

Office of Superintendent G. T. Survey,  
Dehra Doon, 1st November, 1864.

From  
LIEUT.-COLONEL D. G. ROBINSON, R.E.,  
Offg. Superintendent G. T. Survey,

To  
THE SECRETARY TO GOVERNMENT OF INDIA,

ERRATA AND CORRIGENDA

(in Captain J. P. Basevi's Report on the Jeypore Territory.)

- Page 4 Line 3, for "Barli," read "Barhi."  
 " 4 " 4, for "Subalur," read "Subalúr."  
 " 5 Line 8 from bottom, for "Rampali," read "Rampak."  
 " 6 Paragraph 25, for "Tuipúram," read "Inipúram," in two places.  
 " 7 Paragraph 26, for "Baudardé Durgam," read "Bandardé Durgam."  
 " 7 Last sentence of Para. 26, after "Saveri" insert "here."  
 " 7 Paragraph 27, for "Kookonda," read "Korkonda."

(Signed) J. P. BASEVI, Captain, R.E.

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Superintendent, who was expected to reach Dehra about the 10th December; and also to carry out the Surveyor General's wishes that I would inspect Captain Melville's Topographical parties in Central India, I left my head-quarters at Dehra on 15th January, and proceeded *via* Delhi, Ulwar and Keraoli, to the neighbourhood of Sepree, at which place I had directed Captain Nasmyth to meet me. Unfortunately, Captain Nasmyth did not return to India until much later than I had anticipated, and he thus lost the opportunity of seeing the *modus operandi* of those Topographical parties; but he gained a good insight into what is required by personally visiting my head-quarters in June. I returned to Dehra early in March, in time to despatch a small party to complete the survey of Kashmir, and to explore Trans-Himalayan Central Asia,—the latter duty to be executed by natives of the country especially trained for the purpose.

4. The progress of the field work has been satisfactory. Sickness and paucity of officers to replace those sick, unfortunately compelled me to temporarily suspend one of the astronomical parties, and the Mangalore Series had also to be temporarily suspended, owing to the injury done to the theodolite in use when the Palwan station tower subsided, as mentioned in para. 29 of last Report.

Office of Superintendent G. T. Survey,

Dehra Doon, 1st November, 1864.

From

LIEUT.-COLONEL D. G. ROBINSON, R.E.,

*Offg. Superintendent G. T. Survey,*

To

THE SECRETARY TO GOVERNMENT OF INDIA,

*Military Department,*

*Fort William.*

SIR,

By G. O. G. G., No. 1,470 of 1863, dated 2nd October, 1863, I was directed to officiate as Superintendent of the G. T. Survey of India, and on 9th November, 1863, I received charge from Lieut.-Colonel J. T. Walker, R.E., who proceeded to Europe for fifteen months on that date, for the purpose of visiting the principal Observatories, and consulting the leading geodesists and mathematicians of Europe, on various matters of great importance connected with the great triangulation of the peninsula of India.

2. Lieut.-Colonel Walker will, I presume, make a special report of what he has seen and done in Europe. The duty of reporting on the progress of the regular operations of the Department in this country devolves upon me.

3. My first care, after receiving charge, was to complete the organization and arrange for a new party required for the survey of Northern Bombay, which, for reasons given hereafter, was placed under the command of Captain Haig, pending Captain Nasmyth's return from furlough, and for the purpose of instructing Captain Nasmyth, who was expected to reach India about the 15th December; and also to carry out the Surveyor General's wishes that I would inspect Captain Melville's Topographical parties in Central India, I left my head-quarters at Dehra on 15th January, and proceeded *viâ* Delhi, Ulwar and Keraoli, to the neighbourhood of Sepree, at which place I had directed Captain Nasmyth to meet me. Unfortunately, Captain Nasmyth did not return to India until much later than I had anticipated, and he thus lost the opportunity of seeing the *modus operandi* of those Topographical parties; but he gained a good insight into what is required by personally visiting my head-quarters in June. I returned to Dehra early in March, in time to despatch a small party to complete the survey of Kashmir, and to explore Trans-Himalayan Central Asia,—the latter duty to be executed by natives of the country especially trained for the purpose.

4. The progress of the field work has been satisfactory. Sickness and paucity of officers to replace those sick, unfortunately compelled me to temporarily suspend one of the astronomical parties, and the Mangalore Series had also to be temporarily suspended, owing to the injury done to the theodolite in use when the Palwan station tower subsided, as mentioned in para. 29 of last Report.

5. The suspension of this Series, however, has not been productive of inconvenience, as will appear hereafter.

6. The Series now progressing south have done better than could be expected. The malaria of the deadly jungles they have to pass through is so notorious that we have every reason to be thankful they have hitherto escaped without serious casualties. Every precaution has been taken to prevent our over-zealous surveyors entering them during the sickly periods of the year, and to enable them to combat the fever when attacked by it.

7. The important survey of Kashmir has been brought to a satisfactory conclusion during the past year. This survey embraces in an area of 70,000 square miles (or considerably more than that of England) every variety of climate, scenery, and physical formation. The Nanga Parbat, or Dayormur, the peaks marked  $K^1$  and  $K^2$ , and several others, are very nearly the highest mountains in the world, exceeding in altitude 25,000 feet. Wherever our surveyors have been able to obtain access, they have struggled against every difficulty, and mapped the country. There is not a valley in those wild regions of perpetual snow, within the territories of Jamoo or Kashmir, that they have not visited; so that, however much we may regret that the Chinese officials prevent the extension of this survey still further into the *terra incognita* of Central Asia, both Captain Montgomerie (who from its commencement has superintended the operations) and his energetic enterprising assistants may well be proud of what they have accomplished so well and satisfactorily.

8. During the past season the position of many peaks of prominent mountain chains in Afghanistan, Chitral, and other states far beyond European accessibility, have been laid down, and some valuable reconnoissances of Chinese territory have been effected, in addition to the regular topographical delineation of the territories of Kashmir, in the neighbourhood of the Pangong Lake—all that remained to complete the survey.

9. The party is now employed in drawing up the final report of the work, and will shortly commence on British Gurhwal and Kemaon, and thus gradually extend the survey of the Himalayas as far to the east as practicable, *i.e.*, to the frontier of Nepaul; for, unfortunately, the Nepaulese are as jealous of their territories as the Chinese, and will oppose its extension into, or through, their territories.

10. Captain Montgomerie reports as below on the field season of 1863;\* his report for 1864 has not yet been rendered.

## KASHMIR SERIES.

*Ex. Officer in Charge.*  
Capt. T. G. MONTGOMERIE,  
Royal Engineers,  
Astronomical Assistant,  
G. T. S.

## TRIGONOMETRICAL.

*Military.*  
Lieut. T. T. CARTER, R.E.,  
2nd Assistant.

*Civil.*

W. G. BEVERLEY, Esq.,  
Civil 2nd Assistant.  
Mr. L. H. CLARKE,  
Senior Sub-Assistant.  
Mr. C. J. NEUVILLE,  
Senior Sub-Assistant.

## TOPOGRAPHICAL.

*Military.*  
Cpt. H. H. GODWIN AUSTEN,  
Topographical Assistant,  
G. T. S.

Capt. A. B. MELVILLE,  
Topographical Assistant,  
G. T. S.

Lieut. A. PULLAN,  
Topographical Assistant,  
G. T. S.

*Civil.*

E. C. RYALL, Esq.,  
Civil 2nd Assistant.  
Mr. W. TODD,  
Senior Sub-Assistant.  
Mr. J. Low,  
1st Class Sub-Assistant.  
Mr. C. WOOD,  
1st Class Sub-Assistant.  
Mr. C. BRAITHWAITE,  
2nd Class Sub-Assistant.

\* "During the field season of 1863 the Kashmir Series Party completed the triangulations of Khagan, Astor and Zaskar. By the Khagan triangulation a number of peaks have been fixed in Yughistan and Swat, between Swat and Chitral, and also in the ranges beyond Gilgit. The position of Chilas has been determined by fixing a peak close to, and above, it. By the Astor triangulation the fort of Bunjee has been fixed, and also a number of peaks in the Haramosh range, and in the ranges beyond Hunza and Nuggair. The triangulation of Zaskar has been joined on to that of Rukshu. The progress made by the triangulation was good, and in each direction the work remaining undone was finished.

"The triangulation of the Kashmir Series has, by addition of the above, been brought to a conclusion. The points cover the whole of the Jummoo territories, Kashmir, Khagan, Ladak and Little Tibet, besides portions of Chinese Tartary, Hunza, Nuggair, Gilgit, Dheer, Swat, &c., in which many peaks, and a few stations, have been fixed.

"Great progress was also made with the Topographical work, 7,530 square miles having been sketched during the season. Unfortunately, Captain Melville and Mr. Ryall both lost their health, and were unable to contribute their usual quota of work. Had they been well, there is no doubt but that the whole of the topographical materials for the maps of the Jummoo Maharajah's territories would have been completed; for, even with the diminished strength available, only about 4,000 square miles have been left unfinished, all in the north-east corner of Ladak. With this exception, the whole of the materials for the maps are now available. The ground sketched during the season embraces the whole of the Pangkong Lake districts, including the eastern portion of it in Chinese Tartary, which had not been previously explored. The main lake ends in a triangular sheet of water. The course of the River Indus, with the hills on either side of it, has been sketched up to, and slightly beyond, the Chinese boundary.

"The Tartars unfortunately prevented all further progress up the river, and the mountains near the boundary being all about the same height, no satisfactory reconnoissance could be made of the watershed from points in the Maharajah's territories.

"The ground sketched during the season was very elevated, and hardly in any case below 14,000 feet. It was, with the exception of a few Tartar encampments, and two or three very small villages, totally devoid of inhabitants; fuel (in the

## 11. Captain Montgomerie reports very favorably of Lieutenant Carter and the assistants and sub-assistants attached to his party.\*

shape of dung, and a few roots and twigs) was got with great difficulty, and provisions had to be carried from Leh to points distant from twelve to twenty marches. Sweet water could not always be got, most of the lakes and some of the streams being salt, or, at least, brackish. The commissariat arrangements were, in fact, almost more difficult to provide for than anything else, though the physical difficulties were in themselves very trying. Captain Montgomerie thinks that the exertions of the assistants and sub-assistants employed, under his orders, on these arduous operations are deserving of the highest praise. He trusts that their energy and zeal, exerted so successfully under such great difficulties, will meet with approval.

"Since the end of the field season, Captains Austen and Melville, and Mr. Beverley, have been transferred to other Survey parties, and Captain Montgomerie cannot close the last Annual Report of the Kashmir Series in which their names are likely to appear without recording how well and zealously he thinks they have labored in their respective branches, and how much he thinks the Survey owes to their exertions. They have been employed in surveying the most elevated and, in every respect, the most difficult mountains in the world. Trained in such a rough school, he feels sure that their work in any other quarter will give satisfaction wherever they may be employed. They will always carry with them Captain Montgomerie's best wishes for their success."

\* "Lieutenant Carter was employed during the whole of the field season on the triangulation of Klugan. Though the weather was very unfavorable for observing from high peaks, owing to frequent falls of snow, and constantly cloudy weather, Lieutenant Carter was able to make good progress. Besides the exposure due to the bad weather, he had to contend against the hostile feelings of the tribes to the north, who were from the first in a state of excitement about Mulkah-Sittana. By hard work and tact both the physical and political difficulties were overcome, and the triangulation of Klugan was brought to a successful termination on two peaks north-east of the Loloosur Lake, and just to the south of Chilas. The work was only just finished when the Civil authorities sent notice to say that the hill tribes could no longer be trusted, and great credit is due to Lieutenant Carter for completing the work so early, without any of the party coming into actual collision with the northern tribes.

"Mr. Beverley assisted in the computations, projecting the charts, &c., during the recess, and showed his usual aptness in disposing of work well and quickly. During the field season he extended the triangulation in Astor, fixed the fort of Boongee, on the Indus, and completed the triangulation in that direction; progress very satisfactory. Wishing to see how work was carried on in the plains, Mr. Beverley volunteered for continued employment in the field, and was posted to the Calcutta Longitudinal Series.

"Mr. Clarke took up the Zaskar triangulation just to the south-east of its capital Padam. He effected a junction with the Rukshu triangulation near the Baralacha Pass, by means of several very high stations, some over 19,000 feet above the sea. Subsequently he examined some of the ground near the Parang-la, and made a topographical sketch of the valley on the north-east of the Tangling-la, which pass he visited. Altogether Mr. Clarke did a very satisfactory season's work.

"Mr. Neville assisted Captain Montgomerie with the computations, observatory work, and current duties of the Series. The way in which he disposed of the large amount of miscellaneous work necessarily arising in so large a party, when its detachments work so very far apart, was much to Mr. Neville's credit.

"In the Topographical branch, Captain Godwin Austen assisted in the computations during the recess. In the field season he took up the sketching of the very elevated and rugged tract of country that lies along the north of the Pangkong Lake district; though much hindered by cloudy weather, he completed the sketch of that very difficult piece of country up and beyond the boundaries of the Maharajah's territories on the east; he sketched the most easterly portion of what is usually called the Pangkong Lake, and found it to be of quite a different shape from that given in all maps that have been published of that part of the world. The total area sketched by Captain A. amounted to 3,800 square miles,—a highly satisfactory out-turn, and, considering the difficulty of the country, both from its great elevation and barrenness, very much to Captain A.'s credit.

"Captain Melville assisted in the computations during the recess, and continued his practice of photographing maps. He succeeded in taking admirable negatives of the maps of Junmoo territories and Little Tibet, reproducing them on the scale of the originals. During the field season, Captain Melville marched into Ladak, with a view to taking up the sketching of country south-east of the Kankoram Pass. He was, unfortunately, first of all affected by the great heat of Ladak, having to march in the lowest valleys, where the heat of the sun rises to above 140° of Fahrenheit; the great and sudden change from that great heat to the extreme cold on the pass between Ladak and the Pangkong Lake, where there was heavy snow, completely prostrated him, and he only got back to Leh with great difficulty. The great elevation (nearly 1,900 feet) affecting him injuriously in his then weakened state. Recovering his health slowly, Captain M. was unable to take the field again before the passes were closed, and he was consequently obliged to return to Kashmir.

"Lieutenant Pullan joined the Kashmir Series at the end of the recess, and took the field with Captain Montgomerie. He learnt the use of the plane table, and went with Captain Austen into Ladak, and worked under his orders. He sketched a piece of very elevated ground to east and north-east of the Pangkong Lake; in all, completing 1,100 square miles,—a well shaded sketch, and, considering that it was his first season, a creditable result, as the ground was not well adapted to a beginner.

"Mr. Ryall accompanied Captain Melville, and was able to give him medical advice, otherwise Captain M. would have found it very difficult to get out of the country. When Captain M.'s health was partially restored, Mr. Ryall passed on, and took up his work to the north of the Changchenmo, but his health unfortunately suffered in much the same way as Captain Melville's, owing to the very great elevation at which he was working, and he was finally forced to retire, though, before doing so, he was able to complete the sketch of 1,040 square miles, and the reconnaissance of 900 square miles more of that very difficult and desolate tract of country, which, under the circumstances, was very creditable to Mr. Ryall.

"Mr. Todd assisted in the computations during the recess. During the field season he was employed in sketching the Upper Indus Valley. He completed the materials for the map of all the extreme south-east portion of the Maharajah's territories, up to the Chinese frontier, and sketched the course of the Indus in detail, as far as the Tartars would allow him. Though hindered by bad weather, and working at such a very high altitude,—no point of the river being under 13,000 feet above the sea,—Mr. Todd was able to complete the sketch of the whole of the country remaining unfinished on that side; a total of 1,430 square miles, with 650 miles of reconnaissance, a very satisfactory season's work, and much to Mr. Todd's credit.

"Mr. Low was at first directed to take up the sketching of some ground towards Astor, but Captain Melville having fallen ill, it was necessary to despatch Mr. Low to relieve him. He arrived in time to help Captain M. and Mr. Ryall, but, owing to bad weather, was too late to do more than to assist the latter back to Leh. Captain Montgomerie has no doubt but that, if Mr. Low had had the opportunity, he would have turned out a good season's work.

"Mr. Wood was at first directed to accompany Mr. Todd, but his health was not good, and the medical officer recommended that he should not be employed in very high ground; he was, consequently, first of all trained to use his plane table efficiently, and made good progress. When Captain Montgomerie left Kashmir, Mr. Wood was employed there in order to see that the dawk and numerous wants of the party were attended to as quickly as possible, and this necessary duty he performed well, and brought up a number of computations.

"Mr. Braithwaite accompanied Mr. Todd, and made a sketch of a portion of the country south of the Pangkong Lake. He completed 660 square miles, the amount assigned to him, and, considering the difficulty of the ground, his progress was satisfactory."

12. Colonel J. T. Walker, in his Report for 1862-63, has already informed the Government of the accident which occurred to the two-feet theodolite in use with the Mangalore Series towards the conclusion of the field season.

13. This accident was of so serious a nature that the instrument has had to be sent to England for repair, and the Series has been suspended during the past season. The instrument is now on its way out, and the Series will be resumed immediately.

14. This suspension, however, though prejudicial to the progress of the Mangalore Series, far from being a loss, has proved most opportune; for Captain Haig and his party being thus set free, became available to organize and train the new party sanctioned for the topographical survey of Northern Bombay, now under Captain D. Nasmyth, of the Royal (Bombay) Engineers, an able and experienced officer, who took charge of it on his return from furlough in March last.

15. Captain Nasmyth, whilst on furlough in Europe, devoted much time and attention to the study of the modern improvements and inventions in use at the English Ordnance Survey Office at Southampton. We may, therefore, fairly expect to reap considerable advantage from the introduction of much that he saw in England into the Indian Survey, and from his reappointment to this Department.

16. At the request of the Bombay Government, and for other weighty professional reasons, Katiawar is the province selected to commence on. Being a peninsula, a very large proportion of its area had been previously triangulated, so that to procure ample data for his detail surveyors, little was required beyond breaking down this triangulation; but, though this labor was light, Captain Haig had a heavy task in training the many raw hands entertained for the new party, none of whom had any knowledge of the subject whatever.

17. This being the first season of a new party in a new country, a limited out-turn of work was to be expected. Captain Haig had quite fulfilled my expectations, and would have done still better, but for the obstruction offered by the people of the country.\*

18. Captain Haig reports as below † of the work performed by Messrs. M'Gill and Anding, the assistants of the old party.

19. After finishing the observations at Bhownuggur, Captain Haig sailed with his party for Poonah, which he reached on the 17th of May, but they did not reach their recess quarters without encountering further trouble and peril from shipwreck. ‡ It is evident that, but for Captain Haig's energy, decision and pluck, the whole of the Government instruments, property, and many valuable lives would have been lost.

#### BOMBAY SURVEYS.

##### BOMBAY PARTY.

###### Executive Officer.

Capt. C. T. HAIG, R.E.,  
1st Assistant.

###### Assistant.

J. M'GILL, Esq.,  
Civil 2nd Assistant.

###### Sub-Assistants.

Mr. G. A. ANDING,  
2nd Class Sub-Assistant.

Mr. J. E. DONOHUE,  
3rd Class ditto.

Mr. A. D. CHRISTIE,  
3rd Class ditto.

##### NORTHERN BOMBAY.

Capt. D. J. NASMYTH, R.E.

###### Assistants.

None.

###### Sub-Assistants.

Mr. A. DE SOUZA,  
Senior Sub-Assistant.

Mr. N. GWINNE,  
3rd Class ditto.

Mr. W. WAITE,  
3rd Class ditto.

\* "The building parties met with all sorts of obstruction from the heads (grassias, or land owners) of the different villages. In almost every case where labor or material was required, even of the most simple description, such as old cotton stalks for signal fires, there was difficulty and delay in procuring it. Mr. M'Gill also complained of the petty annoyance and hindrance to his progress that he met with from the grassias, otherwise he might have completed another untriangulated space, which I had intended him to do."

† "Mr. M'Gill commenced by breaking up the large triangles of the quadrilaterals Bhownuggur Palitana, and Palitana Itria, into a network, and then covering the space between the Series on 71° 30' and 72°. While his stations on this space were being built, he selected the stations on the next space between Series 71° 30' and 71°. He then returned, and took up the final observations between 71° 30' and 72°, and while on this he also took some simultaneous vertical observations with me on rays Anniali Null Baoli Anniali, Siani-Siani, Rallol and Siani Jamri. After completing the final observations of this space, he returned to that between 71° and 71° 30', and completed the final observations there.

‡ "Mr. Anding, after completing the final observations of the space between 71° and 71° 30' south of the Longitudinal Series, took up the triangles of the space between 70° and 70° 30' north of the Longitudinal Series, the final observations of which he completed before closing for the season."

§ "When I was at Barbir, on the 28th April, an earthquake occurred, the shock of which lasted about fifteen or twenty seconds; on examining the centering of the instrument, I found it had been displaced about an eighth of an inch. Mr. M'Gill tells me that at Wodwan (a large town) several houses were thrown down, and the walls of the travellers bungalow at Barwalla was cracked in several places. I understand the shock was felt all over Guzerat.

20. Captain Haig, in his report, with great modesty makes no mention of the great severity of the storm, nor of the difficulty he had in keeping the men together, and at work at the pumps, or how much was due to the personal exertions of himself and subordinates.

21. I hope Government may see fit to allow compensation for loss of their camp equipage, much of which had to be thrown overboard.

22. The Calcutta East Longitudinal Series, for reasons given below by Lieut. H. R. Thuillier, R.E., in charge, could not take the field earlier than the 20th of November, and even at that late period the swampy nature of the country greatly impeded the progress of the work. It was originally intended that this very important Series should be double throughout; but, near Calcutta, cocoa-nut groves, valuable trees, buildings, and villages are so numerous, that the amount of compensation that would have had to be paid for clearing the rays between stations rendered it impossible, without enormous expense, to have more than a single chain of triangles.

23. From the 26th November to the 4th of March the whole party was engaged on the preliminary operations of clearing rays, selecting stations, and building towers. On the 5th of March Lieutenant Thuillier commenced his final observations, which he completed on the 15th of May.\* The amount of work executed is shewn in table in Appendix.

24. No secondary work was effected, owing to the paucity of establishment attached to the East Longitudinal Series party, and to the jungle and orchards of high trees which surrounded all the villages.

25. Hitherto, the country traversed has been densely populated, and comparatively dry, but next season the Series will have to cross to the east of Mudhoo-Mutti River, where, though comparatively freed from the obstruction of trees, villages, &c., their progress will be retarded by the network of tidal nullahs, large rivers, and immense swamps, and where the ordinary kinds of carriage being useless, they will have to resort to boats to move themselves and baggage from station to station.†

\* "On completing observations at Bhowuggur, I left that port with Messrs. Donohoe and Christie, and five of the native establishment, by steamer for Surat, *en route* to Bombay and Poonah; but, before reaching Surat, we experienced considerable danger from the steamer leaking, so much so that, at the most critical time, the master (who was only a Parsee) wanted me and Mr. Christie to escape stealthily with him, and five or six others, in the boat; and on my refusing, and taking steps to prevent anybody from losing the boat, he gave himself up in tears to despair, telling me that I was captain, and whatever I ordered should be done. A portion of our kit was thrown overboard, and also a few articles of Government property, viz.,—two sets of flashing apparatus, made up in the Department by Captain Nasmyth, at Bhoer, a few years ago, and some masons', and other, tools. The steamer ultimately stranded at the mouth of the Taptac, from whence all passengers came by land to Surat, and three days afterwards the steamer was brought up the river.

† "Mr. Donohoe, who had general charge of the office, died on board the steamer on the 4th May, and the native duffty died on the shore, when the steamer stranded. This, and the circumstances above related, occasioned some confusion in the office, and delay in sending in the different monthly statements for April."

\* "The state of the country in which our operations commenced not permitting of any field work before the end of November, owing to the unhealthiness of the low swampy lands after the breaking up of the rains, the party did not leave recess quarters till the 20th of that month, marching, *via* Dum Dum and Barsat, on the 25th November.

† "Mr. W. G. Beverley was employed during the earlier part of the season,—viz., December and January,—in clearing trial rays; during February and March he was occupied in clearing some of the final rays. When these were completed, about the end of March, he continued the Approximate Series, and on closing work on 15th May, had selected eight stations, extending over a length of forty miles, and cleared about 130 miles of trial rays between them. One station on each bank remains to be fixed on the left bank of the Megna. This portion of the country is much worse than the part across which observations had been taken, consisting of very extensive jheels, intersected by a network of rivers and khalls. These great swamps in Burreedpoor and Backergunge cover a very large portion of the districts which during nearly half the year, are completely under water,—the only really dry land being on the banks of the rivers and streams. The village sites are raised on mounds, the entire communication being boated. During the months of April and May, the time when Mr. Beverley was employed there, the jheels had in some measure dried, rendering the difficulty of moving about still greater, there not being sufficient water even for small boats, and too wet to go by any other means. The difficulty, therefore, of carrying rays of nine to eleven miles in length across such a country can be readily imagined. Some of the rays Mr. Beverley had to abandon, on account of the swamps being impassable, and the impossibility of pitching the flag-staves. Mr. Beverley's progress, under these circumstances, was very creditable.

26. The Madras Coast Series Party, on the completion of the Base Line computations (5th November), marched from their recess quarters at Vizagapatam, and re-commenced operations near Guntoor on 1st December. Consequent on Captain Basevi, R.E., 1st Assistant, being absent on furlough, the command of the party devolved on Captain B. R. Branfill, who had been attached to it for some months previous.

27. Captain Branfill has extended the principal triangulation 138 miles, from north to south, and brought it down to lat.  $14^{\circ} 20'$ . He also visited Madras, and made arrangements for connecting the Madras Observatory, the origin of the Indian longitudes, with the great triangulation. This important connection will be effected next year.

28. In addition to the principal, a considerable quantity of secondary triangulation was executed, for the purpose of fixing the geographical position of Masulipatam, the lighthouses, and other important points upon the coast.

29. Captain Branfill reports favorably of his assistants and sub-assistants—Messrs. Clarkson, F. Ryall, Mitchell and O'Neill.\*

30. The Eastern Frontier Party, under the command Mr. C. Lane, Chief Civil Assistant, took the field on the 17th November, 1863, arrived at Comillah on the 23rd, and Agartolla on the 29th, and after making the necessary arrangements for mark-stones, supplies, &c., started on the 10th December for the G. T. Survey station Bajatua. They returned into quarters at Chittagong on the 25th May, 1864.

31. The work completed during the season is shewn in table in Appendix.

## MADRAS COAST SERIES.

*Executive Officer.*  
Capt. B. R. BRANFILL,  
2nd Assistant,  
Senior Grade.

*Assistant.*  
R. CLARKSON, Esq.,  
Civil Assistant.

*Sub-Assistants.*  
Mr. F. RYALL,  
2nd Class.  
Mr. J. W. MITCHELL,  
3rd Class.  
Mr. J. R. L. O'NEILL,  
3rd Class.

## EASTERN FRONTIER PARTY.

*Executive Officer.*  
C. LANE, Esq.,  
Chief Civil Assistant.

*Assistants.*  
W. C. ROSSFRODE, Esq.,  
Civil Assistant.  
H. BEVERLY, Esq.,  
Civil 2nd Assistant.

*Sub-Assistant.*  
Mr. W. C. PRICE,  
3rd Class.

"Mr. G. W. Atkinson was employed from the time of his joining my party (in the beginning of March) till the end of the field season as observatory recorder, and in current office work. The duplicate angle books were brought up uniformly by him in the field, and he gave entire satisfaction.

"Mr. G. A. Harris was employed during the whole season in erecting towers, in which he showed his usual energy and good management.

"Mr. J. T. Mendes was appointed to the G. T. Survey, and joined his party on the 3rd December last. I kept him with me for a short time, until some stations had been selected in advance of those Mr. Harris was engaged on, and on 8th January he was deputed to undertake the building of seven towers. I have before mentioned the delay I experienced by these towers not being ready, as they should have been, when required for the observations. Mr. Mendes had been previously employed in the Department Public Works, in the Jessore district, in superintending buildings, and it was thought that his experience would have been useful for building our towers, but he did not show the experience expected from him, and had his arrangements been better, I think the works would have progressed far quicker; but, I believe he did his best, and had many difficulties to encounter, and I have every reason to hope that, from the experience he has gained this year, he will be more successful in the ensuing season."

\* "Mr. R. Clarkson selected and observed the six triangles, as the origin of the Masulipatam and Point Divy Minor Series, starting from the sides Bézivada, Anantawaram-Gorantla, having to trace and clear most of the rays, and build platforms at the stations. This work occupied him nearly three months; he then superintended the erection of the platform at Puripad S.; after which he proceeded with the Approximate Series in advance, and was occupied for five months in carrying forward the work to the vicinity of Madras. He has selected seventeen stations,—forming a double polygon, a heptagon, and part of a single polygon,—extending the Series 118 miles. Mr. Clarkson has done a hard season's work, and I have always found him diligent and painstaking, and I trust he will receive your favorable consideration in submitting his case to Government, for the award of a liberal pension.

"Mr. F. Ryall performed the duties of recorder and observatory assistant for one month quite to my satisfaction, after which he has been for six months engaged on the minor series in the delta of the Kistna, a very difficult country indeed, being overgrown with jungle, and intersected by watercourses and swamps, in a deep alluvial soil. He has selected the whole of the stations forming 25 triangles, extending 45 miles, clearing 260 miles of rays, and connecting with Masulipatam and Point Divy Lighthouse. Whilst taking final observations at his tenth station the rains set in, and obliged him to return into quarters.

"Mr. J. W. Mitchell, after assisting Mr. Clarkson for a month, acted very efficiently as recorder and observatory assistant, till relieved by Mr. O'Neill's return from leave. He only reached the origin of the secondary series, the execution of which I entrusted to him in April. During the four months he has been engaged independently he has selected 15 stations, or 17 triangles, extending over 49 miles, built 1 platform (18 feet), and cleared 133 miles of ray. Mr. Mitchell has now completed three years in the grade of 3rd Class Sub-Assistant. His training at the head-quarters computing office, though it delayed his initiation into the practice of our field duties, has rendered him a good computer. I am glad to report that Mr. Mitchell's conduct has been uniformly good, and I beg to recommend him to your favorable consideration for promotion.

"Mr. O'Neill only rejoined from sick leave about the middle of the field season, and after taking part in the building of Darrutippa station platform, performed efficiently the duties of recorder and office assistant till the close of the season."

32. The physical difficulties this party have to surmount continue very great. The appended extract from Mr. Rossenrode's report gives some idea of what they are in such a country, though he says nothing of the sickness, heat, and other trials the surveyors are exposed to, nor of the difficulty of maintaining amicable relations with the semi-barbarous tribes of the district. These relations have throughout been conducted with unusual tact, and reflect great credit on Messrs. Lane and Rossenrode.

33. The copious extracts from Mr. C. Lane's report which I have appended contain much valuable information concerning the natural products of the country; and there is one curious circumstance mentioned by him to which I would call especial attention, viz.,—that those who sleep in unhealthy tracts, under forest trees, invariably get jungle fever, while those who are encamped in bamboo jungle escape.

34. The field triangulation has now passed the latitude of Comillah, will pass Chittagong next field season, and then turn south, parallel to the Arracan coast.

35. Mr. Lane reports on his assistants as below.\*

SUMBHULPORE MERIDIONAL  
SERIES.

*Executive Officer.*  
H. KEELAN, Esq.,  
1st Assistant.

*Sub-Assistants.*  
Mr. E. T. KEELAN,  
1st Class.  
Mr. H. W. PEYCHERS,  
3rd Class.  
Mr. J. TROTTER,  
3rd Class.

36. This Series was commenced last season by the party which, under Mr. 1st Assistant H. Keelan, completed the Ragoon Series in 1863, and thus became available for the purpose.

37. They marched from head-quarters on 14th October, reached Benares 17th November, and commenced work on 1st December, 1863, at Gora hill station, (in the Sirgoojah district),—the origin of the Meridional Series,—which connects the Calcutta West Longitudinal Series with the North-East Himalayan Series, on meridian  $83^{\circ} 30'$  East longitude.

38. The upper mark-stone had, as usual, been destroyed, but the lower one, engraved on the rock *in situ*, had not been tampered with.

39. Mr. Keelan's instructions are, first to revise a portion of the West Longitudinal Series, which, having been executed upwards of thirty years ago, with a very defective instrument, and in the days when accurate geodesy was comparatively little understood, is utterly unfit to remain the basis of the many Meridional Series which emanate from it. He is then to work south, on the meridian of  $84^{\circ}$  east longitude, until he runs into the Coast Series, near Madras. This obliges him to pass through Sirgoojah, Sumbhulpore, and other wild tracts, covered with almost impenetrable forests, and in which roads, habitations, and other signs of man, are few and far between.

40. As was to be expected from the nature of the country, the means of communication were found to be bad and very limited, the population scanty, provisions scarce, and fever at the commencement and at the end of the cold season very prevalent; twice the camp suffered severely from its attacks. On the first occasion—19th and 20th December—the Europeans suffered little, but every native, without

\* "Mr. Civil Assistant W. C. Rossenrode carried on the Approximate Series throughout the season, and assisted in fixing the position of Comillah. The selection of some of the principal stations was, as already observed, most difficult, which he got over in his usual masterly style.

"Mr. Civil 2nd Assistant H. Beverley was employed at the beginning of the season in repairing wooden platforms, clearing obstructions in rays, and making rays. He assisted in the observatory and current duties at Dawa hill station, where circumpolar star observations were taken for azimuth. After this Mr. Beverley was engaged in making roads between principal stations, and towards the end of the season in laying down some secondary points.

"Mr. 3rd Class Sub-Assistant W. C. Price joined, as already observed, at Agartalla, and has been in training throughout the season in the duties of observatory assistant and in current office work, in which he has evinced much zeal and assiduity, and is likely, in time, to turn out a useful member of the Department."



exception, was prostrated. On the second, the Europeans suffered most, and had not Mr. Keelan closed work, and left the country at once, it is probable that we should have to mourn heavier casualties. As it is, two of his sub-assistants are too much shaken to enter these tracts again this season, and have, consequently, been transferred to other parties.

42. This party will be employed during the ensuing field season in completing the revision of the Longitudinal, and pushing forward the Meridional Series. The difficulties at present are very great, but so soon as they reach the high level of Chota Nagpore, they will progress better. Mr. Keelan is not only a skilful observer, but he is prudent and careful, and having had thirty-two years experience of camp life, will, I feel assured, carry out this difficult operation as successfully as he has all other work hitherto entrusted to him. Mr. Keelan reports very favorably of his sub-assistants—Messrs. Keelan, Pechers and Trotter,—who, notwithstanding the depressing nature of the difficulties they had to contend with, have been most zealous in the performance of their duties.\*

43. This, also, is a new Series, and is under charge of Mr. Civil Assistant George Shelverton, who, on the completion of the Gurbagurh Series, was directed, with his party, to revise, for reasons already stated, the Calcutta East Longitudinal Series from Seronj to Amua H. S.,—the origin of the Amua Meridional Series,—and thence to carry a Series south, on the meridian of 82° East.

JUBBULPORE MERIDIONAL SERIES.

*Executive Officer.*

G. H. W. SHELVERTON, Esq.,  
Civil Assistant.

*Assistant.*

A. DONNELLY, Esq.,  
Civil 2nd Assistant.

*Sub-Assistants.*

Mr. M. C. HICKIE,  
Senior Sub-Assistant.

Mr. F. BELL,  
1st Class.

Mr. L. POCOCK,  
2nd Class.

44. Mr. Shelverton took the field early in October, and reached Seronj base on 16th December. Arrangements were at once made for strengthening the old Longitudinal Series by the addition of two new stations, thus transforming that portion of it into a chain of four simple polygons, and making it as good as can be desired. These preliminary operations afforded occupation to the above party until the 30th January, 1864, when the final observations were commenced, and concluded on the 10th May.

45. Mr. Shelverton has executed this portion of his work with his usual ability and energy, and has given great satisfaction.

46. Mr. Shelverton reports favorably of Mr. Senior Sub-Assistant Hickie, on whom devolved the building of platforms, cutting of rays, making of roads, and selection of some of the stations, and of Mr. Civil Assistant A. W. Donnelly, who

\* "On the completion of the selection of the two polygons of Merchari and Siwari, the main party left Hainri H. S., and marched for Hoori H. S. in Rewah, to begin the final observations. On arrival at Merchari, several of the men of the establishment, with the native doctor, were suddenly taken ill with fever, and during the following two days, the 19th and 20th December, all in camp were prostrated, including myself. The work was thus, unfortunately, brought to a standstill. My first care was to get the native doctor well, and to leave the locality for an open and healthier tract. I was glad to find that, after a few days illness, the doctor was able, although very weak himself, to administer medicines to the establishment. As soon as it was possible to do so, I left the neighbourhood of Merchari, and proceeded by short marches to the Rewah border, and arrived at the foot of the hill station of Hoori on the morning of the 25th December, where I established an hospital, and reported the sickness of the establishment in my letter, dated the 26th December, 1863. There were three casualties, and, subsequently, four or five desertions. I would take the present opportunity to add that the skill and perseverance of the native doctor throughout was most praiseworthy. Early in January the men of the establishment began to recover from the fever, and on the 11th the main party resumed operations, and commenced the principal angles of the revision at the hill station of Hoori, or Aouri.

"It is in the jungles in which the three last stations of the Gnoruthasa polygon are situated that the Approximate Series party was a second time attacked with jungle fever. When the native doctor joined them, he describes having found both Messrs. Keelan and Trotter in a very precarious state. They were both lying outside on straw, under the shade of trees. Their tents were not pitched, and they were without food, as all in camp, both public and private servants, with one or two exceptions, were prostrated. The native doctor's timely arrival, no doubt, saved the lives of these two assistants, who were found in a most helpless condition; in fact, the fever has laid such hold of their constitutions, that both of them are at the present time more or less sick, and still under medical treatment.

"I beg to bring to your favorable notice the services of Messrs. Keelan, Pechers and Trotter, who have throughout the season, under the peculiar circumstances already brought to your notice, been most zealous in the performance of their duties."

laid out the Approximate Series, on the meridian of Jubbulpore; also of Messrs. Sub-Assistants Bell and Pocock.\*

47. Mr. Shelverton also reports that many of the upper mark-stones of the former stations had been removed, and some replaced *abnormal to those in situ*.

48. The preliminary reconnoissance gives every prospect of the ground to be triangulated next season being easily traversed, and tolerably free from malarial, though there is a good deal of forest and jungle.

49. The two Astronomical Parties were organised during the past season, under sanction marginally cited,<sup>(1)</sup> for the purpose of fixing the absolute or astronomical latitudes of various trigonometrical stations at moderate distances all over the peninsula of India.

**ASTRONOMICAL PARTIES.**  
No. 1.

*Executive Officer.*

J. W. ARMSTRONG, Esq.,  
Civil Assistant.

*Sub-Assistant.*

Mr. G. W. ATKINSON,  
2nd Class.

No. 2.

Lt. W. M. CAMPBELL, R.E.,  
2nd Assistant.

*Sub-Assistants.*

Mr. J. WOOD,  
2nd Class.

Mr. G. BELCHAM,  
3rd Class.

50. No. 1 Party was to have been placed under 2nd Assistant Mr. H. Taylor, a practical astronomer, trained in the Greenwich Observatory, of considerable experience and ability.

51. No. 2 Party was placed under Lieut. W. M. Campbell, R.E., an energetic and talented young officer, who joined the Department in January, 1863, and took a share in the measurement of the Vizagapatam Base Line.

52. No. 1 Party was directed to commence work at Calcutta, and to observe at certain stations on the West Calcutta Longitudinal Series, the origins of Meridional Series named after them.

53. No. 2 Party was to work from north to south, observing from certain stations of the Great Meridional Arc of India, about one degree apart, excepting at the northern extremity, where the vicinity of the Himalayas rendered it desirable to have them closer, in order to obtain a tolerably complete series, whence to deduce an approximation to the amount of the deviation of the plumb-line from the normal at each of those stations, and thereby some insight into the law of local attraction and of that of the Himalayan mass.

54. The latitudes were to be obtained by observations of meridional zenith distances to 36 stars, taken on the five wires.

55. Unfortunately, before the commencement of the field season, Mr. Taylor was compelled by the state of his health to take leave to Europe. No covenanted officer being available for the purpose, No. 1 party was placed under the charge of Mr. Armstrong, one of the most experienced of the Civil Assistants, and one who, from his practical knowledge and well-known powers as a computer, it was hoped, would do the work justice. Unfortunately, here too, we met with disappointment. After spending two months in Calcutta in vain attempts to master the subject, Mr. Armstrong reported that he was physically incapable of making the observations,

\* "Mr. C. Hickie was entrusted with the building of platforms, cutting of hill roads, and clearing of forest on this portion of the work. I am glad to report that his arrangements were good throughout, and his progress rapid enough to enable me to begin my observations on the 30th January, 1864. To Mr. Hickie is also due the credit of having selected, under really difficult circumstances, the principal station of Bhoorgara, which gave us a hexagon round Himilia H. S., and delivered the Series from the complicated figures that had originally been adopted.

"Mr. A. W. Donnelly was directed by me to lay out a double series, consisting chiefly of hexagons, along the meridian of Jubbulpore, basing it on the side Kahlumar H. S., to Lora H. S. of the West Calcutta Longitudinal Series.

"Mr. F. Bell was detached with Mr. Donnelly to help the latter generally, and to observe, with a 12-inch theodolite, the angles of the Approximate Series.

"Mr. I. J. Pocock was my observatory assistant; he was always useful to me; he is quite conversant with observatory and office forms; can use a Vernier theodolite; is intelligent, active, and exceedingly willing, and gives fair promise of becoming, in due course, an excellent surveyor."

(1) Mil. Dept. Letter, No. 822, dated 28th Sept., 1863.

and solicited permission to resign his appointment, and retire on his pension. No other competent person being available, I had no option, and have suspended the party until the return from furlough of Mr. Taylor.

56. With reference to this failure, it is but justice to Mr. Armstrong to state that he was very loth to attempt the observations, and only undertook them at the earnest solicitation of Lieut.-Colonel J. T. Walker.

57. Lieut. W. M. Campbell was more successful. On his joining the headquarters of the G. T. Survey at Mussoorie, on 15th September, he commenced cleaning, putting in order, and making himself thoroughly acquainted with the astronomical circle, also designing and constructing a portable roof, to be placed on the walls of the observatories to be built at each station of observation.

58. On the 3rd of November he commenced observing at the station of Nojhili, nearly midway between Roorkee and Seharunpore, and on the 8th of May had completed the observations at the stations of Amsôt, Nojhili, Dateri, and Noh. Considering that this was his first season, the amount of work finished is very creditable to Lieutenant Campbell. Next season he will commence work a little earlier, and will very probably work down as far as latitude  $21^{\circ}$  north, if the weather be favorable.

59. Lieutenant Campbell speaks in terms of high praise of his two sub-assistants, Messrs. Wood and Belcham. Mr. Wood had to prepare the stations, build the walls (of unburnt brick) of the observatory, and lay out the meridian; he also took his share in recording and computing. Mr. Belcham was employed in recording the observations as made. His attention, intelligence, zeal, and neatness afforded Lieutenant Campbell much satisfaction.

60. Lieutenant Henry Trotter was posted to the Survey Department by G. O. G. G., No. 133A of 5th September, 1863, and took over charge of the party from Lieutenant H. R. Thuillier on the 1st October. On the 14th of the same month they left the head-quarters of the G. T. Survey at Dehra, marched to Allyghur, thence proceeded by rail to Allahabad, and thence by steamer to Bhagulpore, arriving on the 21st November at Tilliagunge, in the neighbourhood of which they took up (at the point where Mr. Donnelly had been compelled by severe illness to leave it in the preceding season) the line of levels which is to connect the mean sea level at Karachi with that at Calcutta, and at the same time to provide a series of accurately determined bench-marks across the northern portion of the peninsula of India.

**LEVELING PARTY.**  
*Executive Officer.*  
 Lieut. H. TROTTER, R.E.,  
 2nd Assistant.  
 ———  
*Native Levelers.*  
 RAMCHUND.  
 HERA LALL.  
 NURSING DOSS.

61. The malaria of the valley of Tilliagunge is notorious, and the party did not escape its influence. Very shortly after commencing work, Lieutenant Trotter and several of his natives were prostrated with fever, and had to proceed to Bhagulpore for change and medical advice. As soon as the Lieutenant was convalescent, he resumed his leveling along the line of railway, as far as Burriapore, at which place, to avoid working through the Monghyr tunnel, he made a detour by the ordinary road, and proceeded, *via* Monghyr, to Burhee, 53 miles west of Bhagulpore. At Burhee he was again attacked by fever, and after attempting to combat it for some days, was finally compelled to proceed to Patna, to place himself under proper medical advice. There he remained until February, when he again took the field, and continued leveling until the beginning of April, by which time he had worked up to Phutka Gerowha, the second encamping ground, near Benares. Thence he proceeded to Allahabad, and availed himself of the low state of the river, to level from the encamping ground of Joosec, on the west bank of the river, to the Alla-

habad Fort on the east bank. This closed the season's work. The total amount leveled was 346 miles of main line and 14 miles of branch line. About this amount of work (350 miles) remains to complete the connexion with the Bombay line at Agra, and will, doubtless, be finished early next season. We shall then have a connected series of levels unsurpassed, if equalled, in accuracy by any in the world, connecting the mean level of the sea at the head of the Bay of Bengal with that at Karachi, on the west coast, and affording points of departure of unquestionable accuracy—to which all other lines of levels can be referred—between Karachi and Attock, Attock and Agra, Agra and Calcutta, Agra and Seronj, in Central India.

62. The line of the East India Railway was selected for our leveling operations, because it was fully expected that the levels taken by the railway engineers would be some check on those executed by our leveling party, and also that the railway company, appreciating the value of the work we are doing for them, would afford us every assistance in their power. Unfortunately, we have been disappointed in both respects. Their levels, as appears from the appended synopsis of results, are very inaccurate, and they declined giving any assistance, or affording any facilities, beyond what is given to ordinary travellers. So far from being of assistance, they have been the reverse; for they have destroyed the G. T. Survey station near Sultangunje, which stood on a mound 60 feet high, quite clear of the line of railway, simply that the resident engineer might place his bungalow on so pleasant and commanding an elevation.

**COMPUTING OFFICE.**

Lieut. J. HERSHEL, R.E.,  
1st Assistant,  
In Charge.

Baboo BHOLANATH MO-  
JOMDAR,  
Deputy Computer.

*Computers.*

Baboo CHEETER MULL,  
GUNGA PERSHAD,

LUCKHYNARAIN GOHO,  
GOPAL CHUNDER SIRCAR,  
KISTODHUN CHATTERJEE,  
TARAPODO MOOKERJEE,  
WODAY CHUNDER DEB.

63. During the past year Lieutenant John Herschel, whose scientific acquirements and business habits prove him a worthy inheritor of the honored name he bears, has continued his investigations, and matured the mechanical application of formulæ required for the reduction of all geodetical figures on the principle of minimum squares—(referred to in para. 47 of last Report). Simple far beyond all expectations, with their aid, the rigorous simultaneous reduction of any kind of figure is effected by purely mechanical processes in a far shorter period, and with less labor, than was formerly the case.

64. As proof of the value and simplicity of the mechanism, I may here state that the arithmetical computations for the reduction of the Sironj base figure, which, though very complicated (covering eleven pages of foolscap, and giving the angular errors true to four places of decimals), occupied two native computers only nine days on the new system, would have occupied the same computers about six months on the old system.

65. These results reflect very great credit on Lieut. Herschel, and justify us in expecting that soon our mathematical processes, like our triangulation, will bear comparison with the best surveys in the world.

66. Great progress has also been made in the initial steps for bringing up the final computations of the enormous mass of work that has accumulated in this office, viz., the general reports of the finished series which complete the north-west section of the gridiron. They cannot be finally closed until the whole triangulation is complete, because the residual errors due to each Series cannot be fairly dispersed until the weight due to each can be fairly ascertained, and applied in the dispersion. This, in fact, involves a simultaneous solution of all the equations of errors of series of the whole triangulation,—a question of enormous magnitude, and the main cause of the Superintendent's visit to Europe, where he has discussed the subject with, and obtained from, the Astronomer Royal, Mr. Airy, tolerably simple formulæ, which can be adapted to the purpose. The following extract from Lieutenant Herschel's Report will afford a fair idea of the nature and magnitude of this task:—

"The various stages through which the actual field observations pass, before any geodetic results are obtained, are so numerous that it becomes advisable, from time to time, to review the progress made, and to consider what remains to be done, and how best to do it.

"The field work itself is of two kinds, viz.,—linear and angular. These are entirely distinct, and, up to a certain point, so are the computations which they involve. Each is absolutely necessary to render the other of any ultimate use, and therefore, in one sense, they may be said to be of equal importance; but, beyond this, there is no comparison between them, for the latter are far more numerous and bulky, and require a much larger share of attention in the Computing Office.

"The measurement and reduction of bases results in perhaps half a dozen linear data, while those of angles produce thousands of angular ones. It is therefore evident that the mass of work, up to the point where the two kinds of data first begin to influence one another, is confined to the 'reduction of horizontal angles.' The point here indicated is one which may be taken as a convenient resting place, whence to look back on what has been done, before starting afresh. By the end of the present month it will have been reached, as regards the greater portion of the Great North-West Quadrilateral, and the opportunity is therefore a good one for the purpose of arranging our ideas.

"A short description of what is meant by the N. W. Quadrilateral will not be entirely out of place here. It consists of four principal series of triangles, forming an irregular quadrilateral figure, at each of the four corners of which a base line has been measured, viz.:—The *Sironj Base* in Central India, some eighty miles W.N.W of Saugor; the *Dehra Base* in the Doon, or valley of that name, at the foot of the Himalayas, about one hundred miles N. of Meerut; the *Chuch Base* on the banks of the Indus, near Attock; and the *Karachi Base* a few miles from the sea coast, near the harbour of that name. These bases are connected together by continuous series of triangles known, respectively, as the '*Great Arc, Northern Section,*' the '*North-West Himalaya Series,*' the '*Indus Series,*' and the '*Karachi, or Western Longitudinal Series.*'

"The above Series form the boundary lines of the quadrilateral under description, which is further crossed by the following Series, viz.:—The '*Rahoon Meridional Series,*' the '*Gurhagurh Meridional Series,*' the '*Jogi Tila Series,*' the '*Sutlej Series.*'

"It will be seen from the above that this huge quadrilateral involves four measured base lines, connected together by some 760 triangles, extending over a continuous length of 3,500 miles.

"The reduction of the horizontal angles of this portion of the Indian Trigonometrical Survey has been the object which has been steadily aimed at in this office during the last two years, and which is now on the point of being satisfactorily obtained. This reduction has been effected throughout, in accordance with recent changes in the system of obtaining the relative probable errors of the triangles, and in that of dispersing actual errors according to the Theory of Probabilities. In other words, (with the exception of those on the Great Arc and Sutlej Series), the whole of the observations have been reduced *de novo*. In the course of these reductions, some 2,800 angles have been abstracted, and their weights computed, and with these newly abstracted angles and their weights, angular errors have been computed for twenty-six quadrilateral, fifty-six polygonal, and twenty-one compound figures, according to the method of 'least squares.'

"The whole of these, with one or two unavoidable exceptions, have been computed with the utmost rigour, all available data being taken into account, and it is to be devoutly hoped that, so far, the work is *final*.

"So far the linear and angular data have been independent of each other, but from this point the case alters. Base will now be made to check base by means of the connecting triangulation, and there will thus be shown up a new kind of error, depending partly on the linear values assigned to the bases, partly on the assumed figure of the earth, but more largely on the angular values of the connecting triangulation. The sources of error in the latter are so much more numerous and effective that it has always been considered advisable to consider the others as practically non-existent.

"The error here alluded to is generally known as 'linear discrepancy between bases.' Starting from one base and computing, with the reduced angles, the series of triangles which connect it with another, a linear value of that other base is obtained which accords more or less with the measured value. The *discordance* is the error spoken of.

"In the present instance we have four such connecting series between bases, which, for the sake of distinction, we will call *First Class* Principal, to distinguish them from other principal series, (which we will call *Second Class*) which traverse the included area of the quadrilateral without proceeding direct from base to base. In classing them thus there is no intention to imply *inferiority* in either. So far from such being the case, it is the very superiority of some of the latter over some of the former that necessitates a departure from the practice, hitherto adopted rather for expedience' sake than for any more logical

reason, of temporarily ignoring the influence of each intersecting series. Such departure, however, from the system of *piecemeal reduction* being once conceded as required by the circumstances of the case, we find ourselves committed to the only alternative—that of *simultaneous reduction* of the whole. It is not my intention at present to enter upon any discussion of the means by which this simultaneous reduction is to be effected, but rather, taking it for granted as a thing *that will have been done*, to prepare for it by a timely consideration of the necessary preliminary steps."

## DRAWING BRANCH.

W. H. SCOTT, Esq.,  
Civil Assistant,  
In Charge.

Civil 2nd Assistant.  
J. PEYTON, Esq.

## Draftsmen.

SHEIK GOLAM KADAR,  
SHEIK KULLEEMOODDEEN,  
SHEIK SAIDUDIN HOSSEIN,  
MR. W. MANLY,  
and six Apprentices.

67. The progress made in the Drawing Office between May, 1863, and May, 1864, is shewn in Table C. The maps turned out consist mainly of a sketch map of Jeypore and Bustar, the country alluded to in para. 11 of Report for 1862-63 as so little known to Europeans, and continuation of the maps of the Kashmir territory, besides the usual charts of the triangulation.

68. In the Photographic Department but little has been done. Those maps which had been specially prepared for the purpose, were photographed, part by Captain Melville, who kindly devoted his leisure hours to the object, at my Dehra office, and the remainder in the Surveyor General's Office at Calcutta; but the results, though good of their kind, and exceedingly useful, are but photographs, and fall far short of what is produced by photo-zincography or photo-lithography. Next year, *i.e.*, after the return of the Superintendent and Mr. 1st Assistant Hennessey, both of whom have studied the subject at Southampton, and collected a good stock of materials to bring out with them, we shall probably be able to produce anything of the latter kinds equal to what is executed at the Ordnance Survey Office at Southampton.

69. Another important result of the Superintendent's visit to England will be the introduction of pendulum observations, sanctioned by the Secretary of State on the requisition of the Royal Society of England, the addition of a good set of magnetic instruments and of some valuable astronomical instruments to our hitherto, in this respect, defective equipment. With such instruments, and with a staff fully competent to observe with them, we may fairly hope to render our full share towards the investigation and development of the laws of meteorology, terrestrial magnetism, and other branches of physical science, the practical value of which is daily becoming more apparent, and for the advancement of which no other section of the community possesses equal opportunities, though they may have more leisure to devote to the study of them.

I have the honor to be,

Sir,

Your most obedient Servant,

D. G. ROBINSON, *Lieut.-Colonel, R.E.*,  
*Offg. Superintendent G. T. Survey of India.*

(*Postscript.*)

Whilst this Report was in the Press, Mr. Civil Assistant Johnson rejoined

Mr. W. Scott has, as usual, conducted the duties of his office with alidity and assiduity, and has been well seconded by Mr. Peyton and the other draftsmen.

I have also to acknowledge the great assistance I have received from Mr. Personal Assistant Harry Duhan, whose intimate knowledge of the correspondence and general intelligence greatly facilitates all work connected with his branch of the Department.

Mr. R. Scott maintains the character he has long enjoyed of being careful and zealous in the discharge of all duties entrusted to him, either as in charge of the stores, or in the Correspondence Office.

The Printing Press has also proved a most valuable addition to the office establishment. The Printer, Mr. T. Keightley, is a highly intelligent, painstaking man, and has given me great satisfaction.

my head-quarters, from Kashmir, after completing, in a most satisfactory manner, the only remaining unsurveyed portion of the territories of the Maharajah of Kashmir.

The following letter to my address, from the officer in charge of the Kashmir Series, gives a brief account of what has been effected by Mr. Johnson's small party during the past field season. It speaks for itself, but it is impossible to withhold one's admiration of the pluck of the men who, trying first one impracticable route, and then another, in inhospitable regions, finally effected their purpose by climbing over mountains upwards of 23,000 feet above the level of the sea.

The satisfactory completion of the field work of the survey of the territories of Maharajah Rumbheer Sing of Kashmir, without a single casualty or serious failure of any kind, affords a most fitting opportunity for soliciting a further marked expression of the approbation of Government for Captain T. G. Montgomerie and his assistants.

The progress of this Survey from its commencement has been watched with unusual interest both in India and in Europe. The learned societies of England from time to time have applauded its progress, attracted rather by the extraordinary nature and magnitude of the physical features examined and mapped, than by the mere name, fascinating though it be.

If we pause to consider the difficulties of such an enterprise, the actual danger that must have been incurred in ascending precipitous mountains of such stupendous height, or of traversing glaciers of such enormous length, where the traveller had literally to poke his way over the drift snow with the utmost care to avoid the hidden crevasses, or the difficulty of breathing in an atmosphere whose pressure was diminished to less than half of that which men thrive best in, and the serious effect of this rarity on the animal functions of all men, or if we only bear in mind the physical exertion, the fatigue, the intense cold, the privations, the absence of fuel, and the necessity of carrying it, as well as supplies, for many marches, we must admit that this has been an undertaking of no mean order, and we must applaud the determination of the men, and the completeness of the arrangements that have characterized their operations throughout.

To Captain T. G. Montgomerie, Royal Engineers, who from the first has commanded the party, and conducted its difficult political relations with the jealous native chiefs with so much tact and ability, the main credit of course is due; but his talents would have availed little had he not been supported by so splendid a staff of talented mountaineers, prominent amongst whom are Captains Godwin Austen and Melville and Messrs. Civil Assistants W. Johnson, W. Beverley, E. Ryall and W. Todd, who have been attached to the party for many consecutive seasons.

“Sir,—

“In my letter, No. 566, dated 7th November, 1864, I had the honor to report that the field work of the Kashmir Series had been completed. The following general account of the last season's operations will, I think, prove interesting. The camp of the detached party which has been working in Ladak has not yet reached head-quarters, but as soon as it does a more detailed account of the operations will be drawn up for your information.

“Mr. Johnson, with Messrs. Clarke and Low, left Kashmir early in June. Owing to a severe and late winter they had considerable difficulty in crossing the Himalayas. When crossing the range by the Zoji-la (pass) no less than nineteen miles of snow had to be traversed. Notwithstanding the severity of the season, Mr. Johnson pushed on to the Changchenmo Valley. On arrival there he found that a great part of the plains towards Tartary were still covered with snow, even at the end of July.

“The country to be surveyed proving even more difficult than had been anticipated, Mr. Johnson took with him nothing beyond the actual necessities of life, and reduced his party to the lowest number possible.

"Starting from Changchenmo, he advanced first in a northerly direction, then returning in a south-westerly direction for some distance, he approached nearly to the Shayok River; but finding that there was no path of any kind along that river, he marched right over the mountains, till he struck upon the Yarkund road.

"During the latter portion of his march he visited several places of very much greater elevation than have ever been reached by any man. One of the points is upwards of 23,000 feet above the sea.

"Having reached the Yarkund road, Mr. Johnson marched on to the Karakoram Pass, and descended three marches into Eastern Turkistan, and having more than completed the work allotted to him, he returned to Leh, and thence to Kashmir.

"The above will give you but a very faint idea of the hardships encountered. The country traversed was utterly desolate, fuel and food had to be carried, and for a whole month Mr. Johnson was at elevations over 15,000 feet.

"Mr. Clarke advanced towards the Karakoram by the Nubra, with supplies, which proved very useful to Mr. Johnson, but his services were not required for sketching, as the whole of the ground had been surveyed before he joined Mr. Johnson.

"Mr. Low had great difficulty in proceeding up the Shayok River, and deserves great credit for sketching a large amount of difficult ground in the Changchenmo and Shayok Vallies.

"All things considered, I think Mr. Johnson deserves very great credit for completing the work near the Karakoram, and I hope his services will meet with favorable recognition.

"I have, &c.,

"T. G. MONTGOMERIE, *Capt., R.E.*,  
"In charge Kashmir Series."

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# APPENDIX.

## Table A.

ABSTRACT OF THE OUT-TURN OF WORK EXECUTED BY EACH TRIANGULATING PARTY OF THE  
G. T. SURVEY OF INDIA DURING THE OFFICIAL YEAR 1863-64.

STATISTICS.	Kashmir Survey, 14-inch Theodolite.	Madras Coast Series, 24-inch do.	East Calcutta Longitu- dinal Series, 24-inch do.	Eastern Frontier Series, 24-inch do.	Jubbulpore Meridional Series, 36-inch do.	Sumbulpore Meridional Series, 24-inch do.	Bombay Party and Northern Bombay Party, 18 and 12-inch do.	Total Out-turn of Work.	REMARKS.
Number Principal Stations, . . . . .	...	25	13	13	16	11	20	98	
"  "  Triangles completed, . . . . .	...	29	13	18	17	11	22	110	
Area of "  Triangulation, . . . . .	...	3954	606	764	4328	4300	901	14853	
Length of "  "  . . . . .	...	138	68	52	128	118	79.8	583.8	
Mean Error of Principal Triangulation, . . . . .	...	0.69	0.41	0.51	0.38	0.47	1.76	...	
Mean Reciprocal Weight of Angles, . . . . .	...	0.10	...	0.21	0.12	...	1.42	...	
Azinuths Observed, . . . . .	...	1	...	1	1	...	...	3	
Area of Secondary Triangulation, . . . . .	5500	280	...	359	...	...	5342	11481	
Number of Secondary Triangulation, three } angles observed, . . . . .	54	14	...	6	1	...	113	188	
Length of Secondary Series, . . . . .	144	105	...	...	...	...	...	249	
Number of Intersected Points, . . . . .	175	17	1	28	...	...	285	506	
"  Secondary Stations, whose } heights have been fixed, . . . . .	109	4	...	9	2	...	58	182	
"  Principal Stations of Approxi- } mate Series, . . . . .	...	17	10	12	...	...	13	52	
"  Towers built, . . . . .	...	...	14	11	...	...	10	35	
"  Platforms, . . . . .	...	7	...	...	20	12	3	42	
Direct distance of Approximate Series, . . . . .	...	118	52	78	...	104	58	410	
Number of miles of Rays cleared, . . . . .	...	500	400	50	3	...	180	1134	
"  Roads made, . . . . .	...	...	...	220	20	...	...	240	
Number of Computation of Elements, &c., } Principal Triangulation, . . . . .	...	24	...	26	26	...	30	106	
Do., do., Secondary Triangulation, . . . . .	412	17	...	52	214	...	...	695	
"  Preliminary Charts prepared, . . . . .	2	1	...	1	1	1	1	7	
Area Topographically Surveyed, 1 mile to } 1 inch, . . . . .	...	...	...	...	...	...	333	333	
Do., do., ¼ mile to 1 inch, . . . . .	7530	...	...	...	...	...	...	7530	

EXTRACTS FROM A REPORT ON THE REMAINING PORTION OF HILL TIPPERAH, BETWEEN LAM-  
BUSARA AND SAISUM HILL STATIONS AND THE RIVER FENNY, TRIANGULATED DURING  
1863-64 BY MR. CIVIL ASSISTANT C. LANE.

(1.) The Report of 1862-63 embraced the portion of Hill Tipperah comprised between lat. 23° 50' and 24° 26' and long. 91° 20' and 92° 8'. It now remains to speak of the contiguous country to the south, which has just been crossed by the operations of the Eastern Frontier Series G. T. Survey during the late field season.

(2.) There are no districts or divisions in this thinly inhabited country, which, as was before observed, is, for the most part, an utter wilderness. The following are said to be the thanas:—Koileshar, Sarwa-Dharamnagar, Kamalpur, part of Asampara, part of Bamattia, Chorabari, Bisulgar, Udepur, (the former capital of Hill Tipperah, but now only a ruin), Billeenia, Chaopar—(but, in reality, the people of this thana reside near Chameham, close to south Deotamura hill station),—Khandal and Amligatta.

(3.) The aspect of the country in the tract under consideration is much the same as the preceding, or northern, portion, being the continuation of the block of hills described in last Report, intersected by innumerable watercourses and a few streams and rivers, and covered similarly with the densest possible

reed or makla bamboo, occasionally with patches of tall tree jungle, or forest, and here and there with plots of high grass jungle. The hills, which are also almost entirely of earth, are low, the high ranges being situated further east.

(4.) The climate of Hill Tipperah has not before been spoken of. The cold weather is scarcely below the temperature of summer heat on the summits of the hills, whilst in the valleys, and vicinity of watercourses, intense cold and excessive damp and chill are felt. The latter is the sort of cold weather which is experienced during the months of November, December and January at new Agartalla, the present capital of Hill Tipperah, situated in the plains, within a short distance of the foot of the hills, owing to the bogs and marshes, tanks, and numerous little ponds about the place. These peculiarities would lead to the inference that this town cannot be healthy, and that fevers and bowel complaints must be more or less prevalent at all seasons of the year, especially during the warm weather; indeed, cholera is said to occur annually and to cause, as elsewhere, much loss of life. The warm weather in Hill Tipperah is excessively trying to march in except in low and damp localities contiguous to streams, or under large forest groves where it is deliciously cool although far from healthy to halt at or bivouac, even for a single night. Of the regular rainy season in this country there has been no experience, but, judging from the physical features, the amount of annual rainfall must be pretty considerable, and owing to the numerous bogs and fens the country must be scarcely fit to live in, except on the summits of hills, and then communication with the contiguous low lands of British Tipperah would occasionally be absolutely cut off. At best, to move about at all during the rains, when the streamlets are swollen, and the marshes in their worst condition, could not but be extremely disagreeable, as well as involve some risk. As regards salubrity, it was discovered early in season 1862-63, shortly after entering the country, that, throughout these hills, the tracts of bamboo jungle, destitute of all undergrowth, or brushwood vegetation—a feature worthy of note—are extremely healthy during both the cold and the warm weather. It was found so even throughout an entire month of rain experienced in all April, 1862, when it poured heavily every day, and often two and three times within the twenty-four hours, with the exception only of one or two days. It is, however, the reverse of healthy in the forests. To encamp a single night under, or even within a short distance of jungle trees, is to lay in, unmistakably, the germs of jungle fever. These opinions are not fanciful, but the result of careful observation and actual experience during the last two seasons in Hill Tipperah. In proof of the salubrity of plain bamboo jungle, it may be mentioned that whilst cholera, fever, and even small pox, prevailed at Comillah, New Agartalla, Chittagong, Sylhet, and even on the Cosyah Hills, in 1862, my head camp enjoyed perfect immunity from these and all other maladies, except colds and coughs, the latter of which were, in many instances, extremely obstinate;—there can be little doubt but that it arose from the muddy and deleterious water which the poor men were obliged to drink. The different kinds of water met with were described in the former Report, but during this last season even worse was used by some of the men. Later in season 1862-63 a few casualties did occur, but these were chiefly among the men on detached duty, owing, perhaps, as well to bad water, as to nonavoidance in the trying heat of the warm weather of the no slight temptation of shade and shelter under tree jungle.

(5.) The woods in Hill Tipperah are as follows, viz. :—Jaril, gāmbār, of two kinds, “sil” and “ful,” the former used for posts, and the latter for boxes; rángi, of two sorts, of which boxes, trunks, and palankeens are made; garjan, of which an oil is extracted from the upper roots overlying the ground surface; rúdrík, or udras, of the fruit\* of which necklaces are worn by the Hindoos; anwarkali, of which handles of spears are made, and it is also used for rafters of huts and dwellings; nágcsri, sometimes called iron wood, owing to its excessive hardness; sisú, used for planks and posts; bándárlāti, which attains a height of about fifteen feet, and a girth of about three feet, is said to form posts impervious to the attacks of white ants, and to be very durable, but little used, owing to its crookedness; dhúp, which is burnt at the worship of idols in Hindoo temples; agar, the core of which is highly prized for its scent in burning; chamal, of which there are two varieties, is valued for the width of its planks, which are up to two and two and a-half cubits, an expensive kind of wood, used for native furniture; pitraj, also used for native furniture, and considered durable, oil is extracted from the nut (fruit) of the pitraj, and is used for burning; bajna, or bádráng, rafters made of which, owing to immunity from rot and decay, are said to endure for eighty or ninety years, an oil is likewise extracted from its fruit, which, when fresh, is eaten like ghee; hargajja, used for beams and rafters, and, if seasoned, is said not to be subject to rot, being a heavy, close-grained wood, and also durable; awal, a very hard description of wood, mentioned in last Report in speaking of petrifications; singari, of which the natives of the adjoining plains make ploughs; lohajori, said to be extremely hard and heavy, is used for making large pestles for pounding off the husk of rice; panituri, the wood of which is used for rafters and scantlings.

(6.) The following native medicinal plants are also obtainable in Hill Tipperah, viz. :—Amaloki vel aila, harra, and bahera, the three together called “trifala”; sil-ada, harina-gokhur, sial-shuis, zabar-

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\* This fruit, found with a single natural line or streak on it, termed “ekmúkh,” being a great rarity, is valued at 50 Rupees. It is used by Hindoo priests for decorating the idols in their temples.

partab, masa-gando, har-banga, nagesar, or nagesri ("iron wood" tree), kutchila, chawal-mugra, ghila, gand-bhada, zer-mul, tal-muli, indra-jao, isaph gele, topchini, bagdar, sukchini, and nirbis.

(7.) There are also wild vegetables, and some kinds of fruit in Hill Tipperah, viz. :—Thorai (Bengali katchu), tha (Bengali mukhi), thadúk (Bengali gatch-alu), thaktoi (Bengali mo-alu), tha-bolong (Bengali jungly alu), raisuk (Bengali galla-bent). Fruit—Bamboo kernel, jamun (Bengali), búbi (Bengali), anjir (Hindustani) figs. The tea tree was found in Hill Tipperah by Mr. Civil Assistant W. C. Rossenrode, whilst carrying on the approximate triangulation in advance last season, at a hill called Sabrong, in latitude  $23^{\circ} 3'$  and longitude  $91^{\circ} 48'$ . There is another tree in this country, called in Bengali the "maritcha," growing up to twenty-five or thirty feet in height, the venation of the leaves of which is the same as that of the tea. The leaves are also alternate, and, indeed, in appearance and size, the two leaves bear the greatest possible resemblance, and, by itself only, that of the "maritcha" could not be distinguished from the genuine tea leaf, the color and freedom from down being also the same in both. The only visible difference is that the tea twig has a very small stipule at the base of the petiole, which the "maritcha" has not; in all other respects they are precisely identical.\* It has been said that the tea tree will grow and thrive wherever the "maritcha" is found; this appears to be the case. It is not impossible the "maritcha" may be a species of tea. It is to be seen about the hill of Sabrong, where tea was found, as above stated, as well as on the extensive table-land between Gojalia H. S., in latitude  $23^{\circ} 9'$  and longitude  $91^{\circ} 36'$ , and Tulamura H. S., in latitude  $23^{\circ} 11'$  and longitude  $91^{\circ} 48'$ , and on the right bank of the River Fenny; indeed, there can be little doubt it is to be met with throughout the portion of Hill Tipperah between latitude  $23^{\circ} 18'$  and the Fenny, and, consequently, it may be inferred that the tree considered to be the genuine tea would also thrive here. The clove plant has likewise been found indigenous on the table-land between Gojalia H. S. and Tulamura H. S. Other spices would, no doubt, thrive here also. Specimen twigs of the "maritcha," of the tea, and of the clove were kindly taken charge of by a gentleman proceeding to Calcutta, but, unfortunately, when there, he did not find time sufficient to take the samples to the Secretary of the Horticultural Society, Mr. Bleychenden, for his opinion.

(8.) Mr. Civil Assistant W. C. Rossenrode has mentioned three kinds of dyes in use in this country, viz., indigo, asú, or ason, and rankari.

(9.) In last Report it was stated that there are fourteen castes among the Tipperahs, of whom two were originally Kookies. Such was the information obtained at the time from the Maharajah's people in attendance on my main camp. It seems, however, that each sub-division of a tribe is ruled by a head man, or petty chieftain, consequently the term clan will be more appropriate than caste. From recent enquiries, it appears that, besides the clans of Kookies before specified,† the chief tribes consist of Tipperahs, Halams, and Nawatias. The Tipperahs, who sometimes use the prefix of "Puran," signifying old, or aboriginal, are divided into nine clans, viz.,—Guttpai, Jamatia, Rookum, Morasing, Dongaro, Mosobang, Totaram, Ramuk, and Amuk. The Guttpais affirm they are of the same clan as the ruling family, and, it is said that, when applying for situations under the ruling raj, preference is always given to candidates of this clan. Of the Halams there are twelve clans,—Knifeng, Múrsung, Kaloi, Rangkhal, Rasti, Rupni, Julai-Rupni, Nitchamte, Karbong, Bángser, Suiang, Ribang, or Riang. These Halams are also called Sani-Kookies. In former days these people were the slaves or laborers of the Tipperahs, and are so still, in some measure, to the present day. The Nawatias are divided into twelve clans also, viz.,—Amúkia, Phátong, Gabeng, Ashlóng, Tongbai, Khali, Laitong, Khàklo, Moiching, Kéna, Koran, and Kewa. All the Halams and Nawatias have as many modifications of dialect as there are clans.

(10.) Among the inhabitants of Hill Tipperah the warriors consist of all the Kookies, the Jamatias, all the Nawatias, and the clan of Riangs among the Halams. The weapons in general use are muskets and fowling-pieces, the former mostly with flint locks, and the latter of Monghyr origin, spears, dows, and bows and arrows. Many are tolerably good shots, and some very good, with the gun, but the majority are believed to excel with the primitive bow and arrow. They have no manufactories of metals, nor gunsmiths, and all the firearms they possess, as well as the powder and musket balls which they use, are evidently conveyed from British territory.

(11.) The movement of large bodies of Kochaks (alluded to in last Report) who have, it is said, hitherto made periodical incursions into Hill Tipperah and villages on the frontier for plunder, without apprehensions of running short of provisions, and of consequent starvation,—travelling, as they have to do, many stages across a wilderness country, and notwithstanding that they set out with a large supply of rice, and notwithstanding the hope of taking back by plunder a sufficiency for their return trip,—is now intelligible, owing to the discovery of the wild vegetables specified in a previous part of this Report, on which

\* When about taking the field last November, the Commissioner of Chittagong desired me to look out for tea in the jungles of Hill Tipperah. To remove all doubts on the subject it was deemed advisable to offer high remuneration to two of the hill men, if they would gather seed at the proper season, and bring them to Chittagong. It remains to be seen if they will do so.

† There are more clans of Kookies as well as other savage tribes out of Hill Tipperah, and further south along the eastern frontier, of whom particulars may be ascertained hereafter, as the G. T. Survey operations progress.

the savages, and even natives of the plains and native troops may subsist for many days without suffering the slightest inconvenience. It is well known that all Bengalis, and natives who live chiefly on rice, require to take several meals in the course of the day. On predatory excursions, it is said, the Kochaks do not, the same as other natives, halt on the march to cook their victuals, but manage it thus : A bamboo pole is placed on the shoulders of a couple of men, to which is suspended a vessel with fire and ashes, over this fire are placed stout green bamboo tubes, filled with rice and water, and vegetables and water, and the mouths closed with green leaves. The men then proceed on the march ; in a short time the meal is ready, and it is then shared and eaten by the people, as they are going along.

(12.) No cattle were found in Hill Tipperah, except in the plains of Bisalgar, Billenia, and Udepur Thanas, situated in valleys in the block of hills. The only village in the hills where a few goats were seen was Waisabari, and they appeared healthy. Of wild animals, tigers were frequently heard and seen last season, also wild elephants, and the bison, or wild goboï ; lairs of the bear were met with occasionally, and signs of deer and wild pigs frequently.

(13.) Of the different kinds of crops, particulars were given for 1862-63 in last Report. They are the same in the country traversed during the last season.

C, LANE, *Chief Civil Assistant, G. T. Survey,*  
*In charge Eastern Frontier Party.*

Chittagong, 15th August, 1864.

**Table B.**

STATEMENT, SHOWING THE DIFFERENCE BETWEEN RAILWAY AND G. T. SURVEY LEVELED HEIGHTS, WHEN REDUCED TO THE COMMON DATUM OF HOWRAH DOCK SILL.

E. I. RAILWAY STATIONS.		Height of Rails above Howrah Dock Sill. Railway Values.	Height of Rails above Howrah Dock Sill. G. T. Survey Values.	DIFFERENCES.
	Miles from Calcutta.			
Scrapore, . . . . .	13	36.40	32.552	+ 3.848
Pundooah, . . . . .	38½	58.40	54.031	+ 4.369
Mymarce, . . . . .	51½	82.97	78.330	+ 4.640
Burdwan, . . . . .	67½	116.40	111.958	+ 4.442
Kanoo Junction, . . . . .	...	137.47	133.172	+ 4.293
Ghooshkarah, . . . . .	87½	127.47	122.137	+ 5.333
Biddiah, . . . . .	94½	149.47	143.903	+ 5.567
Bulpore, . . . . .	99½	176.47	171.268	+ 5.202
Ahmudpore, . . . . .	111½	148.47	145.846	+ 2.624
Synthea, . . . . .	119½	185.47	179.963	+ 5.507
Mullarpore, . . . . .	129½	159.77	155.342	+ 4.428
Rampore Haut, . . . . .	137	135.45	128.443	+ 7.007
Pakowr, . . . . .	169½	121.47	116.025	+ 5.445
Teenpahar, . . . . .	196	121.39	115.412	+ 5.978
Colgong, . . . . .	246½	135.39	130.050	+ 5.340
Ghoga, . . . . .	252½	138.39	127.003	+ 11.387
Bhagulpore, . . . . .	265½	163.39	155.336	+ 8.054
Sultangunje, . . . . .	280½	141.39	135.387	+ 6.003
Burriarpore, . . . . .	291½	139.51	138.094	+ 1.416
Monghyr, . . . . .	303	148.39	139.407	+ 8.983
Burrheca, . . . . .	336½	165.39	159.917	+ 5.473
Mokameh, . . . . .	347½	168.19	154.700	+ 13.490
Barr, . . . . .	363½	172.99	161.375	+ 11.615
Bukturpore, . . . . .	374½	177.09	168.792	+ 8.298
Puttooha, . . . . .	389½	184.65	174.500	+ 10.150
Patna, . . . . .	396½	188.99	183.372	+ 5.618
Bankipore, . . . . .	402½	186.57	177.872	+ 8.698
Dinapore, . . . . .	408½	194.51	184.407	+ 10.103
Bihla, . . . . .	419½	207.77	199.019	+ 8.751
Soane River, . . . . .	{ E. end. ...	239.37	231.798	+ 7.572
	{ W. end. ...	239.37	231.828	+ 7.542
Arrah, . . . . .	433½	208.37	200.294	+ 8.076
Beeha, . . . . .	446½	224.37	214.528	+ 9.842
Deedulnugger, . . . . .	498	241.82	233.922	+ 7.898

The Railway Values given in this Table are the latest supplied by the Railway Department.  
 October 11th, 1864. (Signed) HENRY TROTTER, *Lieut., R.E.*

Table C. 105

ANNUAL RETURN OF WORK EXECUTED IN THE DRAWING BRANCH OF THE OFFICE OF  
SUPERINTENDENT G. T. SURVEY FROM 1ST MAY, 1863, TO 1ST MAY, 1864.

No.	Description of Work.	Remarks.
	Sheet No. 2 "Baltistan, or Little Tibet, with the adjacent districts of Ludak," on the basis of the Great Trigonometrical Survey, by Capt. T. G. Montgomerie and Assistants (original), scale 4 miles = 1 inch,	For Home Government.
	Sheet No. 3, portion of Zaskar, on the basis of the G. T. Survey, ditto,	Do.
2 Copies.	Diagram showing the order and arrangement of the sections for the new Kashmir Map, scale 32 miles = 1 inch, ... ..	
	Preliminary Chart of the Cherrapoonjee, Sylhet, and Cachar Series, ...	For Srvt. Genl's Office & Home Govt.
	Trace of Rahooon Series Chart, season 1861-62, scale 4 miles = 1 inch,	For the use of Gwalior Topl. Survey.
	Trace of ditto, 1860-61, ditto, ... ..	Do.
	Section No. 7, new Kashmir Map, (for photography), ... ..	
	Do. No. 8, do., do., ... ..	
Original & Copy.	Chart of the Northern Trans-Indus Frontier Survey, season 1849-53, scale 4 miles = 1 inch, ... ..	Copy for Surveyor General.
	Preliminary Chart of the Jogi Tila Meridional Series, season 1856-57, do.	For Home Government.
	Section No. 9, new Kashmir Map, (for photography), ... ..	
	Extract from Calcutta and Great Longitudinal Series Chart, comprised between the Rahooon and Budhoon Series (on vellum cloth), scale 4 miles = 1 inch, ... ..	For the use of Gwalior Topl. Survey.
	Chart of a portion of the triangulation of the Northern Trans-Indus Frontier Survey, season 1849-53, scale 4 miles = 1 inch, ... ..	
	Sheet No. 3, (Jamoo territories), scale 2 miles = 1 inch, (for lithography),	For Colonel Thuillier.
	Sheet No. 2, do., do., ... ..	
	Sheet No. 1, do., do., ... ..	} Printing of names in progress.
	Section No. 4, new Kashmir map (for photography), ... ..	
	Two Extracts from Major Walker's Triangulation Chart of the Northern Trans-Indus Frontier Survey, ... ..	
2 Copies.	Preliminary Chart of Minor Triangulation along the River Chenab, Sutlej Series, season 1861-62, scale 4 miles = 1 inch, ... ..	For Captain Montgomerie and Colonel Robinson.
Do.	Do. of the Rahooon Meridional Series, season 1862-63, scale 4 miles = 1 inch, ... ..	For Home Government and Surveyor General.
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W. H. SCOTT, Civil Assistant, G. T. Survey,  
In charge Drawing Office.

