sufficient time to allow the field observations to be continued without break.

GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

46. Under this head are included surveys and reconnaissances which are executed on the $\frac{1}{2}$ -inch or smaller scales. In Kashmir and neighbourhood an area of 3,224 square miles was surveyed on the $\frac{1}{2}$ -inch scale, and on the N.-W. Frontier an area of approximately 20,000 square miles was mapped on the $\frac{1}{4}$ -inch and $\frac{1}{8}$ -inch scales.

A survey party, consisting of Major Renny Tailyour, R.E. (in charge), Munshi Ikbaluddin, K. S., and three surveyors, was sent with the China Field Force. Captain C. H. D. Ryder, R.E., being in China at the time was ordered to join the Field Force where he remained until the whole party returned in August 1901. Thanks to the energy of Major Renny-Tailyour and Captain Ryder, and the co-operation of the Intelligence Branch, the triangulation of 16,000 square miles of country was completed, and the large area of 17,000 square miles was mapped in detail on the $\frac{1}{2}$ -inch scale. Major Renny-Tailyour has since been promoted to Brevet Lieutenant-Colonel.

HEAD QUARTERS OFFICES, CALCUTTA.

47. The general direction of these offices remained in the hands of Colonel St. G. C. Gore, R.E., Surveyor-General of India, throughout the year. The Revenue Branch Section was under Colonel J. R. Hobday, I. S. C., Deputy Surveyor-General, up to 30th March 1901, when he proceeded on leave and Major F. B. Longe, R.E., was appointed to officiate for him.

48. The other offices in Calcutta were, as usual, supervised by three Assistant Surveyor-Generals. The General and Topographical Branch Sections as well as the Mathematical Instrument Office were under Major Longe, R.E., up to 30th March, and thereafter under Major G. B. Hodgson, I.S.C. The Drawing, Engraving and Map Record and Issue offices were under the supervision of Major J. M. Fleming, I. S. C., throughout the year, while the Photo-Litho. Office was under Mr. T. A. Pope, up to 15th November 1900, when he proceeded on furlough and Mr. A. E. Spring succeeded him. Major Hodgson was on duty at Head-Quarters from 26th November 1900 to 30th March 1901.

49. In the *Correspondence Office* there has practically been no change in the procedure.

50. *Drawing Office.*—The Geographical Section has been engaged on the compilation of the various general maps, as well as the bringing up to date and adding to sheets when fresh material is available, and preparing for press and publishing these, as well as sheets received from the various field parties. Of the North-East and South-East Frontier Series seven sheets have been completed and published, while ten more are passing through press or in hand. Eight more sheets have been added to or brought up to date. Many of these sheets are in several sections, additions having been made from time to time, or more reliable work substituted for that already drawn. As this causes frequent mistakes, an attempt is now being made to join up all the latest material in single sheets. Several have been thus treated and the result should be a considerable saving in time in reproducing them when required. Of the North-western Frontier Series two sheets on the 1-inch and $\frac{1}{2}$ -inch scales have been brought up to date.

Of the 1-inch standard sheets, five of the Burma maps have been under preparation, and of these three are either at, or almost ready for, press. Thirteen other sheets have been prepared for press and published, while additions to five more have been made. Of the standard sheets of the rest of India 45 have been in hand, and of these 25 have been published, the remainder being under publication or awaiting further material. Of the Madras Forest Survey on the 4-inch scale, 47 sheets have been dealt with, and of these 35 have been completed and published. Nineteen Provincial maps on various scales have been brought up to date. Of District maps on the $\frac{1}{2}$ -inch scale, 25 have been added to in various ways. These maps, particularly in Assam and Bengal, are mostly compiled from old Atlas sheets, and often in a very unsatisfactory state. Several complaints have lately been received about them; one stated that a river shown on the map was 15 miles out of its true position, another that on one of these maps, along a road inserted from extra-departmental sources, the adjoining villages fell on the wrong sides of the road, while a third stated that owing to changes all over, the sheet supplied was utterly useless. Twenty-two of the Administration report maps on different scales have been in hand, and of these seven have been completed and published. Of the sheets of the Atlas of India 116 have had additions made to topographical features or names, while eight have had hills brush-shaded for the Engravers, and a considerable amount of brush-shading on other maps has also been done. The various Departmental General maps of India on various scales have all been in hand for revision, and most are now quite up to date, and will shortly be ready for issue, revised in railways and boundaries. Progress on the new 64-mile map has been suspended for the present owing to press of work, but a considerable amount of outline in one sheet has been engraved. It is now proposed to prepare this sheet by reduction from a new 32-mile map of India. The compilation of the duplicate 64-mile map of India has made satisfactory progress, while that of the new material for the outline of the new 32-mile Litho. map of India is practically finished. A new edition of the 48-mile railway map has been issued, but as the stones are very much worn out and the map somewhat out of date, a new edition is under preparation, and is well advanced. The 32-mile map of India showing railways with stations has at last been published, while that on the same scale showing railways and canals has been brought up to date in railways and boundaries, and will, it is hoped, shortly issue. It is intended to bring out a new engraved map of India on the 32-mile scale, and a good deal of revision of the existing map on the same scale as well as of fresh compilation has been accomplished. Of the new $\frac{1}{1,000,000}$ scale map of India and adjacent countries two sheets (Nos. 78 and 83) are approaching completion in outline, and another has been projected. It is now intended to engrave at once such sheets of this map as reliable material is available for, instead of bringing out a preliminary photo-zinco edition as was originally intended.

The maps of various cities and cantonments have been brought up to date or added to, and new maps of Maymyo on the 16-inch scale in 15 sheets and of Aijal in two sheets on the 24-inch scale have been sent to press, and the first published.

As usual there has been a very large amount of extra-departmental work.

A series of 23 maps of the various Provinces or Districts of India was prepared under instructions received from the Census Commissioner. Some of these had to be subsequently added to or modified at the request of the local officials, and two additional maps to supersede the one first supplied have been prepared for the Central Provinces. The Route map of the Punjab and Bengal Command has been most troublesome from various causes; but it is hoped that the latest proof submitted to the Military Authorities will be finally approved. Eight sample sheets (comprising Bihar and part of Bengal) of a proposed new postal Atlas of India on the 8-mile scale have been in hand, and proofs have been supplied to the postal authorities for approval. Other maps have been prepared for the Archæological and Botanical Surveys, and for the Foreign, Military, Forest, and Medical Departments.

The Section has been until the latter part of the year much handicapped by lack of supervising Establishment and at times work has been carried on under great difficulties. Owing to this, the much needed revision of the map catalogues has had to be delayed, though that of Madras is now ready for press.

APPENDIX.

Narrative report of MAJOR T. F. B. RENNY-TAILYOUR, R.E., Superintendent 2nd grade, on the Survey Operations with the China Field Force, season 1900-1901.

The survey party detailed for the China Field Force under Lieutenant-General Sir

Major T. F. B. Renny-Tailyour, R.E.
Captain C. H. D. Ryder, R.E.
Munshi Ikbaluddin, K.S.
Surveyor Abdul Rahim, K.S.
Surveyor Natha Singh.
Sub-Surveyor Hazrat Ali.
1 Interpreter and 29 *Khalasis*.

A. Gaselee, K.C.B., is given in the margin.

At the time of deciding to send an expedition from India to China the outlook was so doubtful that it was considered advisable to delay the despatch of a Survey Party until it appeared certain that operations would actually take place. Conse-

quently it was not until the 15th July 1900 that orders for the survey party were issued.

I left Bangalore for Calcutta with Munshi Ikbaluddin and the surveyors on the 20th July.

Captain Ryder received orders on his arrival at Shanghai to join the expedition and left there for the front on the 21st July.

The *khalasis*, who were supplied by No. 15 Party and came from the neighbourhood of Rawalpindi, joined me at Calcutta. In addition to the ordinary equipment, which was supplied by the Dehra Dún office, I took two Perambulators. The tents for the party, as laid down in the Field Service Regulations, Intelligence and Surveys, were obtained from the Ordnance Department at Calcutta, and clothing, etc., from the Commissariat Department at Calcutta. On field service, surveyors, sub-surveyors and *khalasis* have relative rank as native officers, havildars and sepoy for the scale of allowance of tentage, baggage, rations, etc., but for clothing they are also allowed in addition such articles of the equipment authorized for followers as may be necessary, this is sanctioned in letter No. 248-W, dated 2nd May 1895, from the Military Department to the Surveyor-General of India.

The Survey Party was ordered to leave Calcutta on the 2nd August in the S. S. "*Rewa*" which had also a squadron of the 16th B. L. on board. The "*Rewa*" was a comfortable steamer but rolled badly, and we had a fairly rough passage, losing twenty horses and mules. We called at Hong Kong and Wei-Hai-Wei, and arrived early on the 24th August at the Taku anchorage, about ten miles from the shore, where an enormous number of warships and transports of all nationalities were collected. We were transhipped into a small steamer and landed the same evening at Sinho, the British depôt near Taku. Next day we proceeded by rail to Tientsin which presented an extraordinary sight; the streets were crowded with an endless variety of foreign troops, many of whom were passing through on their way to Peking. The bank of the Pei Ho (river) alongside the Foreign Concessions was covered with stores of all descriptions, and the river itself crowded with boats, the larger of which were being unloaded of stores brought up from Taku, while the smaller ones were loading up for Peking and the Posts *en route*.

On my arrival at Tientsin I wired for orders to the Chief of the Staff at Peking, suggesting that I should send a small detachment there for Captain Ryder, and start the survey work myself at Tientsin before moving on.

The telegraph line was not working properly, and it was some time before I received a reply ordering me to proceed to Peking and to survey the Pei Ho and the roads along its banks on my way. While awaiting this reply I had time to complete a triangulation in the neighbourhood of Tientsin and started Surveyor Natha Singh on a 1-inch survey of the town and the country round about. It was impossible to make an extensive triangulation here, owing to the flatness of the country.

Leaving Natha Singh with some *khalasis* and the heavy baggage at Tientsin, I started with the remainder of the party for Peking on the 9th September, surveying the river and roads as ordered. Our baggage was carried in boats as far as Tungchow, from which place Peking is about 14 miles distant by road. On the 17th September we arrived at Peking, where I met Captain Ryder who had joined at Tientsin from Shanghai in time to accompany the International Force which relieved the Peking Legations on the 14th of August; he had done a certain amount of surveying assisted by the Intelligence surveyors. After my arrival in Peking the field offices of the Intelligence and Survey were practically one, and the military surveyors worked so much under Captain Ryder and myself that it would be impossible to altogether separate the work done by the surveyors of the different branches.

As there were a large number of villages and most of the country to be surveyed was in the plains, I decided that the plane-tableing should be on the half inch scale. I started triangulation; measured a base; observed for latitude and azimuth; and in a short time had relatively fixed the principal hills within sight of Peking, as well as prominent points in the plains.

At first we were unable to move much out into the country, but the surveyors had plenty of work, making large scale plans inside the city, and compiling maps of the neighbourhood from surveys made by the Japanese prior to the disturbances.

Manshi I kbaluddin started off on the 9th of October on a reconnaissance to the south-west; and on the 12th I set out with an International expedition under Lieutenant-General Sir A. Gaselee, K.C.B., for Pao-ting-fu; I took Abdul Rahim and Hazrat Ali with me, and there were also two military surveyors. A column was also sent from Tientsin to combine with us, and I arranged for Natha Singh to accompany it. Pao-ting-fu is situated about 100 miles to the south-west of Peking.

We were not opposed by the Chinese, and arrived at Pao-ting-fu on the 19th of October, the Tientsin column with Natha Singh arriving the following day. As the road was entirely in the plains and the weather generally hazy it was impossible to carry on a connected triangulation *en route*; I was, however, able to fix our position at several points, by observations to hills already fixed from Peking.

At Pao-ting-fu we were able to rescue several Europeans who had been very badly treated and had had several narrow escapes. A number of Europeans had been murdered here some months before, and an International Commission was appointed to enquire into the matter. Punishments were inflicted on the town, and the principal official and several others were beheaded.

During our halt at Pao-ting-fu I measured a base and did some triangulation; I also observed for azimuth and latitude, and by this means was able to connect on to the Peking series. Abdul Rahim accompanied a small column sent out to the west and did some useful mapping.

We started back from Pao-ting-fu on the 28th, leaving a garrison of French and German troops. It was arranged that the columns returning to Peking and Tientsin should split up and march back by several new roads, and, as a surveyor was sent with each party, we were enabled to get in a good deal of new country. The party I accompanied made a considerable detour to the east and arrived at Peking on the 6th of November.

Soon after my return permission was obtained to send Captain Wingate of the Intelligence and also a Survey detachment with a German column proceeding to Kalgan, about 120 miles to the north-west of Peking and on the outer Great Wall. This detachment consisted of Captain Ryder, Ikbaluddin and Hazrat Ali with one military surveyor, and started on the 12th of November. Owing to the long marches in pursuit of continually retreating Chinese troops no triangulation was possible, but a route traverse was kept up all the way. At Kalgan reliable information was obtained regarding the murder of Captain Watts-Jones, R.E., which had taken place some seven marches to the west, in the month of July. As the German column was returning by the same route, Captain Ryder decided to send Ikbaluddin back with it to fill in additional detail, while he with Captain Wingate returned by a new and more circuitous path through the hills, rejoining the Germans at Ch'ang-pi'ng-chou near the Ming Tombs about a week later, and from there making a small detour in the plains before returning to Peking on the 6th of December.

Surveyor Natha Singh came up to Peking from Tientsin on the 21st of November with the remainder of the *khalasis* and the heavy baggage.

Owing to the severe winter very little surveying was practicable for the next two or three months, and it was not until March that we again got the surveyors regularly out into the country. During these months we were fully employed compiling maps etc., principally with a view to the possibility of expeditions in the spring to the south and south-west. Great use was made of Chinese maps which in this part of China appear to be very fairly accurate in the plains, although the delineation of the hilly country is weird in the extreme. The translating of the names alone was a considerable undertaking.

Captain Ryder proceeded in March to Shan-hai-kuan, started a triangulation there and continued it to Tong-Shan, where he joined a column of about 200 men under Major Turner, Jodhpur Lancers, detailed as an escort for himself, Natha Singh and a military surveyor. In spite of hazy weather he managed to carry on and eventually connected his triangulation on to my Peking series.

A similar column under Colonel Phayre, 3rd Bo.C., with whom I sent Surveyor Abdul Rahim with Hazrat Ali and a military surveyor, working from Peking, met Major Turner's column at the Eastern Tombs, and between them a very large amount of country was surveyed up to the Great Wall.

Besides these columns, from March until the end of June we were able to obtain numerous small escorts, generally under an officer, which kept us very busy, and, with sometimes as many as ten military surveyors working in addition to the Survey Party, a large block of country was mapped in detail.

Surveying becomes quite impracticable in the plains in this part of China during the rains, which commence early in July, and as there was no prospect of being allowed to survey further afield, it was decided that the Survey Party should return to India about the middle of July.

Two draftsmen of the Intelligence arrived from Simla at the beginning of June. This additional help enabled us to reproduce, before our departure, preliminary maps for the use of the troops remaining behind.

The Survey Party left Peking on the 14th of July, and returned to India in the S. S. "*Sumatra*," arriving at Calcutta on the 2nd of August 1901.

Altogether the triangulation of 16,000 square miles of country was completed. As it was impossible for us to obtain our own longitude accurately we based our work on the Naval value of the Shan-hai-kuan lighthouse. The triangulation has been carefully computed at Bangalore, and the connection between the Shan-hai-kuan and Peking series

has proved very satisfactory, the Pao-ting-fu series also connecting well on to the Peking series.

There is thus a good continuous reconnaissance triangulation right round from Shan-hai-kuan to Pao-ting-fu.

The actual surveying in detail on the half-inch scale was carried on by means of plane-tableing, and a total area of 17,000 square miles was completed.

Owing to the hazy weather and the flat nature of the country it was impossible to use triangulated points for a great deal of the work, but, by means of accurate traverses by our own surveyors, the country was fairly well divided up, and thus a good check obtained of the work of the other surveyors. The Perambulators came in very useful for these traverses.

The military surveyors are of course not in the same class as the trained surveyors of the Survey Department, but their work, with a certain amount of adjustment, has generally fitted in wonderfully well; the final maps, drawn on the return of the Survey Party to Bangalore, and based on the triangulation and on the accurate work of our own surveyors, are very satisfactory and quite sufficient for all general purposes.

Without the intimate and cordial relations, which always existed on the expedition between the Intelligence Branch under Captain Norie and ourselves, it would have been quite impossible to have obtained anything like such good results; great assistance was also rendered by Doctor Gatrell, who was attached to the Head-Quarters as Interpreter, in the transliteration of the Chinese names, for which the official system (Wade's) was always adopted.

We had occasional communications with Captain Koenemann, the Officer in charge of the Survey Party with the German army. We gave them some assistance, and received in return a trace of a considerable area of country surveyed by them to the south of our own work. They did not attempt any triangulation, but their work, which was in the plains, appears to be very accurate; it was, I believe, done by officers and chained throughout.

On landing at Taku the country presents one dead level, but as Peking is approached ranges of hills appear to the west and north; these hills continue eastwards towards the sea, till at Shan-hai-kuan they are within three miles of the coast. The whole of the plain is well cultivated and studded with large and prosperous villages, except near the coast, where mud flats abound, relieved here and there by salt heaps, the collection of which forms a most important industry. The crops when full grown rise to 15 or 16 feet in height and absolutely prevent any extended view of the country being obtained.

The weather encountered was extremely annoying to a surveyor and at no season of the year was there a certainty of having two consecutive clear days. In the rains although the atmosphere is clearer clouds hang about the higher hills, in the cold weather there is an almost continuous haze, while the hot weather is no better. This haze is probably largely due to duststorms emanating from the bleak Manchurian plateau.

It is probable that there is a greater range of temperature in North China than in any other part of the world, the temperature in the shade varying from 100° (Fahr.) in the summer to below zero in the winter. In spite of this, the climate is not unhealthy, and good food is everywhere obtainable.

A plentiful supply of warm clothing was issued to the Force, and the good health of the party was in no small measure due to this precaution.

Captain Ryder is a very experienced surveyor and rendered me invaluable assistance throughout; his knowledge of the Chinese was extremely useful.

Munshi Ikbaluddin is very energetic and hard-working, and showed considerable tact in his dealing with military and other officers.

Surveyor Abdul Rahim is a very quick and experienced surveyor, he is most trustworthy and has a great knack of getting on with anyone whom he comes in contact.

Surveyor Natha Singh is a good and capable surveyor, and may always be relied on to bring in neat and accurate work.

Sub-Surveyor Hazrat Ali's knowledge of Chinese was most useful, he is very zealous and promises to turn out well.