

GENERAL REPORT

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ON THE

Topographical Survey

OF THE

BENGAL PRESIDENCY,

SEASONS 1860-61-1861-62,

No. 24A—DATED CALCUTTA, 15TH APRIL 1863.

CALCUTT

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JULY 1863.

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No. 76.  
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Office of Superintendent,  
Great Trigonometrical Survey.  
DEERA DHON, 25th August, 1862.

From  
Major J. T. WALKER, Engineers,  
Officiating Superintendent G. T. Survey,  
To  
The SECRETARY TO GOVERNMENT OF INDIA,  
Military Department,  
Fort William.

Sir,  
I have the honor to narrate the progress made in the course of the operations of the Trigonometrical Survey, since its late Superintendent, Sir Andrew Waugh, submitted his last Tabular Progress Report, with his No. 19,115, dated 31st January 1861, to your office.

**KASHMIR SERIES.**

Executive Officer :  
Captain T. G. MONTGOMERIE,  
Bengal Engineers.

**TRIANGULATION.**

Assistants :  
Lt. H. R. THUILLIER,  
Engineers, 1st Assistant.  
W. H. JOHNSON, Esq.,  
Civil 2nd Assistant.  
W. G. BEVERLY, Esq.,  
Civil 2d Assistant.

Sub Assistants.  
Mr. S. H. CLARK.  
Mr. C. J. NEUVILLE.  
Mr. J. Low.

**TOPOGRAPHY.**

Capt. H. H. G. AUSTEN,  
Bengal Staff Corps,  
Topographical Assistant.  
Captain A. B. MELVILLE,  
Bengal Staff Corps;  
Topographical Assistant.  
Lieut. H. DE BRETT,  
Late 57th N. I.  
Probly. Topl. Assistant.  
Mr. E. C. RYALL.  
Mr. W. TODD.  
Mr. H. J. BOLST.

2. Government having objected to the form of the Tabular Progress Reports hitherto submitted, I proceed to adopt a form of Report, somewhat similar to the late Surveyor General's triennial narratives of the progress made in this Department, which I trust will meet with approval.

3. The operations in Kashmir under the superintendence of Captain Montgomerie have made good progress, notwithstanding the increasing difficulties which have had to be encountered as the work progressed, and entered higher and more inhospitable ground. In the year 1861, the triangulation was extended over an area of more than 12000 Square Miles, including some very elevated and difficult country in Zaskar, Rukshu, the Upper Indus, and in Khagan and Nubra. At several points it was carried up to the Chinese Boundary, and stations were visited in the neighbourhood of the Parang and Baralacha passes, where a junction of secondary points was formed with the North West Himalaya Series, the basis of the Degree sheets recently published in Calcutta by the Surveyor General. The stations in Ladak Upper Indus were very high, generally over 17,000 feet. Mr. Johnson took observations at a station more than 20,000 feet high, the greatest altitude yet attained as a station of observation. Several remarkable peaks Trans Indus, probably forming the watershed between the Chitral and Swat Vallies, were fixed from the stations West of Khagan.

4. The Topography embraces an area of about 14,500 square miles, executed on the scale of 4 miles to the inch, leaving but a very small portion of little Thibet unfinished, and completing the greater portion of Nubra, Ladak, Rupshu, (or Rukshu) and Zaskar. Several of the Salt Lakes on the Table land of Rukshu have been surveyed. Some exceedingly difficult ground was sketched, by Captain Austen, in little Thibet, varying in altitude from 7000 to 28,800 feet above the Sea. The glaciers he has discovered and surveyed are probably the largest in the world out of the Arctic regions. The Baltoro Glacier, in the Braldo branch of the Shigar Valley, being no less than 36 miles long. The Biafoganse is nearly as long, and forms, with the glacier on the Nuggair side, a continuous mass of ice nearly 64 miles in length. To delineate them properly a great amount of roughing and exertion, and not a little danger, had to be undergone by Captain Austen, as it was necessary for him to encamp on them for days, and to ascend to great heights on either side.

5. The carrying out of these interesting operations has involved vast labor and exposure. The country was found to be barren and desolate in the extreme, and the weather very unfavourable, in consequence of the extraordinarily heavy rains, for which the year will probably be long remembered. Contrary to their wont, the clouds crossed over the South of the Himalayas to the Northern side, bringing heavy falls of snow in August, and generally hindering the work. Supplies and firewood had to be carried great distances, argols of Yak dung being often the only fuel available. Under these circumstances, the outturn of work is most creditable to the Officer in charge and his Assistants. Captain Montgomerie testifies to the zeal and cheerfulness with which all under his orders have executed the difficult tasks assigned to them. He also acknowledges the cordial assistance which the members of the Survey have invariably received from the Maha Rajah of Kashmir and his higher officials.

Captain Montgomerie reports, that "Lieut. Thuillier extended the Triangulation across Khagan, and fixed a number of points Trans Indus, thus making a good foundation for further extension, completing a good season's work, and altogether making very good progress."

"Mr. Johnson pushed on his work with his usual energy and success over very difficult ground, involving the ascent of some very elevated peaks. Notwithstanding the natural difficulties of the country and the bad weather, he crossed Rukshu, and completed a good season's work, and made very satisfactory progress."

"Mr. Beverly triangulated a very elevated piece of country and finally fixed the position of a point, the most important point on the Upper Indus, in the South East of Ladak, — altogether progress very satisfactory, and out-turn of work good."

"Mr. Clarke made good progress in Zaskar, and completed a satisfactory season's work."

"Mr. Neuville continued his Triangulation in Nubra, and made very fair progress, having to visit several very high stations."

(6.) The Kashmir party being employed in mountains which are only accessible during the Summer months, its Field Season is the period of recess of the Trigonometrical parties employed in ordinary districts. The usual Survey year commences in October, by which month the computations and maps of the preceding field Season are generally brought up, and the party is ready to take the field again. The Kashmir Survey year is exceptional and commences in March. The Officers in charge of the various parties submit their respective annual Reports on the termination of the Field operations, which are the real test of the advance made during the year. Thus the Superintendent of the Department cannot prepare Progress Reports for strictly synchronous periods. Sir Andrew Waugh's last report embraced the Summer of 1860, and the preceding Winter.—The present narrative embraces the Summer of 1861, and the Winters of 1860-61 and 1861-62, and consequently gives the progress which has been made in two successive field seasons of ordinary Tringulation, and one season of the Kashmir operations.

(7.) The COAST SERIES,\* between Calcutta and Madras was placed under the Superintendence of Captain Basevi, Bengal Engineers, in the autumn of 1860, the exigencies of the Department having required his transfer from the Trans-Indus Frontier all the way to the Madras Coast.—His operations commenced in the vicinity of Vizagapatnam, and were proceeding towards Rajahmundry, when on approaching the hill of Kapa in the Rampa estate, he found that his signallers had been driven away from the hill with threats of violence, and that the inhabitants of the District were assembling to prevent him from ascending. The estate is Rent free, and the people are a lawless set, though under the control of the Godavari Magistracy. Captain Basevi, having obtained an extra Military Guard and a body of Police, made his way to the summit of the hill without molestation, and took the necessary observations. One day, the people set fire to the grass on the hill, which was about 8 feet high, and a Rajah brought intelligence that they were collecting to attack the Surveyors; but the fire was extinguished, and the attack was not attempted. Captain Basevi's chief apprehensions were for the signallers whom he had to leave behind at the station, but a guard was left with them, and they were unmolested. The only serious inconvenience occasioned was in having to construct the station on a block of laterite several feet below the hill, for the summit was covered with dense jungle which there was no means of clearing away without the assistance of the villagers, all of whom had absconded.

(8.) Fortunately, such interruptions are of rare occurrence, only happening in the unusually lawless districts around Hyderabad. The operations proceeded without further opposition or hindrance, excepting from the physical difficulties of the ground passed over.—The district between the Godavery and Krishna Rivers was crossed, with considerable trouble, owing to the absence of high hills, and the undulating nature of the ground, which was all the more difficult because covered with dense jungle. Thus the selection of stations in such a manner as to form an unbroken chain of quadrilaterals and polygons, became a very tedious and laborious undertaking, involving the repeated rejection of positions which at first promised the requisite visibility in all directions, but were afterwards found to be deficient in some essential relation. Nevertheless, in the two field seasons

"Mr. Low assisted Captain Montgomerie, in computing and current duties of the Season. He was, subsequently employed on Topographical work, in which he made very fair progress."

"Captain Austin completed his sketch in first rate style, made very good progress in all directions, and turned out a first rate season's work."

"Lieutenant Melville, commencing in the north of Zaskar (or Zaskar) surveyed a large portion of it, including all the large glaciers, to the West, as well as those, at the head of the Butnai river. Some of these glaciers were 15 to 7 miles in length. Total progress very good, and with the Trigonometrical points now available, he will be able to complete the sketch of Zaskar during the ensuing season. Whilst surveying, Lieutenant Melville made some very successful, and characteristic Photographs of Glaciers, and of the Country generally. His progress in Photography has been very rapid, and highly creditable. Captain Montgomerie has no doubt but that Lieut. Melville will become a proficient in the art."

"Lieutenant De Brett was trained in the use of the Plane Table, and assisted Captain Montgomerie in the computations and current duties of the Series, and will no doubt be able to turn out a piece of independent work during the ensuing season."

"Mr. Ryall sketched a large portion of the Shaltow, and Shayak or Nubra vallies, the ground varying in height from 27,000 feet to 9000 feet, including some very large glaciers, one of them 24 miles in length. Notwithstanding the very great difficulties of the ground, Mr. Ryall made very good progress and turned out a first rate season's work, and executed it in good style."

"Mr. Todd sketched a very rugged and difficult piece of the Upper Indus and also a portion of Rukshu, right down to the Parang Pass, altogether a very elevated and desolate piece of country, which Mr. Todd sketched very characteristically, and notwithstanding the difficulties of such a country, he made very good progress and turned out a first rate season's work."

"Mr. Holst sketched a portion of the Indus Valley, and of Rukshu—progress fair, and execution characteristic and neat."

\* On the Coast Series, the principal operations consist of 42 Triangles, arranged so as to comprise one double and five single polygons, and one quadrilateral. 21 Triangles were measured during the first Season, with a 2-foot Theodolite by Barrow, giving a mean triangular error of 0.65, and an equal number measured the next season, with a similar instrument by Troughton and Simms, gave a mean error of 0.37.—Azimuthal observations on Circumpolar Stars were taken at 3 stations.

The selection of stations depended almost entirely on Mr. Clarkson, excepting when he was so delayed by the difficulties of the ground that Captain Basevi had to suspend the triangulation and proceed to his assistance. After crossing the Kistna River, Mr. Clarkson's advance was very rapid, and he succeeded in selecting Stations as far South as Nellore, 140 miles beyond the terminal side of the triangulation.

Mr. Howard was employed in conducting a secondary series immediately along the Sea Coast. He worked on fast one well as long as he had hills and clear ground, but on approaching Coconada, his progress was much retarded by having to clear every ray through very valuable ground, abounding in mangoe trees and palm trees. His triangles extend over a distance of about 100 miles, defining the Coast Line well, and fixing the positions of the light-houses at Coconada and Coringa,—points of Nautical importance.

Mr. Ellison was employed in building Platforms at the Principal Stations, and he subsequently carried a Secondary Series of Triangles to fix the positions of Rajahmundry and Dowleiswaram. In December 1861 he was transferred to the Assam Series.

Mr. F. Ryall was employed as recorder, and afterwards in building Stations and in Secondary Triangulation, in which his progress was very satisfactory.

**COAST SERIES**

Executive Officer,  
CAPT. J. P. BASEVI

Assistant.

R. CLARKSON, ESQUIRE,  
Civil Assistant.

Sub Assistants:

Mr. G. HOWARD, } Topographical  
1st Class. } Survey

Mr. J. ELLISON, } 1st Class. } 1860-

Mr. F. RYALL, }  
2nd Class. }

the principal triangulation was carried a distance of upwards of 180 miles. It has now reached a point in the Guntour district near the meridian of Madras, whence it will merge into the meridional arc which is intended to connect Jubbulpore and Madras, and to be extended Southwards into Ceylon.

9. After completing his triangles thus far, Captain Basevi returned to Vizagapatam, to select a site for the Base line of verification, which it is proposed to measure in this neighbourhood. He succeeded in obtaining a suitable site, but not until his field operations had been so long protracted that it was the middle of June before he could break up his Camp and return to quarters. In the event of Captain Smyth's expedition into Central India taking place, Captain Basevi has been nominated to accompany it in the capacity of Astronomer and Topographer.

10. The INDUS SERIES, running parallel to the Western Frontier of British India, was completed by the close of the Field season 1859-60, when the late Surveyor General decided on carrying an oblique series along the South East Bank of the Sutlej, from Mittankote to Ferozepore, to tie up the Punjab Meridional series, and form a basis for futuro triangulation into the deserts of Sind and Rajpootana. Certain small portions of the Indus triangulation which had been executed with a two foot theodolite gave unusually large re-entering errors. Lieutenants Herschel, and Thuillier, both of the Bengal Engineers, and 1st Assistants of the G. T. Survey, were consequently sent to revise them with the Great Theodolite, while Mr. Armstrong was selecting Stations and building Towers on the line of the Sutlej. 21 principal triangles were ably and rapidly revised, after which Lieut. Thuillier proceeded to join the Kashmir party, while\* Lieut. Herschel took in hand the Sutlej Triangulation. This consists of a Series of single triangles, of which one flank rests on the sand hills fringing the Bahawalpore desert, and the other in the lowlands which are periodically inundated by the Sutlej. Thus the greater portion of the rays traverse moist jungles of tamarisk and long grass, alternating with ridges of sand, forming a combination which is peculiarly troublesome in disturbing the atmosphere, and causing lateral refraction to perplex and weary the observer, and impair his measures. The Principal operations consist of 38 triangles, extending over a distance of 182 miles from a side of the Indus series below Mittankote to the vicinity of Pak Pattun. Being entirely in the plains they cover an area of only 1960 miles.

11. Lieutenant Herschel reports that "all the principal towns and villages along the line of the Series have been fixed where practicable. They are necessarily few in number, as the country is more and more thinly populated from Ahmedpur eastwards as far as the British boundary. From Bahawalpore to Fazilka, the towns become fewer and of less importance, reaching a climax of insignificance in Bahawalgurh, the capital of nearly half the whole state, which is nothing but a hamlet without a single pukka house in it, and deriving its importance apparently

\* Lieutenant Herschel took astronomical observations for the direct determination of azimuth at 3 stations at an average distance of 72 miles apart. His mean triangular error is 0".53. In 85 angles his mean probability of error is 0.25 between extremes of 0".10 and 0".38. He has given the following interesting table as a test of the accuracy of his work.

**SUTLEJ SERIES.**

- Executive officer.
- HERSCHEL, *Engineers.*
- 1st Assistant
- Assistant.
- ARMSTRONG ESQUIRE,
- Civil Assistant.
- Sub-Assistant.
- MR. G. F. RYALL,
- or sub-Assst. } *Season*
- W. F. TROTTER } 1860-61.
- 2nd Class
- MR. J. T. BUNT,
- 3rd Class.

(A.) *Maximum difference between observations.*

B Number of mea- sures in a set.	0"	1'	2"	3"	4"	5"	6"	7"	8"	TOTAL.
	to	to	to	to	to	to	to	to		
	1"	2"	3"	4"	5"	6"	7"	8"		
2	1	0	0	0	0	0	0	0	0	1
3	223	251	93	0	0	0	0	0	0	567
4	3	13	75	23	1	0	0	0	0	104
5	0	5	4	29	13	1	0	0	0	52
6	0	0	0	5	11	5	3	0	0	24
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	1		1
9	0	0	0	0	1	0	0	0	0	1
TOTAL	227	269	162	56	26	6	3	1	0	750

Total 0" to 3" = 658. Total greater than 3" = 92

In this Table the unit is a set of measures on an angle of a single Zero, the arguments being  $\Delta$  the maximum difference between the respective measures forming a set, and B the number of measures.

from nothing but the prestige of an old ruined fort, and the residence in it of the temporary holder of the largest (but by no means the richest) Kardari in the states. The country is singularly poor in Mosques, temples, tombs, or indeed prominent buildings of any kind."

12. The **RAHOON MERIDIONAL SERIES**,\* under the charge of H. Keelan, Esquire, 1st Assistant G. T. Survey, has advanced a distance of 176 Miles, by 99 Principal Triangles, arranged in quadrilaterals and hexagons, covering an Area of 4130 Square miles. It has laid down portions of Jeypoor, Ulwar, Deoli, Boondi, and numerous other places of importance. In one more field season, it should reach the Longitudinal Series between Calcutta and Karachi, where it will terminate. The published Charts of the Kotah and Boondi territories indicate a succession of hills over which it was supposed that the triangulation might have been carried and completed last season. But the ground was found to be the very reverse of what had been expected, and to require the construction of Towers, thereby protracting the operations into another Season.

13 The **GOORHAGURH MERIDIONAL SERIES**,† under the charge of Geo. Shelverton Esquire, Civil 2nd Assistant G. T. Survey, traverses a meridian close to that of Umritsur, and was brought to a termination last Season by joining the Arumlia Series, which had some years previously been carried, by Captain Rivers of the Bombay Engineers, up an adjacent meridian, as far as Ajmeer, from the Great Longitudinal triangulation. From Sirsa to Ajmeer it crosses a desert tract, of which Mr. Shelverton reports that "the main difficulties encountered were scarcity of water, of building material, of laborers and of provisions—the country traversed had suffered for three years from extreme drought; large villages originally containing upwards of 500 families had been deserted by all except first class Farmers who were too proud to work. Wholesome water was scarcely procurable, and water even for building purposes had frequently to be conveyed from distances of 4 and 5 miles. The large reservoirs of water upon which the inhabitants depended for their supply during the greater part of the year had invariably been exhausted, and the expensive kucha wells of the country barely sufficed for local wants. It was therefore under very adverse

circumstances Lieutenant Herschel has introduced an improvement in the referring marks at present used in the Survey. Instead of having two apertures one for a lamp, the other for a heliotope, he made both lamp and heliotope illuminate the same piece of ground glass, the aperture of which was limited by a circular diaphragm of diameter suitable to the distance. Thus one object is intersected instead of two, and there is no flickering or unsteadiness of signal from wind or imperfect direction of heliotope; there is no dazzle from too bright a sun, nor total disappearance in its absence, for the mere reflection of the sky suffices to illuminate the glass in tolerably clear weather. One mile is considered the best distance for such a mark.

Mr. Armstrong was employed in both seasons in selecting stations. He has formed a junction with the southern extremity of the Jogi Tila Series, and laid out his triangles so as to merge into the Goorhagurh Series to the East of Ferrozepore. He was subsequently employed in carrying a Series of triangles with a 14 inch Theodolite from the vicinity of Pak Putun towards Mooltan, via Hurruppa, Cheechawutni, Talomba, and Mukdoonpur, near which last place the triangulation has at present closed.

Mr. Geo. Nyall was chiefly employed in constructing the numerous tower stations which it was necessary to erect in the lowlands of the Sutlej. He also assisted Mr. Armstrong in selecting sites. He carried secondary series of triangles to fix the position of Shoojahabad, Myssee, Futtelipoor, and Karori, and finally made a reconnaissance from Balaswagurh into the Desert, for a distance of about 65 miles, as far as Anopgarh, on the Jogi Tila Meridian, to ascertain the feasibility of continuing that Series in a Southerly direction, which had long been doubted, but is now proved to be quite practicable, as the desert was found to have numerous sand hills suitable for Trigonometrical stations.

Mr. W. Trotter acted throughout the field season of 1860-61 as Lt. Herschel's immediate Assistant in the Office and Observatory, giving every satisfaction. He subsequently resigned his appointment in the Survey having obtained an Engineer's Commission in H. M.'s 41th Regiment. He was succeeded by Mr. J. T. Burt who has worked well. The greater portion of the party returned to Head Quarters by the 13th May, followed on the 21st by Mr. Armstrong.

\*Mr. Keelan employed Colonel Waugh's 2 feet Theodolite No. 1 in his triangulation. The average error of his 33 triangles is 0.36. The mean probability of angular error is 0.30, between extremes of 0.12, and 0.55. Azimuth observations were taken at 3 stations. The Secondary triangulation covers an area of 7040 Square Miles.

In the Season 1860-61, Mr. N. A. Belletty assisted Mr. Keelan in selecting sites, on which he afterwards built the requisite Stations. He carried a Series of 37 secondary triangles over a distance of 170 miles, to lay down the position of Ulwar and other towns. During the following recess, he was disabled by a severe accident from immediately resuming field operations, and has ever since been temporarily attached to the Computing Office in consequence.

In 1860-61, Mr. M. C. Hickie carried a Secondary Series of 33 triangles over a distance of 130 miles to fix Sambher, Jeypoor and other towns.

In 1861-62, Mr. C. J. Carty, who was attached to the levelling operations, volunteered to take Mr. Belletty's place for a time, and while his camp was marching to Seronje, proceeded by dak to the Arabull range, to select stations northwards from the side of the Longitudinal Series, with which the Rahoan was to form a junction. He labored very energetically under most trying circumstances, never pausing though daily ill with fever.

In 1861-62, Mr. H. Keelan as Junior carried a creditable Secondary Series of 25 triangles over a distance of 120 miles, and determined the positions of the cantonments of Deoli, and the city and Fortress of Boondi, and numerous other positions.

Mr. C. Braithwaite acted as Observatory Assistant with much intelligence and promise.

† Mr. Shelverton employed Colonel Waugh's 2 feet Theodolite No. 2 in his triangulation. The average error of his 50 triangles is 0.54. The mean probability of angular error is 0.46 between extremes of 0.19 and 0.87. Azimuth observations were taken at only one station. The Secondary triangulation covers an area of 10,954 Square Miles. Owing to the paucity of good natural or artificial objects, 152 Secondary Station marks were built for future reference.

Mr. A. W. Donnelly is very favourably reported of by Mr. Shelverton, for the amount of work he has accomplished in selecting stations, building towers and platforms, and executing Secondary triangulation embracing 126 triangles, and a Series of 160 miles in length, starting from and terminating on the Principal Series to fix Bickaneer and Nagour.

Mr. M. C. Hickie executed a network of triangles 88 miles long by 16 broad on the east flank of the Series, and is reported to have laid out his ground judiciously.

Mr. F. Bell is reported to have worked well in the preliminary operations, and afterwards in executing a series of Secondary triangles over a distance of 104 miles, through the desert, on the parallel of 29° 30' to the meridian of 73° and thence South to Bikaner, to join Mr. Donnelly's Series.

Mr. G. W. E. Atkinson was of much use as Observatory Assistant.

**RAHOON MERIDIONAL SERIES.**

*Executive Officer :*  
H. KEELAN ESQ.  
1st Assistant.

*Assistants :*  
N. A. BELLETTY, } Season  
Esq. } 1860-61  
Civil 2d Assistant. }

C. J. CARTY ESQ. } on tempo-  
rary duty }  
Civil 2d Assistant } Season  
1860-61 }

*Sub Assistants :*

Mr. M. C. HICKIE, } Season  
1st Class. } 1860-61

Mr. KEELAN, } Season  
Junior, } 1861-62  
2nd Class. }

Mr. H. W. C. WILLIAMS, } Season  
2d Class. } 1861-62

Mr. C. BRAITHWAITE,  
3d Class.

**GOORHAGURH MERIDIONAL SERIES.**

*Executive Officer :*  
Geo. SHELVERTON ESQ.,  
Civil 2d Assistant.

*Sub Assistants :*  
Mr. A. W. DONNELLY,  
Senior Sub Assistant.

Mr. M. C. HICKIE,  
1st Class.

Mr. F. BELL,  
2nd Class.

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

circumstances that the Gurhagurh Meridional Series was conducted during the Field Season of 1860-61."

14. During the following season the deserts of Bikaneer, Shekhawati and Marwar were extensively traversed, and a very large area of both principal and secondary triangulation was executed, reflecting much credit on Mr. Shelverton and his Assistants, who skilfully and energetically availed themselves of the facilities offered by mounds and hills, commanding extensive prospects, to fix a large number of positions of importance. In the two seasons the triangulation was carried a direct distance of 342 Miles by 50 consecutive triangles, covering an area of 4,454 Square Miles.

15. The ASSAM PARTY,\* in charge of C. Lane Esquire, Chief Civil Assistant, was employed in 1860-61, in triangulating along the Eastern Frontier, from the South of Gowhaty, to Cherra Poonjee. Recent prohibitions regarding the impressment of Coolies occasioned much embarrassment, notwithstanding that the majority of the Cossyahs are porters by trade; delay was thus caused in taking the field, and often afterwards. Mr. Lane reports that it frequently proved of assistance, as a turning point to the arguments employed to persuade these loyal people to act as porters, to tell them they were required "on Her Majesty's Service," interpreted "Maha Rance ka kam." The operations were further impeded by clouds and mists, and latterly by storms of such severity that on one occasion the whole of the Bunder Bazar, on the bank of the Soorma, was utterly destroyed and no vestige left. Final observations were taken for 19 principal triangles arranged in a double Series, extending over a direct distance of 62 Miles, and covering an area of 1207 Square Miles. Eight important Snowy Peaks of the Bhotan Himalayas were fixed.

16. During 1861-62, Mr. Lane was absent on leave on medical certificate, when his place was ably filled by Mr. W. C. Rossenrode, who extended the triangulation a direct distance of 89 miles Eastwards through Cachar towards Munnipoor, and 25 Miles Southwards towards Independent Tipperah, in all 114 miles, by 30 triangles arranged in a double series covering an area of 2024 Square Miles. Some of the stations were situated in the Jynteepore District, but the observations at them were fortunately completed before the present rebellion broke out. Reciprocal observations had still to be taken to them from other stations around, necessitating the employment of Hindoostani coolies to work the signals on them; the men though robbed and threatened, maintained their posts during the rebellion, and only came away when signalled to do so at the termination of the observations.

\* The area of Secondary Triangulation executed during both seasons is 10,250 Square Miles, fixing the positions of Silchar, Sylhet, Jyntiipoor and numerous other places of importance. One azimuth only was determined by astronomical observation.

Mr. W. C. Rossenrode was employed in 1860-61 in selecting sites for stations, and in secondary triangulation, making good progress.

Mr. H. Beverley was employed in secondary triangulation, building stations, clearing rays, and opening-out paths for the large Theodolite employed in the principal operations. He was subsequently deputed to select stations within the British Territory, to be used in case the attempt to cross Independent Tipperah might prove unsuccessful.

Mr. A. DeSouza was directed by Mr. Lane to make a Topographical survey of the Cossia plateau, of which he accomplished about a thousand square miles, on the scale of 4 miles to the inch. Subsequently he fell ill with inflammation of the knee joint, and as there was no one to take his place, the topography could not be extended further. He was ordered to Sea for change of air, and is now assisting in the astronomical observations for the determination of the longitude of the Andaman Islands.

Mr. Lane having also obtained sick leave it became necessary to call up Mr. Ellison from Vizagapatam to join the party.

Mr. Shuter was employed as an observatory assistant and in desultory secondary triangulation; he is reported to have been diligent and assiduous.

Mr. Rossenrode reports as follows of the tribes who inhabit Independent Tipperah: "The Court of the Rajah at Agratolla is composed entirely of Bengalees. A Bramin of Bengal has the sole management, and conducts the affairs of the state. Being a Bramin he is also the spiritual adviser of the Rajah, who pays him the greatest reverence and respect, and remains standing during any interview which may take place between them. The Praboo, as this Bramin is called, is not very popular from having cut down the expenses of the Rajah, reduced his retinue, discharged many of his retainers, and sold the superfluous elephants and horses. He has done much good since the country has been under his management. A younger brother of the Rajah, Barchand Thakoor, resides at Agratolla. He has received the rudiments of an English education, and has been taught Chemistry, Medicine and Photography, and amuses himself taking likenesses. He takes no part in business, and seems to have no influence whatever."

"The court being composed of Bengalees, none of these men were willing, or would volunteer their services when an agent was required, to accompany Mr. Ellison, and their reluctance to do so may be attributable to the difficulties they would have to encounter in an unexplored, uninhabited portion of the country through which Mr. Ellison pointed out to them on the map that the work would have to be conducted."

"On enquiry, Mr. Ellison learned that the country was uninhabited owing to the inroads of the Kachak Kookies, an Independent tribe, who leave their hills and fastnesses in the interior, and make frequent forays, plundering and murdering the Tippera Rajah's people. The great dread of this savage and inhuman tribe causes such a panic throughout this portion of the country, that all the inhabitants deserted their villages and settled on the Frontier, or in the Cachar, Sylhet and Comilla districts, and no persuasion will induce them to accompany a small detachment such as Mr. Ellison's was. With a large armed force able to repel any attack, these very people formerly subjects of the Rajah of Tippera, are ready to render every assistance, and to guide the force, in order that the Kachak Kookies may be severely punished, nay exterminated from the country."

"There are several tribes in Independent Tippera. The Kookies, Nagas and Tipperas inhabit the hills and jungles. They select a locality for their Village, clear it and the surrounding hills and valleys, and cultivate the rich virgin soil for two, three, or at the utmost, four years, and then remove to some other equally favorable locality. They chiefly cultivate cotton, a fourth of which is given to the Raja annually; a portion is spun and manufactured into coarse cloth for household use, and some pieces of cloth of better texture, as well as the surplus cotton, are taken to the nearest Haat, or market, and exchanged for goats, pigs, dogs, fowls or ornaments. They also cultivate rice, yams, and a grain termed chena, (which grows only on these hills,) for their own consumption. The Kookies and Nagas have no caste, they eat dogs, and cats; in fact every animal and every bird is eaten. The Kookies of Assam, Cachar, Manipur, and Tippera have different dialects, and the same may be said of the lau-

**ASSAM PARTY.**

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

*Assistants :*  
W. C. ROSSENRODE Esq.,  
Civil Assistant,  
Offic. in charge, season  
1861-62.

*Sub Assistants :*  
MR. H. BEVERLEY,  
Senior Sub Assistant.

Mr. J. ELLISON, } *Season*  
1st Class. } 1861-62

Mr. A. DESOUZA, } *Season*  
1st Class. } 1860-61  
Mr. SHUTER,  
2nd Class.

17. I have already reported (1) that on learning that the Bengal Government had ordered a Survey of Independent Tipperah to be made, I arranged with Mr. Buckland the Commissioner of Chittagong, for our Triangulation to be carried across Tipperah, on the direct line from Cherra Poonjoe to Chittagong, instead of taking an extensive circuit westwards, as was originally contemplated, in order to keep within British Territory, and away from a frontier believed to be insecure. Mr. Ellison was deputed to enter Tipperah to reconnoitre the country, and select sites for the stations. He was considerably delayed by having to wait for the Rajah's Agents, but he made some progress, and is reported by Mr. Buckland to have "behaved with much tact and patience, although he had to encounter the usual obstructiveness of the Rajah and his people." Mr. Ellison has supplied some interesting information regarding the Hill tribes inhabiting Independent Tipperah, which I have extracted from Mr. Rossenrodt's report and given in the foot notes.

18. The BOMBAY PARTY,\* under the superintendence of Lieutenant now Captain C. T. Haig Bombay Engineers, 1st Assistant, was engaged in 1860-61 in completing the triangulation necessary to connect the Guzerat longitudinal series, on the parallel of 23°, with the Singi meridional series, which had been brought up from Bombay as far as Surat, by Captain Rivers, some years previously. The connexion was satisfactorily accomplished, notwithstanding that the section of the party employed in selecting stations, got entangled in some malarious Jungles, where both Europeans and Natives were attacked with Jungle fever, and had to retire to Bronch until the sickly season was over. In 1861-62 the Guzerat Longitudinal series was extended eastwards to the Khanpissura series on the meridian of 75°, and a series of triangles on the meridian of Oodeypore was carried between it and the Karachi Longitudinal, thus completing the Triangulation of the northern portion of the Bombay Presidency. The principal operations involve 125 miles of triangles arranged in a double series, and about 190 miles arranged singly, the total number of triangles being 42, covering an area of 7450 square miles.

19. The LEVELLING OPERATIONS,† under Captain Branfill, of the late 5th Bengal European Cavalry, 2nd Assistant, have made good progress, having in the two field Seasons been carried from a point near Mittunkote, on the Indus line of Levels, to the Dehra Dhoon Base Line, via Bahawalpoor, Ferozepoor, Loodiana, Umballa, and Saharunpoor, and thence on to the Seronge Base line in Central India, via Meerut, Allypore and Gwalior, over a distance of 999 miles. In the course of these operations, Stone Bench Marks were fixed at distances of 12 to 15 miles, and the most substantial milestones met with by the road side were also determined, for future reference by Canal or other Engineers engaged in levelling operations. A satisfactory connexion has been made with the Ganges, and the Eastern Jumna Canal levels, and with those of the Allahabad and Agra Railway, which are now capable of being reduced to the mean Sea level as a common datum.

gnage of the Nagas of the above named places. The Tipperas, in dress, appearance, and habits, resemble the inhabitants of Assam. They have their own language and are a low caste of Hindoos; from constant intercourse with the people of the plains they are more civilized, and understand Bengali. The Tipperas are candid, straight-forward, cheerful, and of all the hill tribes met with on this side are most trustworthy and intelligent. The Kookies and Nagas are a sullen, morose, treacherous set, and can not be conciliated or depended upon. They do not mix with their neighbours, and consequently retain their barbarism. The Kacher Kookies are an independent tribe, and nothing is known of them except that they make frequent incursions, rob, plunder, and murder the inhabitants."

\* Astronomical observations for azimuth were taken at two stations.

Of the Meridional Series, south of Oodipoor, Captain Haig reports as follows. "The country through which this series runs is inhabited by the wildest set of savages that I have as yet ever had to do with. The thieves who form a portion of the inhabitants of every Village) for the sake of the clothes a man has on his back, assault him; if he attempts to escape, they bring him down with a shower of arrows, utterly regardless of his life. On this account, communication by messengers was attended with great risk, and consequently Messrs. DaCosta and McGill were each unacquainted with the other's progress until they actually met, otherwise I had intended them to be in frequent communication. It is partly due to this that the Series has a bend in the centre, and partly because the Raj of Saloomber, a very refractory chief, would not permit a Station to be built on his hill, although directed to do so by the Political Agent."

Mr. DaCosta was employed in carrying a Secondary Series of triangles along the west Coast of the Gulf of Bombay, from the mouth of the Saburmathee River to Gogo, over a flat tract of country, which for a great portion of the year is entirely under water. Also in selecting principal stations for the Mungalore and Oodipoor Series, over a meridional distance of upwards of 180 miles. He laid out a Secondary Series down the East coast of the Gulf of Cambay as far as Surat, and carried other triangles to fix the position of Baroda. His services are very favorably reported by Captain Haig.

Mr. G. McGill was employed in selecting and building stations in a malarious tract of country which had often previously been attempted, but never before with success, sickness and other difficulties having invariably driven back the Surveyors.

Mr. Anding rendered valuable assistance in the observatory, and in desultory duties.

† Mr. Carry worked with Captain Branfill during the Season 1860-61; the next Season he carried an independent line of levels from Seronge to Allypore, assisted by Ramchund, an intelligent and hard working native of Lahore who was once in the service of the unfortunate Adolph Schlegel. The first year, Ramchund executed 175 miles of branch levels to fix positions of importance.

In 1861-62, Mr. C. Wood assisted Captain Branfill, by whom he is favorably reported of.

During the course of the levelling operations, it has often been noticed that though the independent results obtained at each station by the respective observers differ at all by almost imperceptibly minute quantities, the differences have a tendency to go all one way, and have occasionally accumulated to large amounts. On this curious and perplexing subject, Captain Branfill reports as follows:

"I think we can all subscribe to the following facts—The state of the weather and the season of the year have a very considerable effect on our results, as shown by the difference between observers. We have found that the apparent law of our differences is least developed some time in the middle of the cold season. In a run of bad weather (i. e. bad for the work) the apparent law of our differences is for the most part marked when the atmosphere is clearest, and when we have supposed our observations to be freest from error; and conversely

(1) My No. <sup>21</sup>/<sub>132</sub> dated 5th March  
at your address.

## BOMBAY PARTY.

Executive Officer:  
Captain C. T. HAIG  
Bombay Engineers  
1st Assistant.

Assistant,  
J. DA COSTA, Esq.,  
Civil 2d Assistant.

G. MCGILL, Esq.,  
Civil 2d do., junior grade.

Sub Assistant:  
Mr. ANDING,  
2nd Class.

## LEVELLING OPERATIONS.

Executive Officer:  
Captain B. R. BRANFILL,  
Late Bengal 5th Cavalry,  
2nd Assistant.

Assistants:  
C. J. CARRY, Esq.,  
Civil 2nd Assistant.

Mr. C. Wood, } Season  
2d Class. } 1861-62.

Native Leveller,  
RAMCHUND.



**COMPUTING  
OFFICE.**

J. B. N. HENNESSEY Esq.,  
1st Assistant.

BABOO RADHANATH  
SIRDAR.

20. The COMPUTING OFFICE in Calcutta, under the superintendence of Baboo Radanath, Chief computer, was engaged in completing the triplicate manuscript volumes of the General reports of the Parisnath, Hurlong and Chendwar Meridional Series, and in furnishing elements for the various Topographical and Revenue Survey Parties requiring them. In March last, Baboo Radanath retired on a pension, after 30 years' service, during which he had repeatedly earned the approbation of the successive Surveyors General under whom he had served. On his resignation it was deemed advisable to remove the computing office from Calcutta to the Head quarters of the Trigonometrical Survey at Dehra Dhoon, to bring it into more direct connexion with the Superintendent of the Department, and also with the field parties whose computations it has to revise and collate.

21. The distant location of the computing office had entailed the formation of a small office at Head Quarters under the superintendence of J. B. N. Hennessey Esq., 1st Assistant G. T. Survey, composed of native Surveyors, and newly joined Sub-Assistants, who thus had an opportunity of being rigorously trained in the theoretical portion of their new duties. This little office has lately completed the triplicate manuscript copies of the General report of the North Eastern Longitudinal Triangulation, between Dehra Dhoon and Purneah, in two thick imperial volumes; it has also been employed in revising the computations of the mountain triangulation of the North West Himalaya Series, computing 3 volumes of the report of the Levelling operations, and preparing the triplicate general report of the Trans Indus Frontier Survey; also in supplying elements, examining candidates, instructing new assistants, and other current work. On the transfer of the Calcutta Office to Dehra, all but one of the old computers took their discharge, but fresh men have been entertained, and I have every reason to expect increased efficiency from the new computers, under the direction of Mr. Hennessey.

**DRAWING  
OFFICE.**

W H SCOTT Esq.,  
Civil Assistant.

J. PEYTON Esq.,  
Senior Sub Assistant

22. The Drawing Office, under superintendence of W. H. Scott Esq., Civil Assistant G. T. Survey, has been chiefly employed in compiling Maps of Kashmir, and Ladak, from the plane table sheets sent in by Captain Montgomerie. The first of these large maps has already been transmitted to the Home Government, the second is well advanced. Ten original preliminary charts of the Triangulation in different parts of India have been forwarded for the use of the Surveyor General's Office, and duplicates have been prepared for the Geographer to the Secretary of State for India. Triplicate charts have also been constructed for the manuscript volumes of the General Report.

23. Between the completion of a Survey, in this country, and its publication, a long interval invariably elapses, during which even the Supreme and Local Governments are without access to valuable information, acquired, but unimpartible because of the costliness of manuscript maps and the time occupied in their construction. I have therefore been induced to attempt to employ photography for making rapid copies of our maps and charts, as a temporary substitute for the final engravings. This process has of late years been extensively adopted in the Ordnance Survey of Great Britain for reducing maps, as a substitute for the pentagraph. Two complete sets of photographic apparatus were sent out to this country by the Secretary of State for India, for similar employment, and it is with one of these that I am endeavoring to have our maps copied. The operation is by no means easy, for the apparatus has had to be specially adapted to make full scale copies, and not reductions merely, for which it was originally intended, and the maps require to be drawn with special reference to future copying or reducing by photography. An ordinary finished map cannot be reduced without a large portion of the names becoming too microscopic to be easily legible. In the first Kashmir Map the rivers were colored in blue, and the broken land and low hills in red, the higher ranges being in Indian ink. Consequently a photograph of it would shew no rivers, and would invert the depth of shading of the high and low hills, bringing the latter into excessive prominence. \*

24. Captain Melville, who has already been mentioned in connexion with the Topographical Survey of Kashmir, has attained considerable skill as a photographer, and succeeded in making an excellent reduction to half scale of the second Kashmir Map, before any names were printed on it. The reduction will have the names inserted by hand, and will then be ready for being copied to full scale, and afterwards printed, for as extensive circulation as the limited means at my disposal will permit. I have every reason to hope that with Captain Melville's assistance, I may be able to supply a want, which has often been seriously felt.

25. In concluding this report of the operations of the Trigonometrical Survey, I am happy to be able to express my opinion that the progress made on all sides, both in the field, and during  
ly in a run of good weather, when the air is hazy from smoke or dust, or greatly agitated by wind, and, in short, when we have found most difficulty in reading the staves, our results have most coincided with each other. Our differences do not appear to vary with the distances of the staves. On the contrary the differences are perhaps even more marked as the day grows older, and the distances of the staves from the instrument are reduced. The general direction in azimuth of the line of our work has some connection with the cumulative differences, and we have noticed that the tendency to differ is more marked when proceeding *towards* a certain point of the compass, than when proceeding *from* that point towards its opposite."

\* A Map of Asia between the parallels of 20° and 60° on the scale of 100 geographical miles to the inch, has been recently compiled under my superintendence, partly in this office, and partly in the Surveyor General's of which I had temporary charge from 10th January to 24th March last. It gives the most recent information available from our own and other sources of the countries between St Petersburg and Peking, Tobolsk and Calcutta. The boundaries of the territories respectively under British and Russian protection are shown, and the caravan routes from India to all parts of Asia. The Map is now available in the office of the Surveyor General, Calcutta.

Mr. James Peyton has rendered valuable assistance in the drawing office, having executed the bill shading of the whole of the Kashmir Maps, and of a Map of Jhelum and Rawul Pindie, from the Topographical Surveys of Captain Robinson.

the recess, by the Survey parties, and by the offices at Head quarters, has been most satisfactory and I would respectfully solicit the favorable notice of Government for the Officers, already cited, in charge of the respective parties and offices.

I have the honor to be,

Sir,

Your most obedient servant,

MAJOR, ENGINEER'S.

*Offg. Superintendent,*

*Great Trigonometrical Survey of India.*

Mr. Harry Dulan, Extra Assistant, in charge of Corresponding branch of this office, accompanied me to the Presidency, and carried out the arrangements for the transfer of the computing office from Calcutta to Dehra, and has invariably been of much assistance.

Mr. Robert Scott has been employed in the Corresponding office and as general store keeper, and has been most assiduous in the execution of his multifarious duties.

Office of Superintendent G. T. Surbey,  
Dehra Doon, 1st September, 1863.

From

MAJOR J. T. WALKER, R.E.,  
Superintendent G. T. Survey,

To

THE OFFICIATING SECRETARY TO THE GOVERNMENT OF INDIA,  
Military Department.

SIR,

I have the honor to report the progress of the Trigonometrical Survey during the past official year.

**BASE LINE PARTY.**  
J. HENNESSY, Esq.,  
1st Assistant.  
H. TAYLOR, Esq.,  
2nd Assistant, joined 1st  
December, 1862.  
Lieut. CAMPBELL, R.E.,  
2nd Assistant, joined 1st  
January, 1863.  
*Sub-Assistants.*  
Mr. J. WOOD, 3rd Class.  
Mr. J. BURT, ditto.  
Mr. T. W. MITCHELL, ditto.

2. In accordance with the sanction of Government, I proceeded, in the autumn of 1862, with the Officers and Assistants marginally detailed, to Vizagapatam to measure a Base Line. Vizagapatam is situated nearly on the same parallel of latitude as Bombay; and is the point where the Bombay Longitudinal Series, when extended Eastwards to the Madras Coast, will terminate. This series of triangles will form, with the Great Arc Meridional, the Calcutta Longitudinal, and the Coast Series, a vast quadrilateral figure, circumscribing the Meridional Series of triangles which are required as a basis for the interior topographical details. Base Lines had been measured several years ago, by Colonel Everest, at Beder, Seronj, and Calcutta, the S.W., N.W., and N.E. angles of this quadrilateral. One more Base Line remained to be measured, which, for considerations of symmetry, it was desirable to place in the vicinity of Vizagapatam.

3. Captain Basevi, the Officer in charge of the Coast Series, being located at Vizagapatam, was directed to select the site. After several trials, owing to the difficulty of carrying a straight line, several miles in length, so as to avoid the numerous irrigation tanks with which this district is studded, he eventually succeeded in finding a suitable line, on the undulating plain between the Military Stations of Vizagapatam and Vizianagram, at a distance of about fifteen miles to the West of the Port of Bimlipatam. The ground was chosen before the commencement of the rainy season of 1862, when trenches were dug to carry away the expected rain fall during the monsoon, and every precaution was taken to keep the line dry. But when Captain Basevi took the field early in October, he found that the rains had been so heavy, that the surrounding tanks had been converted into lakes, and the line lay submerged under a sheet of water, in some parts as much as sixteen feet deep. By great exertions the water was drained off into adjoining ravines. A portion of the line was ready for measuring on my arrival in December, and the remainder had become fairly dried by the time it was reached, in the course of measurement.

4. The apparatus employed, consisted of a set of Compensating Bars and Microscopes, on the principle of those designed by Colonel Colby, for the Ordnance Survey of Great Britain, which had been constructed under the superintendence of Colonel Everest, by whom they were brought out to India in 1832. This apparatus has been employed in measuring three Base Lines on the Great Arc, two at the North and South extremities of the Calcutta Meridional Series, and two at the extremities of the Indus Series. The length of these bases has, in each instance, been determined in terms of ten foot Standard Bar A, the unit of measure of the Indian Survey.

5. At the time this Standard was constructed, it was believed that the length of a well made iron bar, supported by rollers at its points of least flexure, might be considered invariable for any given temperature. But, of recent years, there has been a growing tendency to doubt the invariability which has hitherto been assumed. Series of comparisons made by the Ordnance Survey show there is much probability that the texture of an iron bar changes gradually in the course of years for the factors of expansion obtained from groups of comparisons made at intervals of a few

years apart, differ from each other by larger quantities than are due to errors of observation. It is preferable, therefore, to employ several Standards, constructed of different metals, than to trust to the integrity of a single bar.

6. To ascertain whether our Standard has altered in length, it would be necessary to remeasure the whole, or part, of one of the Base Lines which were first measured after the arrival of the Bar from England. I wished to obtain some light on this subject, by remeasuring certain short sections of the Calcutta Base Line, the extremities of which were originally indicated by permanent marks. But, on examining the positions of the section markstones, I found that, though concealed from view, there had been a regular thoroughfare over them, for many years, of carts and elephants, as well as foot passengers; consequently, they must, in all probability, have been disturbed, and they cannot be safely referred to, to decide so delicate a matter as the constancy of the Standard.

7. Disappointed at being baffled in my efforts to investigate this matter by any simpler and shorter process than the remeasurement of a whole Base Line, I determined to mark the intermediate section stations of the Vizagapatam Base as permanently as the extremities, in order that any future enquiry regarding the length of the Standard, at the time of the measurement of this Base Line, may be conducted without greater labor than the remeasurement of a short section.

8. It has been well said, by one of the greatest living authorities on scientific matters, that "the ends of a base line should be guarded with religious veneration." In this country they are liable to be viewed with mingled cupidity and dread; the Natives sometimes fancy that money is buried below, or they superstitiously fear that the Englishman's mark will cast a spell over the surrounding district. In either case, the mark is liable to be destroyed, as has already happened at the Seronj Base Line.\* To ensure the protection of the ends of the Vizagapatam Base, I have had substantial domes of cut stone masonry built over them, without any openings, so that, before the marks can be reached, the domes must be pulled down, which will be so laborious, that the Police should be able to hear of and arrest the perpetrators, before they have had time to harm the marks.

9. Captain Basevi, and the Assistants of the Coast Series Party, shared in the measurement of the Base Line, which occupied about two months. The length of the line is six and a half miles. It was divided into three verificatory sections, which were subsequently checked by two series of triangles, one on each flank of the base, to test the measure of each section against the others. These tests were satisfactory; for the extreme difference between the measured length of the whole base, and its computed length by triangulation from either section, has been found to be one inch. The comparison of the measured length, with the computed value brought down by triangulation from the Calcutta Base Line, is singularly satisfactory, for the error of the computed value is only a quarter of an inch, though the triangulation embraces a distance of four hundred and eighty miles, much of it passing over flat plains, which are covered with dense forest and jungle, and very difficult to work through.

10. On the completion of the Base Line, Captain Branfill was deputed to connect it with the principal triangles of the Coast Series, and to execute the verificatory triangulation between the sections. Meanwhile, Captain Basevi proceeded, by my instructions, to make a reconnoissance of the neighbouring territories of the Rajah of Jeypore.

#### COAST SERIES.

*Executive Officer.*  
 Capt. J. P. BASEVI, R.E.,  
 1st Assistant.  
*Assistants.*  
 Capt. B. R. BRANFILL,  
 2nd Assistant.  
 Lieut. CAMPBELL, R.E.,  
 2nd Assistant.  
 R. CLARKSON, Esq.,  
 Civil Assistant.  
*Sub-Assistants.*  
 Mr. F. STALL,  
 2nd Class.  
 Mr. J. O'NEILL,  
 3rd Class.

\* On this subject, the following extract is taken from a letter by Colonel Sir George Everest, C.B., to the President and Council of the Royal Society, dated 8th April, 1861:—

"The natives of India have a belief, peculiar to human beings in that state of society, of attributing supernatural and mysterious powers to our instruments, and the sites which have been occupied by them. In cases of death, or any other natural visitations, they often offer up prayers to these sites, and if the object of their prayers be not conceded, they proceed to all sorts of acts of destruction and indignity towards them; nay, as in all cases where it was practicable, my station marks were engraved on the solid rock *in situ*, they have been known to proceed in bodies, armed with heavy sledge hammers, and beat out every vestige of the engraving."

I have to acknowledge the great assistance I received from Mr. Hennessy, First Assistant G. T. Survey, in the Base Line operations. For many years the care of the delicate apparatus of Compensating Bars and Microscopes had been his constant object; his familiarity with every part thereof, together with the practical experience he had gained at former Base Lines, measured under the superintendence of Sir Andrew Waugh, enabled me to entrust all practical details to his management, with the certainty that nothing would be forgotten, no refinement omitted, nor any inaccuracy allowed. The apparatus was safely transported from Dehra Doon, *via* Calcutta, to Vizagapatam, a distance of upwards of 1,500 miles. On reaching the Presidency, the party was attacked with cholera; several men died in a few hours, others deserted through panic, and it was only owing to Mr. Hennessy's assiduous exertions, and personal attention to the sick, that a sufficient number of men were kept together. He himself was ill, and had been ordered to Europe by his medical advisers, but no personal considerations would induce him to leave India, until the completion of the operations where his services would be so valuable. Subsequently, he went home on medical certificate, and he is at present employed in the Ordnance Survey Office, at Southampton, in acquiring information which will be of useful application to the operations of the Indian Survey.

Capt. Basevi reports that "Captain Branfill took a large share in the preparation of the Base Line. He was in

11. It is a singular fact that, in the vicinity of the British Stations of Vizagapatam and Vizianagram, and within sixty miles of a coast which has been frequented by British traders for upwards of a century, there is an extensive tract of country, subject to a friendly Rajah, of which less is known, than of districts occupied by hostile tribes, along the frontier of our recently acquired Punjab Provinces. A glance at any Map of the Madras Presidency reveals a great blank in our geographical knowledge, in the tract of country which lies parallel to the coast, and North-East of the Godavery River. Its deadly reputation appears to have been a bar alike to the explorations of the curious and scientific, and to the visits of sportsmen. No regular survey of it has ever been attempted; the few places given in the Map seem to have been obtained from Native information, for they are generally exceedingly erroneous.

12. A reconnoissance of this tract was required for our own operations, in the extension of the Bombay Longitudinal Series to Vizagapatam. As any reliable information regarding lands so little known might be expected to be of much value and general interest, I was much gratified when Captain Basevi volunteered to reconnoitre this *terra incognita*; though, at the same time, I could not but feel apprehensive for his safety in a country so deadly, for his route would have to pass through dense jungle, in which it would be necessary for him to preserve his reckoning by the troublesome process of traversing, which, under such circumstances, is very laborious, and entails the necessity of performing the greater part of each day's march on foot. The inevitable exposure to be thus undergone is very great, in a tropical climate, and when the district to be traversed is known to be exceedingly feverish and unhealthy, no small amount of courage is needed, to prompt a man to volunteer for such a task.

13. Captain Basevi took with him one European Assistant, Mr. O'Neill, and a few Natives. He, himself, fortunately escaped with a slight attack of fever, but Mr. O'Neill suffered severely, and has not yet recovered, and the Natives of the party were also, more or less, incapacitated by fever, so that but for the assistance afforded by the Rajah of Jeypore, the operations would have been stopped almost at their very commencement. The results are, a good preliminary Map of Jeypore, which has been forwarded to the Surveyor General, to be lithographed and published; a report by Captain Basevi, giving details of his route, and a general description of the country; several valuable astronomical determinations of latitudes and longitudes, and barometrical determinations of heights; also memoranda of various other routes, the details of which were obtained from Native information. In consideration of the great value of Captain Basevi's services, he has been permitted to proceed to Europe on furlough for one year, during which his appointment will be kept open for him.

14. During the summer of 1862, the Field Season of the Kashmir Survey Party, the triangulation made great progress to the East of Leh, and Stations were fixed on the Chinese Frontier, from which a number of peaks in Tartary were determined. Some of these were more than one hundred miles distant, and will materially aid in the construction, from Native information, of maps of districts into which the Surveyors will probably be unable to penetrate. Several of the Stations observed from were over 20,000 feet in height above the sea, and Mr. Johnson visited one peak of a height of no less than 21,072 feet, but, owing to a very heavy fall of snow, was unable to observe from it.\*

#### KASHMIR SERIES.

##### Executive Officer.

Capt. T. G. MONTGOMERIE,  
R.E., Astronomical Assis-  
tant, G. T. Survey.

##### Trigonometrical Assistants.

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

W. H. JOHNSON, Esq.,  
Civil 2nd Assistant,  
Senior Grade.

W. G. BEVERLEY, Esq.,  
Civil 2nd Assistant,  
Senior Grade.

##### Sub-Assistants.

Mr. S. H. CLARKE,  
Senior Sub-Assistant.

Mr. C. J. NLUVILLE,  
Senior Sub-Assistant.

##### Topographical Assistants.

Capt. H. H. G. AUSTIN,  
2nd Assistant.

Capt. A. D. MELVILLE,  
2nd Assistant.

Lieut. H. DE DRETT,  
Probationary 2nd Assistant.

F. C. RTALL, Esq.,  
Civil 2nd Assistant,  
Junior Grade.

##### Sub-Assistants.

Mr. W. TODD,  
Senior Sub-Assistant.

Mr. J. Low,  
1st Class Sub-Assistant.

Mr. C. WOOD,  
2nd Class Sub-Assistant.

Mr. C. BRATTWRIGHT,  
3rd Class Sub-Assistant.

change of a Microscope during the first half of the measurement, and then carried a Line of Levels from South end of Base to the Jetty Station at Vizagapatam, where tidal observations had been previously taken. On the completion of the Base Line he observed an Azimuth, and afterwards conducted the principal observations with the Great Theodolite, and completed them, though laboring under repeated attacks of fever the greater part of the time. The abstract of observations forwarded show that he is fully equal to the management of a large instrument. On all occasions Captain Branfill has rendered me valuable assistance.

"Lieutenant Campbell, R.F., Second Assistant, joined the party early in January. He was present at the latter half of the Base Line, taking one of the Microscopes, and afterwards assisted Captain Branfill in the Principal Triangulation. That Officer reports most favorably of him.

"Mr. R. Clarkson, Civil Assistant, assisted in the Base Line preparations. He was in charge of one of the Microscopes during the measurement, and afterwards executed some minor triangulation, as detailed by Captain Branfill.

"Mr. F. Ryell, Second Class Sub-Assistant, assisted in the Base Line preparations, and superintended the laying of the trestles at the measurement. He afterwards executed a minor triangulation, connecting Ellore with the Main Series, in a satisfactory manner.

"Mr. T. W. Mitchell, Third Class Sub-Assistant, joined the Series on the 1st February, having accompanied the Head-Quarters party from Mysore. He had charge of a Microscope at the Base Line, and afterwards acted as Recorder to Captain Branfill, to whom he gave entire satisfaction.

"Mr. J. R. O'Neill, Third Class Sub-Assistant, took a share in preparing the Base Line, and aided Mr. Ryell in laying the trestles. He accompanied me for a short distance into Jeypore, but was obliged to return, owing to repeated attacks of fever, by which he was so much reduced as to be unable to render any assistance in the remaining operations of the season."

\* Captain Montgomerie reports as follows of the operations of his party:—"During the recess of 1861-62 the Kashmir Survey Party was employed in computing and plotting the observations taken during the hot weather of 1861, in completing the printing and shading, &c., &c., of the Plane Table Sections, and subsequently in preparing two large charts on the 4-inch=1 mile scale, showing all the triangulation.

"The area covered during the Field Season of 1862, embraces some very high ground, between the Indus and the

15. A great many points were fixed in the Pangkong District. The whole of Astor was triangulated, and several peaks were fixed to the North of Gilgit; none of these were of any great height, the highest being only a little over 19,000 feet. The natural difficulties of the country were at first much enhanced by bad weather, which came on with the heavy rains in the Southern and outer Himalayan Ranges. Notwithstanding these circumstances the out-turn of work has been good, and the general progress very satisfactory, the total area of the triangulation being about 10,500 square miles, and of topography 10,400 square miles, on the scale of four miles to the inch.

16. The Topographical operations made good progress, though not so great as would have been the case had all the Assistants retained their health. Unfortunately two of them, on entering the higher ranges, broke down completely, and a third had to leave off work early in the season. The ground sketched was generally very elevated and barren, the Surveyors chief difficulties arising from the want of provisions and firewood, and sometimes even of fresh water. The plane table sketches required for the Map of Little Tibet have been completed, and lodged in the Head-Quarters Office at Dehra. A glacier, about twenty miles in length, was discovered by Mr. Ryall at the head of the Nubra Valley. Some large glaciers were also found in the neighbourhood of the Nanga Parbat.

17. I fully concur in the testimony which is borne by Captain Montgomerie to the great zeal with which these arduous Survey operations have been carried on by all the Assistants under his orders. The good fortune of success has hitherto attended all undertakings executed under the superintendence of this Officer.

18. There is much reason to expect that, if the snows are not unusually heavy, and if most of the Surveyors keep in good health, the remainder of the country to be surveyed in and around Kashmir and Ladak, will be completed during the next field season. Captain Montgomerie has made every effort to persuade the Maharajah of Kashmir to allow one of our Surveyors to go to Gilgit, and has obtained a half promise to this effect. Possibly the fear of being called to account, should any harm happen to a European in his territories, causes the Maharajah to hesitate to sanction an undertaking which might be somewhat perilous. He informed Captain Montgomerie that, during the late winter, his troops in Gilgit had been sleeping; no exacter information could be elicited than what is suggested by this metaphor. If, as Captain Montgomerie thinks likely, the sleep was that which knows no waking, the Sikh garrison of the Maharajah must have been massacred by the hill tribes, in which case there is little hope of our Surveyors being soon able to penetrate into Gilgit.

Changehenno Vallers; it also includes the greater part of the Pangkong District, and Astor, or Hussora. Lieutenant Carter, who joined the party in May, assisted Captain Montgomerie in taking latitude observations, &c., &c., and practised with the Theodolites, and made himself generally acquainted with the work of the G. T. Survey, both in the field and office. Mr. Johnson assisted in the computations during the recess, and in the Field Season took up a secondary triangulation to the East of Leh, the capital of Ladak. He pushed on this work with energy, and his efforts were, as usual, rewarded with success. The great heights and impracticable nature of the mountains between the Indus and Changehenno, made that part of the work very difficult, and great credit is due to Mr. Johnson for carrying his triangulation over it. Many peaks were fixed at considerable distances beyond the frontier, and, altogether, Mr. Johnson's progress was very satisfactory, and his out-turn of work first-rate.

Mr. Beverley assisted in the computations, and in projecting the Chart during the recess. In the field season he took up the Astor triangulation, and carried a secondary series down that valley, fixed a great many points in it, besides several peaks Trans-Indus, both North and South of Gilgit. The ridges between the Deesai plains and Astor are peculiarly rugged, and that portion is more especially troubled with clouds. Nevertheless, Mr. Beverley made good progress, and completed a very satisfactory season's work.

Mr. Clarke assisted Mr. Johnson for some time, and subsequently worked independently in the Pangkong and Changehenno Districts, visiting several very high stations, and fixing a great many points. He also made a very fair plane table sketch to the West of the Tsemogalari (or Pangkong) Lake. Altogether, Mr. Clarke made very good progress, and is now quite capable of turning out satisfactory independent work in high ground.

Mr. Naville assisted Captain Montgomerie in computations, observatory work, and current duties of the Series. He deserves credit for the good business habits which he applied to the large amount of office work which there necessarily is in such a large party, with so many detached Surveyors working at great distances apart.

In the Topographical Branch, Captain Austen was employed in Rukshu and Zanskar. The ground, though generally not so difficult as what he sketched during the season of 1861, was very elevated and barren. The want of inhabitants in the South-Eastern portion was in itself a serious obstacle. Nevertheless, in such difficult ground, he was able to delineate on the quarter inch scale no less than 3,700 square miles, including the whole of Southern Laskar. Altogether Captain Austen deserves great credit for the very excellent season's work which he has turned out, in his usual characteristic and effective style.

Captain Melville continued during the recess to devote a great deal of his attention to photography, and produced a valuable negative of the quarter inch Map of the Jummo territories on the same scale as the original. The value of this will be more appreciated as there is small chance of getting engraved copies from London until at out two or three years more have elapsed. Captain Melville marched into Ladak to take up his field work, but, unfortunately, was taken ill on the road, and forced to return. He recovered his health, in a great measure, before the field season was over, but the medical officer at Srinagar did not think it advisable that he should take the field again, and he was, consequently, employed on office work, photography, &c., &c., during the remainder of the season.

Lieutenant De Brett was employed on office work during the recess. In the field he practised with his plane table, and made such progress that he was to have taken up independent work, had not his health unfortunately failed him. The medical officer thought that he would not be able to stand the exposure, and his health not being reestablished, he resigned his appointment on the 31st October.

Mr. Ryall was employed in sketching the very difficult ground about the Nubra and Shyok Valleys. He completed the whole of the Nubra Valley, including the large glaciers at its head, and also a portion of the head of the Shyok Valley. His health, which had not been good before taking the field, did not allow of his completing the Shyok Valley. Nevertheless, he was able to finish 1,850 square miles, which, considering the state of his health, was very good progress.

## EASTERN FRONTIER SERIES.

*Executive Officer.*  
C. LANE, Esq.,  
Chief Civil Assistant.  
*Assistants.*  
W. C. ROSSENRODE, Esq.,  
Civil Assistant.  
Mr. H. BEVERLEY,  
Senior Sub-Assistant.  
Mr. R. F. SHUTER,  
2nd Class.

19. The Eastern Frontier Party, under the charge of Mr. C. Lane, Chief Civil Assistant, has been employed, throughout the Field Season, in Independent Tipperah. At the end of the preceding season this triangulation had reached a point to the South of Cherra Poonjee, on the confines of Tipperah, where the British Boundary retrogrades Westward to a considerable distance, so that the triangulation would have had to make an extensive circuit, in its onward progress to Chittagong, had the operations been required to be kept within the British Boundary. Fortunately, Mr. Buckland, the Commissioner of Chittagong, had sufficient influence with the Maharajah of Tipperah to induce him to consent to our operations being carried across his territory, on the direct line to Chittagong.

20. Mr. Lane proceeded, in the first instance, to Agartolla, the chief town of Tipperah, where the Maharajah resides; and there he succeeded in securing the friendship and good-will of the Prince and his Court to an extent to justify the expectation, which was subsequently realized, of obtaining their cordial assistance and co-operation. Mr. Lane deserves much credit for the tact he has displayed in cultivating amicable relations with the barbarous races that inhabit the hill country of Tipperah, who have long been a terror to the industrious population of the plains within the British Frontier. Mr. Lane has sent a valuable report on the portion of Independent Tipperah traversed by himself and Assistants during the past Field Season, from which extracts will be given in an appendix to this Report.\*

"Mr. Todd was employed on the East of Rukshu, in the Upper Indus Valley, and Harle District. He was at first hindered by the clouds, and, to some extent, by attending to Mr. Wood. Nevertheless he succeeded in sketching 1,950 square miles of very elevated country. His sketch gives a capital idea of this desolate tract, and the delineation generally is very characteristic. Total progress very satisfactory.

"Mr. Low made a capital sketch of the whole of the Astor Valley, with the exception of a small portion done by him during the previous season. He also sketched a large portion of the Indus Valley, West of Skardo. With the assistance of the Thundar of Astor, he succeeded in ascending the Nildar Peak, across the Indus River, and probably within twenty miles of Gilgit, for which enterprise he deserves credit. His progress was highly satisfactory, covering in all about 2,900 square miles of country, including the glaciers of the Nanga Parbat. His plane table shows great improvement in the shading.

"Mr. Wood joined during the field season, and was trained to the use of the plane table. He made rapid progress, and would, no doubt, have turned out some work, had not his health failed him soon after he got into Ladak. He did not recover in time to resume field work. He has shown himself to be a good computer, and Captain Montgomerie feels sure, from the rapidity with which Mr. Wood made himself acquainted with the use of the plane table, that he will turn out a fair amount of work during the next field season, if his health continues good as it is now.

"Mr. Brathwhite joined later than Mr. Wood. He was trained to the use of the plane table, and accompanied Mr. Ryall into the field, but did not succeed in turning out any independent work. His experience should, however, enable him to do so during the next field season.

"Captain Montgomerie carried on all the usual business, in direct communication with the Maharajah and his higher officials, from whom he received every assistance."

\* The duty of selecting stations for the Triangulation devolved on Mr. Rossenrode, than whom the party could not have had a better pioneer. The following simple narrative of his operations is extracted from his letters:—"When the Kookies were apprized of my arrival at Heera, they naturally concluded that I had come to apprehend and punish them for the robberies and murders they had perpetrated on our frontier. They hid themselves in the jungles, and left their villages. With much persuasion the Rajah's people brought them to my camp. They watched all my proceedings, and asked me no end of questions. I always keep a man near me to interpret, and I answer every question they put me; all seem satisfied with my answers, and the confidence I place in them. Of course my movements are slow, because my work has the greatest difficulties to contend with; the inhabitants must be conciliated, the site to be fixed upon must be traced and found, and cleared of jungle. To fix on sites at all in this dense and almost uninhabited forest, in which the sun can seldom be seen, is a feat any man may be proud of, especially when the inhabitants try to mislead. I hope to get on faster, when I divest the minds of these savages of all suspicion. I am all day long climbing or descending hills, or wading through water. Wild elephants and buffaloes are numerous, and may be come upon suddenly, when wading through the watercourses. Whenever you see a bamboo signal, avoid the direction it points to, because an unerring arrow is placed there, with a bow strong enough to give an elephant his death blow. The Kookies think of nothing but eating and drinking. Feeding them occasionally is a good plan, and they would become very much attached to you, and follow you like dogs, and, no doubt, prove faithful, and work well, if well fed. Last year I had to deal with the Nagas and Kookies of Chahar, as well as those on the Manipoor frontier. They are the same filthy, naked savages as their brethren in Independent Tipperah. They frequently enquired whether I knew of Captain Guthrie, who made the road from Chahar to Manipoor, over the hills, and they said he was the best sahib they had ever met with, and gave them buffaloes, cows, pigs, and goats to eat daily, and grog to drink, so that, even now, they think of his feasts.

"I must notice one peculiarity among the Kookies. They all assemble from adjoining villages of the same tribe, and perform the work allotted to them, and share the hire. If you want twenty men from a village, and there are sixty in that village, all will come, whether you wish it or not. If they have to cut jungle, they will all do it; if they are to carry loads, they will divide the twenty loads into sixty, and each man will carry something. One man will never act as a guide, or do any work singly; he must have a companion, and both must be paid. I have tried to break through this habit, but have been told that, if all are not allowed to work, they will not come at all. One might suppose that sixty men would finish the work sooner than twenty, but this is not the case; they cut three times a day, will not begin work before nine, they work until twelve, and then walk off, without asking or telling anybody. They remain away two hours, cooking and eating, and then return and work till an hour before sunset. During the working hours, some are smoking, some making drinking mugs from the bamboo, and others amusing themselves; half are thus occupied, while the remainder are working, and then they change about, and those who are relieved smoke, make drinking mugs, walking sticks, or otherwise amuse themselves. The Rajah's agents have no control over them, and they do not always obey their own Sirdars.

"A Kossyah coolie is really worth four Kookies. When a Kossyah carries a light load, or is lazy, he is called a Kookie by his companions, which annoys him so that he will carry the heaviest load, or tuck up his sleeves, and work in right good earnest. I attribute the Kookie's want of energy and inability to carry loads to the excessive use of spirits, which are distilled in every hut, and partaken freely by every member of the family. There are many Chiefs among the Kookies in the Tipperah Raj. These are all called Rajahs; they have their Wuzcers, Nazirs, and Sirdars, and a number of servants of both sexes. The Kookies have no written language. The Rajahs never pay visits, even to the Maharajah, and their Wuzcers and Nazirs are sent to the Court only on very important occasions."

Mr. Lane reports that—"Mr. Senior Sub-Assistant H. Beverley was employed at first, for about a week, on the Approximate Series, under Mr. Rossenrode; next, in clearing and making passable roads for the large Theodolite, till the 9th April, from which date again on the Approximate Series till the 4th June, and on the 17th idem he reached Chittagong."

Mr. Sub-Assistant R. F. Shuter accompanied Mr. Lane to Agartolla, and assisted in the observatory, in desultory secondary observations, and in all current office work to the end.

21. The East Calcutta Longitudinal Series Party was formed on the 1st September, 1862, and placed under the charge of Lieutenant Thuillier. The object of this Series is to become the basis for the surveys of the Districts of Nuddeah, Jessore, and on *via* Dacca, to the Eastern Frontier, along a parallel of latitude slightly North of Calcutta. The publication of the sheets of the Indian Atlas, which embrace these districts, has long been delayed for want of this triangulation.

22. The party proceeded from Dehra Doon, by steamer and railway, to Calcutta, where they took the field in November, on the termination of the rainy season. Operations were commenced at Chinsura, on a side of the Calcutta Meridional Series. Much assistance was derived from a carefully executed Map, prepared in the Surveyor-General's Office, by which Lieutenant Thuillier was enabled to lay out his lines so as to pass through a minimum amount of property. In working through forests and jungle, it is usual, in the first instance, to cut a narrow glade, in a perfectly straight line, through all intermediate obstacles, in the direction of the required station; when this trial line has been carried over a distance of eight to ten miles, the ground beyond is carefully reconnoitered for a suitable site, to which a line is cut from a convenient point in the trial line; thus two sides and the included angle of a triangle are given, with which data it is easy to ascertain the direct line between the two stations, which is then cleared to obtain mutual visibility. Owing, however, to the valuable nature of the property through which the triangles were carried, it was necessary to run a traverse along each line, with numerous intermediate bends, to avoid houses and orchards. In clearing the final line, great caution was requisite to prevent any tree from being cut down needlessly, a matter of some importance in Bengal, where every tree is more or less valuable, and has to be paid for. These circumstances greatly increased the labor of the preliminary operations, and protracted them over a longer period than is usual.

23. Further delay was caused in building the principal stations. These are usually, towers, with a central pillar, four feet in diameter, of burnt brick and lime masonry, surrounded by a platform of unburnt bricks and mud, fourteen to sixteen feet square, the whole raised to a height of twenty to forty feet, according to the nature of the obstacles to be overlooked. This structure has been adopted on account of its cheapness, and the rapidity with which it can be constructed; it has hitherto been found to be well adapted for our requirements. But it appears to be inapplicable for the rainy and moist climate of Eastern Bengal, where unburnt bricks rarely have an opportunity of drying sufficiently to be safely used, in raising a structure of such necessarily large dimensions. At one of Lieutenant Thuillier's stations, in consequence of the employment of damp materials in the unburnt brick work, and constant and heavy falls of rain during the construction, the building gave way, under the weight of the instruments and observatory tent. Fortunately, the large Theodolite was packed in its case, and received no injury, but the season was too far advanced for the tower to be rebuilt before the setting in of the monsoon, and as the mishap occurred in the first polygon of the principal triangulation, and there were no more towers ready in advance, the out-turn of work, as measured by the area triangulated, is unusually small, though much valuable experience has been gained, and there is every reason to hope that there will be a full out-turn of work next season. The design of the tower stations will have to be altered to suit the climate of Eastern Bengal; in lieu of the present solid mass of earthwork, it will be necessary to build a masonry wall around the central pillar, to support the observer's platform.

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Mr. J. W. Armstrong selected eight stations, extending over a distance of thirty-six miles, tracing the diagonal rays of the Series. He reports that, in consequence of the heavy rain during April, he was much delayed in carrying on the ray lines, and met with great difficulty in driving the perambulator over the low ploughed fields and wheels, which had been filled by the continued rain.

Mr. C. J. Carly, an Assistant, who had done excellent work in other parts of India, made very unsatisfactory progress last season; as this was, in a great measure, owing to ill-health and hypochondriasis, and as Mr. Carly has, subsequently, resigned his appointment in the Survey, further comment on his work is unnecessary.

Mr. H. W. C. Williams has shown himself to be unfitted for the field duties of a Surveyor; an application has been made to Government for his transfer from the field operations of the Survey to the Head-Quarters Computing Office, for the sedentary duties of which he is better qualified.

Mr. G. A. Harris assisted in the selection of stations, and subsequently acted as Observatory Recorder. Lieutenant Thuillier reports that he gave entire satisfaction in all he did.

**EAST CALCUTTA LONGI-  
TUDINAL SERIES.**

Lieut. THUILLIER, R.E.,  
1st Assistant G. T. Survey,  
In Charge.

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

C. J. CARLY, Esq.,  
Civil 2nd Assistant.

*Sub-Assistants.*

Mr. H. WILLIAMS,  
2nd Class.

Mr. G. HARRIS,  
3rd Class.



**RAHON MERIDIONAL SERIES.**

*Executive Officer.*  
H. KEELAN, Esq.,  
1st Assistant.  
*Sub-Assistants.*  
Mr. H. E. KEELAN,  
1st Class.  
Mr. H. PEYCHERS,  
3rd Class.

24. The Rahoon Meridional Series, under the superintendence of Mr. H. Keelan,\* First Assistant G. T. Survey, was brought to a termination during the last Field Season, by being extended Southwards until it joined the Great Longitudinal Series of Triangles, connecting Calcutta and Karachi. The meridional distance triangulated is sixty-nine miles, by thirteen principal triangles, arranged in polygons, for mutual verification, and covering an area of 1,603 square miles.

25. This Series has taken six years to accomplish. It was commenced by Mr. Logan, late First Assistant G. T. Survey, but has been chiefly executed by Mr. Keelan. It is double throughout, the triangles being arranged in successive quadrilaterals and polygons of remarkable symmetry. Its meridional length is 457 miles; the principal and secondary triangles cover an area of 23,620 square miles. The computations and maps connected therewith will be completed by the 1st October, when the party will be transferred to the districts on the meridian of 84°, between Sumbulpoor and the East Coast. The total cost of the operations, up to 1st October, will be about Rupees 2,01,609, which gives a rate of Rupees 8-8-6, or about 17 shillings per square mile.

**GURHAGURH SERIES.**

*Executive Officer.*  
G. SHELVERTON, Esq.,  
Civil Assistant.

26. The field operations of the Gurhagurh Series, on the meridian of Umritsur, were brought to a termination at the end of season 1861-62, when it formed a junction with the series of triangles on the same meridian which had been brought up by Captain Rivers as far as Ajmere, from the Great Longitudinal Series. By the 1st October, 1862, the recess computations and charts were completed, and the party was available for transfer elsewhere. This Series has taken five years to complete; the greater portion has been executed by Mr. George Shelverton. Its meridional length is 557 miles; the area covered by the principal and secondary triangles, 19,096 square miles; the cost, Rupees 1,08,212, which gives a rate of Rupees 5-10-8, or about 11 shillings per square mile.

**SUTLEJ SERIES.**

*Executive Officer.*  
G. SHELVERTON, Esq.,  
Civil Assistant.  
*Sub-Assistants.*  
Mr. G. RYALL,  
Senior Sub-Assistant.  
Mr. M. C. HICKIE,  
1st Class.  
Mr. F. BELL,  
1st Class.

27. The Sutlej Series follows the left bank of the Sutlej from its junction with the Indus, near Mithunkote, to a side of the Gurhagurh Series, near Ferozepoor. It was commenced towards the close of Field Season 1860-61, by Lieutenant Herschel, and was completed last season by Mr. Shelverton.† It is single throughout. The recess computations will be completed by 1st October, when the party will be transferred to the meridian of 80°, to execute the required triangulation between Jubbulpore and Madras. During the past Field Season the triangulation extended over a distance of 112 miles, covering an area of 1,366 square miles. A very creditable amount of secondary triangulation was also executed. The total cost of the Series, up to 1st October, the date of its completion, will be about Rupees 80,743; the total area covered by the triangulation is 8,142 square miles, thus giving a rate of Rupees 9-14-8, or nearly 20 shillings per mile.

\* Mr. Keelan reports that—"Mr. Sub-Assistant H. E. T. Keelan was detached with a party to continue the Boondi Minor Triangulation Southward to lay down the position of the Palace and Town of Kotah.

† Mr. Sub-Assistant G. W. E. Atkinson was detached at the same time with a second party to carry on a Minor Triangulation on the Eastward to lay down the foot of Nuhargurh and the Town of Chapra, with instructions to measure all three angles of the triangles, and in no case (unless under peculiarly difficult circumstances) to have angles greater than 90°, or less than 30°. The object with which this triangulation was undertaken has been attained, but, I regret to say, several of the angles are to be found below 10°.

‡ Messrs. H. E. T. Keelan, G. W. E. Atkinson, and H. Peychers have, throughout the season, been most zealous in the performance of their duties."

§ Mr. Shelverton reports that—"Mr. George J. Ryall was directed to clear rays, make all preliminary arrangements for the building of towers at the principal stations, and to triangulate on the Northern and Southern banks of the Main Series, with the object of fixing the positions of several towns of importance on both banks of the River Sutlej. Mr. Ryall cleared 300 miles of rays, chiefly through thick low jungle, collected materials for the building of ten towers, constructed fifty seven platforms on his own triangulation, observed angles at fifty secondary stations, and fixed sixty-five points by intersection,—twenty-three of these are first and second class towns. Mr. Ryall's progress was highly satisfactory; his triangles which were most judiciously selected, covered a large extent of country.

¶ Mr. M. C. Hickie was retained by me as Observatory Assistant, in which capacity he was of great service. Near the close of the Field Season he was detached on Minor Triangulation, when he observed angles at thirteen secondary stations; his triangles embrace an area of 400 square miles.

§ Mr. F. Bell was detached to continue the Minor Triangulation begun by Mr. J. W. Armstrong during the previous Field Season. He was directed to conduct this work along the banks of the River Chenab, till he verified it by connection with the Jogi Tila Meridional Series. His progress, at first, was not rapid, and as he was delayed a good deal subsequently by bad weather, he was compelled to remain longer in the field than the rest of the party. I am glad, however, to report that he carried out all that was assigned to him. His triangulation, which is 140 miles in length, embracing an area of about 1,200 square miles, closes on the side Chiniot H. S. to Hoojan T. S. of the Jogi Tila Series, and consists of forty-three stations of observation, from which the positions of all places of importance on the banks of the Chenab River have been determined."

28. The Bombay Party, under the superintendence of Captain Haig, Royal (Bombay) Engineers, having completed the triangulation in Northern Bombay, was deputed to execute a series of triangles to the South of the parallel of Bombay, on the meridian of Mangalore. While the preliminary operations and selection of stations were proceeding, Captain Haig marched to the origin of the Bombay Longitudinal Series, with a view to making this Series double throughout, by adding flank stations, so as to form polygons in parts where there were only single triangles. On reaching the ground, it was found that the ends of the Beder Base Line were, fortunately, in good preservation. Three of the advanced stations had, however, been completely destroyed. Captain Haig judiciously determined to triangulate the Series anew, as far West as the Mangalore meridian. The revision having been executed with a much superior instrument to that employed in the original triangulation, the value of this portion of the Bombay Longitudinal Series is very greatly enhanced.

29. Having completed this revision, Captain Haig was proceeding with the principal triangulation on the meridian of Mangalore, when an untoward accident brought his operations to an abrupt termination. The large Theodolite was set up for observation on the tower station of Palwan, when, without any previous warning, the tower gave way on one side, causing the fall of the instrument and observatory tent, whereby the instrument was so seriously injured that it is incapable of being again used, until it has been repaired by the makers in England. Fortunately, the horizontal circle, the most valuable portion, appears to have escaped injury, but the vertical circle was destroyed, and the injuries are such that the instrument cannot be repaired in this country. Captain Haig convened a Court of Enquiry to report on the circumstances; the proceedings of the Court have already been submitted to Government. The Court came to the opinion, in which I entirely concur, that the fall of the tower was occasioned by the sudden and unexpected sinking of the ground below, and that no blame is attributable to Captain Haig, or any other person, for the mishap.

30. Captain Haig had already turned out a very excellent season's work, comprising thirty-two principal triangles, covering an area of 6,625 square miles, and extending over a length of 260 miles, whereof 66 appertain to the Mangalore meridian, and 194 to the parallel of Bombay.

31. The Spirit-Leveling Operations were carried on by Mr. Donnelly, Civil Second Assistant, under the superintendence of Lieutenant Thuillier. The party accompanied me to Calcutta, to receive the necessary instructions regarding the programme of the season's operations, which could not be decided on until I had obtained reliable information regarding the Railway levels between Calcutta and Agra. I had hoped to be able to incorporate these into our work, so as to avoid the labor and expense of carrying a line of levels all that distance. During the previous Field Season, a connection had been made, at Agra, with the Railway levels brought up from Calcutta, and the Trigonometrical Survey levels, brought up from the mean sea at Karachi. The two sets of results differed by about twenty-four feet, and it was hoped that all difference would disappear, on connecting the Railway datum, the site of Howrah Dock, with the mean sea level of the Bay of Bengal.

**BOMBAY PARTY.**

*Executive Officer.*  
 Captain C. T. HAIG, R.E.,  
 1st Assistant.  
*Assistants.*  
 J. DA COSTA, Esq.,  
 Civil 2nd Assistant.  
 J. M'GILL, Esq.,  
 Civil 2nd Assistant.  
*Sub-Assistants.*  
 Mr. G. A. ANDING,  
 2nd Class.  
 Mr. DONOHUE,  
 3rd Class.

**SPIRIT-LEVELING PARTY.**

*Executive Officer.*  
 Lieut. H. R. THUILLIER,  
 R.E., 1st Assistant.  
*Assistants.*  
 A. W. DONNELLY, Esq.,  
 Civil 2nd Assistant.  
 RAMCHUND,  
 Native Leveler.

The work allotted to Mr. Civil Second Assistant Da Costa was to carry out the final work of the secondary Guzerat Const. Series from Surat to Cambay, the Stations of which he had selected during the previous Field Season. The Series comprises twenty-eight first-class triangles, it determines the geographical positions of Surat, Daroche, and Cambay, and ten minor towns and ports; it crosses the large Rivers Tapti, Nerbuddah and Mbye, also two small ones, the Keem and the Dadur, and embraces about 1,200 square miles of country triangulated. Mr. Da Costa's out-turn of work is most creditable.

Mr. Civil Second Assistant M'Gill was appointed to select some fresh stations on the Bombay Longitudinal Series, and then to proceed to Dharwar, and select stations for a short Longitudinal Series, connecting the termination of the South Konkan Series with the Mangalore Meridional Series. On the completion of this work he went to Belgaum, and laid out a Series to Goa. After this, Mr. M'Gill continued the selection of the stations of the Mangalore Series on the meridian of 75° South of Dharwar, which he advanced to within thirty miles of Mangalore. On this work Mr. M'Gill next met with many difficulties, the surface of the country being covered with dense teak jungle, and the tops of all the hills with high trees; a malignant epidemic fever was also then prevalent, from which nearly the whole party suffered more or less. Mr. M'Gill's progress, under these circumstances, was most satisfactory.

Mr. Anding had charge of the building parties on the Mangalore Meridional Series, and was also employed in observing secondary triangles.

Mr. Donohue throughout the season was employed in the observatory and in the office, on current work.

32. That level had already been closely ascertained, by a Series of Tidal Observations taken at Kydd's Dock, and subsequently verified by others taken at Kejiri, from the description of which (*vide* foot-notes) it is evident that the mean sea level of the Bay of Bengal may be considered to be known to within a few inches of the truth. On connecting the Railway levels with Kydd's Dock, it was found that there still remained a difference of about twelve feet between the Railway and the Survey height of Agra. On discussing this subject with the Chief Engineer of the Railway, I ascertained that there were several breaks in the Railway levels, that, in consequence of the pressure of other work, there had been no opportunity of preparing a correct and true section of the whole line, and that it was contemplated to re-level the line, as soon as the Engineers had leisure to do so. I decided, therefore, on deputing the Leveling Party to re-level the line of the Railway, and connect all the Trigonometrical Stations within reach thereof.

33. Mr. Donnelly made good progress, and accomplished two hundred and forty-two miles of first-class leveling,\* forty-one of which had to be re-leveled, on account of large discrepancies which were found in the Railway levels. The opera-

\* With an Assistant leveling the line, independently, behind him, station by station, after the method described in the published volume of Tables of Heights.

The following description of the connection of Kydd's Dock with the mean sea level of the Bay of Bengal is taken from a Report, dated 1st November, 1854, on the Calcutta Meridional Series, by Colonel Waught, Surveyor-General, and Superintendent G. T. S. :—

" A Register of the Tides in the River Hoogly is regularly kept at Kydd's Dockyard, near Calcutta, the height of each successive tide being referred to a fixed datum line or zero, which is the bottom or sill stone of the dock, and therefore an object of invariable character.

" A transcript of the Register of the Tides for two years, viz.,—from May, 1846, to April, 1848, having been obtained from the Marine Department, a Monthly Abstract of Mean Tides was deduced therefrom.

" The waters of the ocean would maintain a constant level if undisturbed by the action of the Sun and Moon. Laplace has demonstrated that this level is a mean between the highest and lowest state to which the surface of the ocean is reduced by the attraction of those bodies. This mathematical truth is corroborated by observations made on open coasts, from which it results that the mean of high and low water for two consecutive tides represents, very nearly, the level of the sea, and that the average for a lunation is constant within a very small quantity.—*Tide* Professor Whewell's Report, 7 vol., British Association's Report.

" An examination of the Abstract of Monthly Mean Tides will, however, show that considerable irregularity exists in the River Hoogly, the monthly means differing as much as six and a-half feet. Now, if the annual average be considered as the true level of the sea, it would follow that for some months, consecutively, the mean height of the River is two and a-half feet below the sea level, a conclusion which is altogether inadmissible.

" The lowest monthly mean tide occurs about February and March, when the fresh water in the River is lowest, and strong southerly winds do not prevail. The mean tide rises gradually, as the River rises during the South Monsoon, until it attains its maximum in September or October, at which time the monthly mean exceeds that of February by no less than six feet. This rise is, obviously, the effect of accumulation, produced by inundation in the Valley of the Ganges, and the force of the South-West wind, which dams up the freshes in the long and narrow channel of the River.

" It has been remarked by Colonel Cheape, Chief Engineer, in his Memoirs, dated April, 1825, that the surface of the Salt Water Lake, wherein the rise of the tide is almost imperceptible, would, on account of its wide expanse, represent very accurately the level of the sea with which it communicates. He also observes that Captain Taylor's levels indicate that the surface of the lake in the dry season is 2*f*. 4*in*. below the mean state of the River. This result corresponds very nearly with the mean tide of the River itself, which in February is 2*f*. 5*in*. below the level of the annual mean.

" Colonel Cheape further states that the periodic rise of the surface of the lake in the wet season is ten inches. Now, the contemporaneous rise in the mean tide of the River has been shown to be six feet, and as the cause of these elevations is precisely the same, though the effects are in the ratio of seven to one, the greater rise in the River can clearly be attributed only to the narrowness of its channel compared with the bay; it is probable that a considerable portion of the rise of ten inches in the surface of the lake is also due to accumulation; so that, although a rise may be supposed to take place in the level of the sea at the head of the bay, during the continued pressure of the S. W. Monsoon, still, that elevation must be much less than what takes place in the lake, where the effect of this rise is increased by the narrowness of the channel, and the influx of fresh water during the inundation.

" It has been shown that if the annual average of mean water be taken as the sea level, it would lead to the inadmissible conclusion that, in the dry season, the average level of the River at Calcutta is twenty-nine inches below the sea, with which it freely communicates. It has also been shown that the surface of the Great Salt Water Lake, in the dry season, is on a level, or nearly so, with the mean tide of the River at the same time. It is likewise manifest that the periodic rise of mean tide during the monsoon, to the extent of six feet in the River and ten inches in the Lake is occasioned by local causes, independent altogether of the true level of the sea, which is a constant level, and these causes, it appears, operating in narrow channels are capable of producing exaggerated results in the proportion of seven to one, showing clearly the fact of accumulation. Hence the conclusion is inevitable that the lowest monthly mean tide of the River, observed in February and March, represents the nearest approximation to the actual sea level, and that the rise of mean tide at Calcutta during other months may fairly be ascribed to disturbing causes of an inland character, altogether independent of the true and constant level of the ocean. The variable character of the disturbing causes is shown by the fact that the monthly means of corresponding months for the two years differ considerably, except in the months of February and March, the monthly mean tides of which are very accordant.

" Proceeding upon this principle, I have used the following observations to refer the datum line in Kydd's Dock to the sea level :—

" Mean Tide February, 1847, above Datum, as Measured on Gauge, ..	...	...	8-11 feet.
" " " " " "	"	"	8-45 "
" " " " " "	"	"	8-48 "
" " " " " "	"	"	8-50 "
" " " " " "	"	"	8-28 "
" " " " " "	"	"	8-62 "
" " " " " "	"	"	7-34 "
" " " " " "	"	"	8-36 "

Mean, ... .. 8-313 feet.

" Correction for Error of Graduation on Gauge by Mr. Bedford's Measurements, ... .. 0-233 feet.

" By Tides Measured at Calcutta in February and March, Mean Sea Level above Datum, 8-576 feet.

" Again, in the years 1850 and '51, Mr. Bedford, the Marine Surveyor, took a series of tidal observations at Kejiri, and connecting this point by a series of levels with Kydd's Dock, found that the datum line at the latter point is 9-07 feet below the sea level. Mr. Bedford's observations, from which this result is derived, are as follows :—

tions had reached the vicinity of Bhagulpore, when Mr. Donnelly was compelled, by severe illness, to close work.

MEAN LEVELS OF THE RIVERS MOUTH AT KEJIRI, AT NEAP TIDES FOR THE YEARS 1850 AND 1851, EXCLUDING THE SOUTH-WEST MOONSON.

MONTHS.	Highest Low Water.		Lowest High Water.		MEAN.	
	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.
<b>1850.</b>						
January, . . . . .	5 4	0 0	11 11	9 9	8 7	8 10½
February, . . . . .	5 4	6 9	11 11	0 6	8 8	3 1½
March, . . . . .	6 4	0 9	11 12	0 0	8 8	0 4½
April, . . . . .	6 4	9 9	11 12	0 6	8 8	10½ 7½
May, . . . . .	6 5	9 3	12 13	0 0	9 9	4½ 1½
June, . . . . .	6 6	6 0	13 1½	3 9	9 10	10½ 4½
November, . . . . .	7 4	0 9	12 13	3 0	9 8	7½ 10½
December, . . . . .	5 4	9 6	11 12	9 3	8 9	9 4½
<b>1851.</b>						
January, . . . . .	4 4	6 3	11 11	9 0	8 7	1½ 7½
February, . . . . .	4 5	3 0	11 10	3 3	7 7	9 7½
March, . . . . .	4 6	9 3	11 11	0 9	7 9	10½ 0
April, . . . . .	5 7	3 0	12 10	9 6	9 8	0 9
May, . . . . .	6 7	6 0	12 12	9 6	9 9	1½ 9
June, . . . . .	6 6	0 9	1½ 13	6 3	10 10	3 0

" Mean Height of Sea Level above the Datum Line at Kejiri, . . . . . feet. inches. 8 9.75  
 " Datum Line at Kejiri above that of Kydd's Gauge, . . . . . 0 2.88  
 " Sea Level above the Datum Line of Kydd's Gauge, . . . . . 9 0.63  
 " Which reduced to decimals of a foot becomes, . . . . . 9.053

" Which differs from my determination by half a foot; but, if the tides at Kejiri for February and March be alone taken into account, at which period the inland waters flowing seaward are lowest, the result would agree with that derived from my discussion of the tides at Calcutta to about one inch."

The tenant Thuillier rendered very valuable assistance in reducing the field work of the Leveling Operations, and preparing the Tables of Heights for publication.

Mr. Donnelly reports that he was much delayed by the discrepancies which were found between his levels and those of the Railway. They entailed the re-measurement of two sections, one fifteen, the other twenty-six, miles in length. In the first, the discrepancy was five feet; in the second, seventeen and a-half feet. Mr. Donnelly and his Assistant re-measured both these sections, and obtained results differing from their first results by only .032 of a foot in the first instance, and .013 in the second, clearly shewing that the error did not lie in their work.

In the course of the Field Season, Mr. Donnelly laid down nine G. T. S. Bench Marks, fixed two G. T. S. Trigonometrical Stations, and connected one hundred and forty-one points, principally Railway Mile-stones, Bridges, Bench Marks, and Station Platforms.

COMPARISON OF RAILWAY AND G. T. SURVEY LEVELED HEIGHTS.

NAMES OF RAILWAY STATIONS AND BENCH MARKS.	G. T. SURVEY.		RAILWAY.		G. T. S. Railway.	REMARKS.
	Height above Mean Sea Level.	Height above Howrah Dock Sill.	Height above Howrah Dock Sill.	Height above Howrah Dock Sill.		
Serampoor, . . . . .	+ 20.919	+ 32.552	+ 32.230	+ 0.322		Level of Rails.
Pundooa, . . . . .	+ 42.338	+ 51.031	+ 51.110	- 0.103		Do.
Mynuree, . . . . .	+ 66.697	+ 78.330	+ 73.260	+ 5.070		Do.
Hurdwan, . . . . .	+ 100.325	+ 111.958	+ 107.260	+ 4.6.8		Do.
Kunoo Junction, . . . . .	+ 121.539	+ 133.172	+ 128.250	+ 4.9.22		Do.
Goskarral, . . . . .	+ 110.504	+ 122.137	+ 118.250	+ 3.887		Do.
Heddial, . . . . .	+ 132.270	+ 143.903	+ 140.250	+ 3.6.3		Do.
Bulpoor, . . . . .	+ 159.635	+ 171.238	+ 167.250	+ 3.9.8		Do.
Aknuddpoor, . . . . .	+ 131.213	+ 145.816	+ 142.250	+ 3.5.6		Do.
Cynthea, . . . . .	+ 168.330	+ 179.663	+ 176.250	+ 3.7.13		Do.
Mullarpoor, . . . . .	+ 143.709	+ 155.312	+ 151.230	+ 4.1.12		N. W. Point of Station-house, Square Pillar in centre of Line, opposite to King-post.
Rampoor Haut, B. M., . . . . .	+ 116.810	+ 128.143	+ 124.660	+ 3.4.83		Level of Rails.
Pakowr, . . . . .	+ 104.392	+ 116.025	+ 112.250	+ 3.7.75		Do.
Tecupshar, . . . . .	+ 103.779	+ 115.412	+ 123.250	- 15.8.58		Do.
Tillinghuree, B. M., . . . . .	+ 110.900	+ 122.533	+ 135.310	- 12.307		Square Pillar on Line to E. mile +.
Do. " . . . . .	+ 96.638	+ 108.271	+ 121.000	- 12.319		Head Stone of Oblique W. Gate of Fort, N. side original B. M.

34. During the year under review, I was called upon to collect all the available data of levels, existing in the Public Works, Railway, and Survey Offices, all over India, in order to reduce them to a common datum. As a first step towards this desirable measure, I have published a volume of Tables of Levels, based on the Spirit-Leveling Operations of this Survey, and reduced to the mean sea level of Karachi Harbour, as their datum. Additional volumes will be published as soon as possible. They will enable Officers of the Public Works and Railway Departments to reduce their levels to the mean sea, by connecting them with the nearest Bench Mark, or Station, of the Trigonometrical Survey. In most instances, however, the business of connecting will probably devolve on the Survey Department. At present, we have only one Leveling Party, which is employed in Bengal; I therefore submitted a project for the formation of other parties, to carry on operations, simultaneously, in the Madras and Bombay Presidencies, as the only means of speedily accomplishing an operation, of which the practical value will be greatly enhanced by early completion. Unfortunately, financial reasons have interfered to prevent this proposal from being sanctioned.

**ASTRONOMICAL PARTY.**

J. NICOLSON, Esq.,  
Assist. Surveyor-General.  
H. TAYLOR, Esq.,  
2nd Assistant G. T. S.  
Mr. A. DE SOUZA,  
1st Class Sub-Assistant.

35. I now proceed to report on the Astronomical Observations for the determination of the Latitude and Longitude of the Andaman Islands, which were instituted on a representation by the Superintendent of Port Blair, that the erroneous positions assigned to some of these Islands, in the published Charts, endangered the safety of ships sailing between Calcutta and Singapore. Under the orders of Government, in the Home Department, the Surveyor General had deputed a Surveyor, Mr. Nicolson, to conduct the necessary observations, the superintendence of which was subsequently transferred to the Trigonometrical branch of the Survey.

36. Mr. Nicolson started from Calcutta early in December, 1861, to reconnoitre the Coco and Andaman Islands. He found that, in order to take a complete Series of Astronomical Observations at the Great Coco, it would be necessary to have a steamer placed at his disposal for some weeks, to keep up his communication with Port Blair, and bring the necessary supplies for his party.

37. About this time, a communication was received from the Bombay Government, representing that there was as much doubt about the accuracy of the position of Port Blair, as of that of the Coco Islands. Under these circumstances, it seemed advisable that Mr. Nicolson should begin operations by fixing Port Blair, in order that the proposed operations might be commenced at the place where the greatest facilities for their execution existed.

38. The inaccuracy of the present Charts of the islands lying between Sumatra and Burma being admitted on all sides, it appeared necessary, in the absence of any regular survey of those islands to fix, by astronomical observations, the positions of Acheen Head, Port Blair, the Great Coco, or the Preparis Island, and an island in each of the other groups, intermediate between Acheen Head and Cape Negrais. It is believed that the relative positions of the mutually visible islands of each group are already correctly shown on the Charts; consequently, by determining the absolute position of a point in each group, it would be possible to rectify the existing Charts, without making a general re-survey.

39. Mr. Nicolson, having completed his reconnoissance, returned to Calcutta in February, 1862, by which time one of the large 3-foot astronomical circles of the Trigonometrical Survey had been got ready, and a portable observatory, with rotating dome, constructed for the observations. There was no good astronomical telescope available in the stores of the Mathematical Instrument Department; consequently, Mr. Nicolson was directed to take all his observations, whether of occultations, eclipses, or moon culminations, with the telescope of the astronomical circle, which he could point to any part of the sky, through the aperture in the rotating dome of the observatory. Owing, however, to the small number of occultations and culminations which occur monthly, and the risk of losing some of them in cloudy weather, Mr. Nicolson was directed to base his observations for Longitude chiefly on the measurement of lunar zenith distances, for which the astronomical circle is well adapted. He was supplied with an astronomical clock, and all other necessary instruments, from the Calcutta Observatory.

40. In May, 1862, Mr. Nicolson had set up his observatory at Port Blair, and was ready to commence observations. Unfortunately, the season of fine

weather had then nearly terminated; the Monsoon set in with unusual severity, nights favorable for observing were few and far between, and, consequently, several months elapsed before the whole of the necessary observations for Latitude and Longitude were completed. The work was further impeded by the delays attendant on postal communication between Calcutta and Port Blair, making it very difficult for me to exercise that degree of supervision over the operations, which their delicate and difficult nature required.

41. By the end of 1862, Mr. Nicolson reported that he had taken a sufficient number of observations to fix the position of Port Blair; he, therefore, applied for a vessel to be placed at his disposal to enable him to proceed to fix the positions of the Great Coco, and other islands. Owing to postal and other delays, it was not until the end of February, 1863, on my return from Vizagapatam, that I learnt from the Marine Department that no vessel was available, nor could one be got ready before the fine weather season would have terminated.

Memo. of Secretary to Government of India, Marine Department, No. 189, dated 18th Feb., 1863.

42. From the same communication I also learnt that the Secretary of State for India had ordered a complete Maritime Survey of the Andaman Islands to be executed. Being then in Calcutta, I went to Captain Rennie, the Secretary to Government of India, Marine Department, and was informed that, under instructions from the Admiralty Hydrographer, it had been determined to find the differences of Longitude between the various groups of islands, chronometrically, by a battery of thirteen or fourteen chronometers.

43. The circumstances under which it was originally proposed to fix a series of positions by astronomical observations had thus entirely altered. The complete Maritime Survey, which has been ordered by the Right Hon. the Secretary of State for India, renders further astronomical observations unnecessary. The determinations of differences of Longitude, which are the only really difficult portion of the work, can be done chronometrically by the Marine Surveyors, with much greater rapidity and economy, and, probably, even with greater accuracy, than by the best astronomical observations for absolute Longitude.

44. Consequently, in March last I desired Mr. Nicolson to restrict his operations to taking as many more observations for the determination of the Longitude of Port Blair as could be obtained before the setting in of the Monsoon, and then to return to Calcutta. He reached the Presidency in June, and has ever since been employed in reducing his observations. They consist of 32 lunar culminations, 136 lunar zenith distances, 130 transits of clock stars, and 162 meridional zenith distances of stars for Latitude, observed up to the 12th March, when the astronomical clock met with an accident, and Mr. Nicolson was afterwards obliged to employ a chronometer. His subsequent observations are, consequently, not as valuable as the earlier ones; they consist of 9 culminations, 64 lunar zenith distances, and 36 clock stars. The whole of the Latitude observations have been reduced, and found exceedingly satisfactory. There has not yet been leisure to reduce more than a few of the observations for Longitude, but the results obtained hitherto are satisfactory. The final resulting Longitude will be communicated for publication in the *Calcutta Gazette* as soon as ascertained. It should serve as an excellent datum for the proposed Maritime Surveys, and save the expense of a series of voyages between Madras and Port Blair, which would otherwise have to be incurred to obtain a good chronometric determination of the Longitude of Port Blair.

Mr. Nicolson reports as follows:—

"In June I kept up every night, in the hope of obtaining observations, but although there was not much rain, clouds always hung over the island, nearly all night, and, consequently, very little could be done. In July, August, and September, very heavy weather prevailed, and squalls were frequent, and came on so suddenly that it became necessary to tie down the observatory with large ropes to posts buried in the ground; even with this precaution the roof was nearly carried off two or three times. In October, when the weather moderated, I opened the observatory, and made preparations to observe, but neither during that month, nor the following November and December, had we much clear sky, in consequence of which, very few observations were taken. In January, the weather was better, and some observations were made, both for Latitude and Longitude, but the passing clouds, as usual, caused a good deal of interruption to the progress of the work. In February, most of the observations for Latitude and Longitude were made, and I believe the results of these observations will be found the best. Again, in March, except for a few days, there were much rain and clouds, which put a stop to observations for a time. I was also obliged to go away for a fortnight, to Ross Island, for change of air, as I was suffering from fever. In April, the South-West Monsoon having set in, very few observations were made.

"Mr. Second Assistant Taylor joined on the 11th April, but, unfortunately, too late to take part in the observations. During the whole time he was on the island, not a single favorable night for observation occurred.

"Finding the South-West Monsoon had set in, and there was no further chance of fine weather, and Mr. Taylor being satisfied with the observations taken by me, I took down the instruments, and quitted Port Blair, with my party, on the 8th of May.

"The climate of Cintham Island, where we were located, proved very detrimental to our health. I suffered much from repeated attacks of fever, and Mr. De Souza latterly became seriously ill. We are still suffering, more or less, from the effects of the climate, although since we left Port Blair, we have had the benefit of a sea voyage.

"Previous to leaving Port Blair, a pucca platform, four feet square and two and a-half high, was erected over the pillar on which the instrument stood. I could not procure assistance from the Superintendent to build a larger one. In the

45. THE OUT-TURN OF WORK EXECUTED BY EACH PARTY DURING THE FIELD OPERATIONS OF THE OFFICIAL YEAR 1862-63 IS SHOWN IN THE FOLLOWING ABSTRACT:—

STATISTICS.	Kashmir Series.	Coast Series.	Satlej Series.	East Calcutta Longitud. Series.	Rahoon Meridional Series.	Eastern Frontier Series.	Bombay Party.	Total Out-turn of Work.
Principal Triangles,	19	29	4	13	16	32	113	
Average error of Principal Triangles in seconds,	0.91	0.43	0.44	0.46	0.43	0.89	0.65 average.	
Observed Azimuths,	1	1	2	1	1	5	5	
Secondary Triangles with all 3 Angles observed,	10	132	16	16	32	190	190	
Area of Principal Triangulation, square miles,	256	1366	220	1693	881	6625	10,954	
" Secondary Triangulation, " "	10,500	4816	950	263	1510	18,139	18,139	
" Topographically Surveyed, scale 4 ) miles = 1 inch, square miles, " )	10,400	...	...	...	...	...	10,400	
Intersected Points,	12	112	18	22	110	274	274	
Length of Principal Triangulation in miles,	112	112	20	69	49	260	490	
" Secondary do.,	340	...	72	100	...	512	512	
Miles of Rays cleared between Principal Stations,	300	253	159	...	...	712	712	
Towers built for Principal Stations,	11	5	5	...	2	23	23	
Platforms do.,	12	6	17	44	79	79	79	
Platforms built for Secondary Stations,	95	...	...	...	95	95	95	
Length of Triangulation laid out in advance ) in miles, " )	45	77	150	272	272	272	272	
Principal Stations selected in advance, " )	8	17	36	61	61	61	61	

COMPUTING OFFICE.

Lieut. HERSCHEL,  
1st Assistant G. T. Survey,  
In Charge.

Deputy.  
Baboo BUOLANATH,  
Computers.

CHETUR MULL,  
GUNGA PERSHAD,  
and six Native Assistants  
recently appointed.

Sub-Assistants,  
under training.

Mr. J. WOOD,  
Mr. J. T. BURT,  
Mr. J. TROTTER,  
Mr. BELCHAM.

46. The Computing Office has been employed in a variety of preliminary operations, which are necessary to form the basis of a general reduction of the whole of the principal triangulation of this Survey, which will shortly become necessary, now that almost the whole of the triangulation of the tracts of country comprised in the great quadrilateral figure connecting Calcutta, Karachi, Attok, and Purnea, is completed. Though the triangulation has been executed with the very best instruments, and though the system of observation which was introduced into this Department by Colonel Everest, is more rigorous and accurate than that of any European Survey, it is evident that, in consequence of the vast length of each Series, and the imperfections which necessarily attend whatever is the work of human hands, each Series generates a certain amount of error, which becomes apparent as linear error on the termination of the Series on a measured base line, while on the close of a circuit formed by two Meridional Series, and the portions of the connecting Longitudinal Series at their extremities, it produces errors of Latitude, Longitude, and Azimuth. The dispersion of these errors in such a manner as to obtain the most probable results of the whole, giving its due weight to each fact of observation, and taking into consideration the bearing of every such fact on all the rest, is a matter of great intricacy and difficulty, on which it will be necessary for me to consult with the ablest mathematicians of the present day in Europe, before deciding on the system to be finally adopted. Meanwhile, the necessary preliminaries for the eventual calculations are being carefully elaborated by Lieutenant Herschel, to whom I am indebted for numerous very valuable suggestions, and for co-operation as cordial as it has been unintermittent.

47. While the practical operations of this Department may be confidently pronounced to be of a superior order to similar operations in any other part of the globe, it must, on the other hand, be admitted, that the theoretical applications, for the reduction of the triangulation, have not kept pace with recent improvements in geodetical science, which have been introduced into some European Surveys. The method which has hitherto been employed for reducing the observed angles, so as to satisfy all the equations of condition of each figure, though a great improvement on any previous method, has had, in its turn, to give way to the subsequently discovered method of minimum squares. The algebraical solution of the equations necessary to satisfy the condition that the sum of the squares of the errors shall be a minimum, is by no means difficult, but hitherto there has been no practical adaptation of it in this Survey, chiefly owing to the pressure of other and more urgent business, on those alone capable of dealing with the subject. Much progress has however been recently made in this direction, and I am indebted to Lieutenant

pillar below are buried three mark-stones, each with a circle and dot engraved on it; and also on the platform there is a large stone, in the centre of which is set in a copper plate, with a dot and circle engraved on it."

Mr. Taylor, late of the Greenwich Observatory, has rendered valuable assistance in the reduction of the observations, for which duty his mathematical talents and training render him well qualified.

Mr. De Souza did good service in recording the observations, and otherwise assisting Mr. Nicolson.

Herschel for devising methods of calculation, which will enable the reduction of our figures to be effected, according to the new and rigorous system, by Native Computers possessing little more than a knowledge of arithmetic, with even greater facility than the less refined methods of reduction, which have hitherto been employed.

48. The Drawing Office has been chiefly employed in compiling Maps of the dominions subject to the Maharajah of Kashmir, from the plane table sheets sent in by Captain Montgomerie. A new Chart of the Triangulation of this Survey, up to date, has also been prepared, and a Chart to illustrate the volume of Tables of Heights recently published; both these Charts were lithographed in the Office of the Surveyor General, Calcutta. Nine original preliminary Charts of the triangulation, in various parts of India, have been prepared, in duplicate, for the use of the Surveyor General's Office, and the Geographer to the Right Hon. the Secretary of State for India. The Photographic apparatus is also being usefully employed in copying and reducing Maps, and in furnishing preliminary copies for current use, until the originals are engraved and published. Owing, however, to the small establishments at my disposal, the photography is necessarily restricted to the short period of the recess of the Kashmir Party, three to four months, when the services of our best Photographer, Captain Melville, are available for their management.

49. In the Instrumental Department, great advantages may be expected by the appointment recently made by the Right Hon. the Secretary of State for India, of an Officer, Colonel Strange, to superintend the construction of the new Great Theodolite, and various astronomical instruments, which are being prepared in England for this Department. When they are received in India, we shall be in a position to undertake the necessary operations for ascertaining our Longitudes, in connection with the Observatory at Greenwich, by means of the Electric Telegraph, which is now brought across from the Mediterranean to India.

I have the honor to be,

Sir,

Your most Obedient Servant,

J. T. WALKER, *Major, R.E.*,

*Superintendent Great Trigonometrical Survey.*

**DRAWING OFFICE.**

W. H. SCOTT, Esq.,  
Civil Assistant  
G. T. Survey,  
In Charge.

J. PEYTON, Esq.,  
Civil 2nd Assistant  
G. T. Survey.

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I am much indebted to Mr. W. Scott for the ability and assiduity with which he has turned out a large amount of work from his small office, and also for the excellent training which he gives to the probationary draftsmen.

Mr. Peyton has rendered excellent service in the Drawing Office, and has made a series of very characteristic sketches of Himalayan scenery, which I hope shortly to see published.

Mr. H. Duhau has been of much assistance in managing the Corresponding Office. On the departure of Mr. Hennessey to Europe, Mr. Duhau was entrusted with the charge of the Base Line Apparatus and Party, and his arrangements for bringing them from Calcutta to Delbra were entirely to my satisfaction.

Mr. R. Scott has been most useful and zealous in the discharge of his multifarious duties, in connection with the Corresponding Office, and as keeper of the instruments and stores.





# EXTRACTS FROM A REPORT BY G. LANE, ESQ.,

Chief Civil Assistant, Great Trigonometrical Survey,

ON A PORTION OF INDEPENDENT TIPPERAH, TRIANGULATED DURING 1862-63.

(1.) Independent Tipperah was entered from the North side, in the vicinity of Koileshar, a large village with a Thana belonging to the Rajah, in Lat.  $24^{\circ} 19'$ , and Long.  $92^{\circ} 3'$ . The River Munnoo flows under the Haut, or Market-place, of Koileshar, and is here about thirty yards in width. From the South, or left, bank of this stream the territory begins. It consists of an immense block of earth hills, intersected by innumerable watercourses and a few streams, covered with the densest possible reed, or "makla" bamboo, jungle, from thirty to eighty feet high, with trees from eighty to one hundred and twenty feet high. Excepting in beds of streams, and on land contiguous to one or two jheels, there was not a single plot of ground up to twelve square feet met with that was free from jungle.

(2.) The principal Rivers crossed in the course of the operations within Lat.  $23^{\circ} 50'$  to  $24^{\circ} 26'$  and Long.  $91^{\circ} 20'$  to  $92^{\circ} 8'$  were the Munnoo, Deo-gang, Kwahce, or Kohee, and the Dolai-gang. The Munnoo flows from South to North, within the hills, and afterwards towards the West, falling into the Kooseeara near Badarpur (a corruption of Bahadurpur), in Zillah Sylhet. The Deo-gang, which comes from the East, crossing the extensive range on which the Trigonometrical Stations of Harargaj and Komuntah are situated, falls at a point some three miles North of Komuntah, into the Munnoo River. The width of the Deo-gang was about forty yards, where it was crossed by means of a bridge constructed of bamboos, at about five miles direct distance North-West of Komuntah. The superficial velocity in the middle of February was 1.16 miles per hour. It must, however, be a powerful torrent during the rains. The word "Deo" signifies a giant, and "Deb," a Hindoo divinity; so, either way, Deo or Deb-gang would seem to imply a mighty stream, in the estimation of the Kookies. The Kwahce, or Kolie, which had a remarkably strong current, flows from South to North, and falls into the Borak, near Hubbeegurij, a large village in the District of Sylhet. And the Dolai flows from South to North, and falls into the Munnoo River at some three miles North-East of Laorago Hill Station, which is in Lat.  $24^{\circ} 26' 30''$ , and Long.  $91^{\circ} 49' 14''$ . It will be seen, from what has been said, that three out of the four principal rivers specified, have their sources among these hills, whilst the Deo-gang comes from a country further East, of which nothing is known, save that at the present time it is inhabited by the Kochak Kookies, and other wild tribes.

(3.) Within the limits of the final operations of last field season there are four parallel ranges of hills. The first in order from the West is that on which Champamura, Bornura, and Saisum Trigonometrical Stations are situated; it is about thirty miles in length; the next, on which Atar Mura Station is situated, is about forty-three miles long; then comes the Langturai Range, about fifty-six miles in length, on which the Station of Batehia is situated; and, East of this again is a range, about forty-one miles long, on which our Stations of Harargaj and Komuntah are situated.\* The three last named ranges stand on a plateau of two to four miles in breadth on either side, which again are the summits of hills distinctly elevated above the rest of the contiguous hills. The ranges run nearly North and South, excepting at their extremities, which curve towards the West.

\* From Harargaj and Komuntah Hill Stations, towards the East, are several high hills and great ranges.

(4.) Our principal Stations of Komuntah, Batehia and Atar Mura are elevated above the beds of the adjacent rivers about 871, 1,071 and 1,276 feet respectively, as determined approximately with a Mountain Barometer. Throughout this country the marching was for distances through water six to eighteen inches deep, across bogs, and over numerous ascents and descents, many of which were very steep and tough, and after the least fall of rain extremely slippery, and often not a little dangerous from deep chasms and abrupt precipices. Roads were made for the large Theodolite by cutting and removing the bamboo jungle to a width of

six to eight feet. They were constantly choked by bamboos and trees falling across from the dense jungle on either side. Travelling from one Station to another, from 8.3 to 18.5 miles direct distance, generally occupied three or four days. The water at the different stages was frequently extremely bad, sometimes of a reddish hue, at others of a milky color, or greenish and greasy.

(5.) It has been stated that the general mass of these hills is composed of earth. Occasionally clay slate and granite have been met with in the beds of some of the streams. On the march between our principal Stations—Champamura and Lambu Sara—a deep and narrow gorge, or chasm, with perpendicular sides of granite, from about one hundred and fifty to two hundred feet high, was passed through. Within this was a watercourse abounding with blocks of petrified wood\* of various sizes up to four feet in length and ten inches thickness. These were most beautiful and perfect specimens of petrifications.

\* Of the Awal tree, said to petrify in these hills in about five years. This wood is used in the Sylhet District for construction of boats, as well as for posts of huts.

(6.) The country of Independent Tipperah, as far as our final operations extended last season, was for the most part a perfect wilderness, particularly in the neighbourhood of our Stations of Komuntah, Batelia and Atar Mura. In fact, it is only very thinly inhabited for a few miles in the interior, along the Northern and Western frontiers, by Kookies, Tipperahs, and some Munneepoories. The country further East and South-East of Harargaj and Komuntah Stations is, as already mentioned, occupied by Kochak Kookies, and other wild and hostile tribes. These people, in former years, by their repeated depredations caused the desertion, and eventual abandonment, of a populous town, situated in the rich and fertile valley East of Harargaj Station.

(7.) The Kookies are divided into five tribes, viz.,—Umroi, Chutlang, Halam, Baipai and Kochak. The Baipais in former days were dependents and slaves of the Kochaks, who are the most formidable of these races. For many years past they have been separated, and, such is the hatred of the Kochaks for the Baipais, that the latter will never mention or dare to meet their former masters, but will fly on the least signs of their approach, and if ever taken by any chance they are sure to be butchered as ingrates. The Umrois and Chutlangs intermarry, and are on friendly terms with the Baipais. The Halams are the only tribe who dress, and that somewhat after the style of Bengalis. The Kookies of both sexes marry when they attain puberty, or about that time. On the marriage of an orphan Kookie girl the Rajah of the tribe receives Rupees 40 from the bridegroom, or Rupees 30 if the bridegroom is very poor. If a girl's parents be living, they receive Rupees 77 or 57, according to the ability of the bridegroom, while the Rajah receives only Rupees 13 as his right. If the bridegroom be unable to pay the money at once, he must do so by instalments. Should he, however, die before this is done, his descendants must, in course, liquidate the balance due to the Rajah.

(8.) The Kookies bury their dead. When a Rajah dies his household place the corpse on a platform of wood, not bamboo, elevated about four and a-half feet above the ground; a moderate fire is kept up underneath, in order to dry up all the humours. After the corpse has been kept in this wise for three months it is interred, in the usual horizontal position, in a grave seven or eight feet deep.

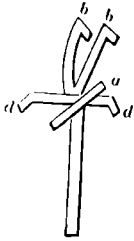
(9.) The Kookies worship a deity they call Lachee, and no other. The worship consists in fixing in the ground perpendicular strips of bamboo, about two feet long, in a rude circle, and one in the centre, with a crude and very coarse basket suspended from its head. Within this basket are placed a little cotton, thread, paddy, chillies, and other produce of the soil, as offerings of propitiation, and petitions for plenty. At times, a low circular *chevaux-de-frise* is constructed, with the view to keep off wild animals, and within this the offerings are left. The neck and head of a cock is often offered, whilst the body of the bird is eaten by the people, as a treat; but, of all offerings, a young monkey, killed with one dash against the ground, and left on the spot, is considered the most acceptable that can be made. There appear to be no priests among the Kookies.

(10.) There are four petty Kookie Rajahs in the district of our last season's operations, viz.,—Lalhulian, Murchailal, Rangbung, and Thoma, also called Mor-Thoma. Among them the best in pedigree is Rangbung; the two wealthiest, Murchailal and Lalhulian, and the latter has the most subjects, altogether between two hundred and two hundred and fifty. These Rajahs are subject to the Maha Rajah of Independent Tipperah, but they pay no tribute, beyond nuzzurana, such as tusks of elephants, gings, or gongs, of Burman manufacture, buck goats and khasis, gobois, large animals supposed to be the bison domesticated, and cotton fabrics, white and black, of Kookie manufacture. Some of these articles are occasionally presented by

each Rajah, according to his ability, to the Maha Rajah. When this is neglected to be done for four or five years, and such instances are said to be not uncommon, the Maha Rajah issues orders to his Jemadar and Dulashia (interpreter) to proceed to the Kookie Rajah's place, and see to the matter, and the customary muzzurana is forthwith tendered. About some sixteen or twenty years ago there was a Kookie Rajah, named Lalchukla, a notorious freebooter, dreaded by the Kochak Kookies, and the scourge of the country. His followers numbered 1,500, and in one of their last raids in Cachar killed ten or twelve persons, and carried off three Munneeporee women captive. They lived in a long straggling village called Komuntah, after which the adjoining Trigonometrical Station is called, the name literally signifying an assemblage of good dwelling houses.

(11.) After the raid in Cachar this petty Rajah was taken captive by British troops, and the common belief is that he was eventually transported for life. Murchailal, one of the present Rajahs, is the only surviving son of this notorious freebooter, of whose exploits much mention is made by the Kookies of the present day. Murchailal is said to be married to a daughter of a Kochak Chief. He was recently summoned to Sylhet, per roobakaree addressed to the Maha Rajah, to answer to a charge of holding captive several Bengalis, British subjects, in his village. It appears that two women who were among the captives, hearing of our approach, believed that British troops were coming to operate against the Kookies. Being naturally discontented with their confinement, they watched for the first favorable opportunity, and made their escape in the hope of joining my camp, and so securing their personal safety, but we had moved on. After wandering in the jungles for some three days, they found themselves, fortunately, in a village on the British side of the frontier, and having given their izhar, or statement, to some of the Police, it led to the above mentioned requisition by the Magistrate of Sylhet for Rajah Murchailal.

(12.) Kookie messages, or orders, are communicated in this wise: A "Puroi" is made out of peeled strips of bamboo, about eight and a quarter or eight and a half inches long, of the shape in annexed figure. The two prongs of the fork, *b b*, are formed by splitting the upper portion of the central rod, to which a cross piece, *d d*, is tied at right angles. If the prongs, *b b*, be aligned, by holding the "Puroi" so that the two shall appear as one, the missive will be seen to resemble a cross. The tips of the prongs and cross piece being turned in breaks, indicate black mail to be levied—a rupee for every such break. If an additional piece, *a*, having its ends charred, be attached, this implies that the people to whom the "Puroi" is sent are to come on, even at night, with torches. If a chilli is fixed at the intersection of the cross, it signifies, literally, that disobedience to the summons will meet with punishment, as severe as the chilli is hot. If both the burnt bit of bamboo and piece of chilli are attached, the indication is that the requisition is extremely urgent and imperative, and must be forthwith complied with; whilst, if a piece of plain bamboo, or stick, is added to the cross, it means that disobedience of the order will entail corporal punishment.



(13.) When a Kookie Rajah desires to have a piece of land cultivated, his subjects are bound to provide laborers, one from each hut or family. If the Rajah wants a new hut constructed, laborers are similarly furnished to execute the work. If a Kookie commits murder, he immediately becomes the personal property of the Rajah, and is then by the people called the Rajah's Sepoy. When he dies, should he leave no issue, the whole of his effects become the Rajah's. If the man should have a son, he will be allowed possession of half the property, but a daughter, or wife, is not considered entitled, of right, to any portion beyond whatever the Rajah chooses to bestow of his own free will or gift.

(14.) The Kookies eat all kinds of meat, except human flesh, and that of cats, kites, crows and monkeys. Elephant flesh is highly esteemed, and is devoured even in a state of decomposition. Snakes, the goh, and the ghikú, species of the lizard tribe, are also eaten, as well as carcasses of dogs and cattle, if not actually putrid. When a Kookie kills a male elephant, his Rajah is entitled to a tusk, and a fourth of the body for meat. If any game, such as a deer, or pig, be killed by a Kookie, the Rajah is, in like manner, entitled to a fourth part. On occasion of a Kookie Rajah leaving his residence to go out anywhere, either on business or pleasure, it becomes incumbent on his subjects to provide him with a pig, and liquor, for himself and his household.

(15.) The Kookies cultivate paddy, cotton, katchú, a species of wild yam, Indian corn, indigo, some kinds of pumpkin, including vegetable marrow, sém, a sort of bean, kúlant, a kind of pulse resembling mung, chillies, and til, or sesamum, an oil plant. All these are used for their own consumption, except sesamum and cotton, which, after reserving a sufficiency for household purposes (2), are exported into other districts, through the agency of Bengalis, by sales and barter (3) effected at the marts of Koilesnar, Adampur and Kamalpur. A large quantity of the cotton is also taken to the bazar at Agartalla, where it is purchased by the banias and others. Of all products, cotton is the most extensively grown in these hills. During the month of March the bamboo jungle is felled, and allowed to dry by the sun, which takes ten to fifteen, or twenty, days; it is then fired, and the stumps are after that removed. After the first good shower of rain, men, women and children proceed with tools and seed to these plots, which are frequently at long distances from their hamlets; their chief tools are dows, with which instrument oblique cuts are made by single strokes, and in the pits so formed, which rarely exceed a depth of three to three and a half inches, the seeds are dropped; either paddy, by itself, or paddy, cotton, indigo, sesamum, and Indian corn, all together, or any two or three of these together, in the same pit, just as the cultivators feel disposed, or may happen to require.

(16.) The tea tree is said to be indigenous to this country. A tea planter has declared that he collected about two maunds of the seed from the jungles of Independent Tipperah, in the vicinity of the Cachar District. It is also said to exist along the borders of the hills near Agartalla. Such may, partially, be the case, and I have no doubt that the tea tree is growing in wild luxuriance along both the Southern and South-Western confines of Cachar, simply because it is found in many of the jungly parts of that district, and the features of the country, soil, and climates near the frontier, on both sides, are similar. It may also exist, not only in the immediate neighbourhood of Agartalla, but throughout the hill border, from this place to the Phneebee, and to Mollhong, on the South-Eastern limits of Cachar; but, in the course of all our travels during last field season, neither myself nor the Assistants ever saw tea trees in any part of the country, although I had search made for it expressly along the marches, and in the vicinity of our hill stations. The block of hills about our Station of Laoraga, on the Sylhet frontier, would answer perfectly for the culture of tea.

(17.) No limestone has yet been met with, nor is any believed to exist here. The whole of this country is admirably adapted for the growth of cotton. The thousands of acres at present lying waste might, with English capital and energy, be converted into an immense cotton field. Mr. Huxham, formerly a grower of cotton at Travancore, recommends the "New Orleans" variety to be cultivated, as being the quality best suited for the European market. He also observes that the best quality, next to "Sea Island," cotton could be raised in India, by due attention to the preparation of soil. In this wilderness the soil is in itself so well adapted for the growth, that ploughing or manuring is hardly necessary. The ashes of the jungle bamboo answer as a good substitute for manure, whilst simple dow pits, as previously described, at proper distances apart, are all that are required. On the occasion of my last interviews with the ruling Maha Rajah, at Agartalla, I suggested the advisability of leasing, or setting, in fee-simple, to Europeans and Christians, some of the waste lands of his vast domain, under concurrence of Her Majesty's Government, as a means of replenishing his treasury, as well as, from thus creating apprehensions of resistance from the new class of land owners, of preventing the Kochak Kookies from continuing their present periodical visitations of rapine and wholesale murder. The Maha Rajah, Birechandro Bahadoor, being in the presence of his courtiers, made no reply. He is not yet confirmed in the Raj by the British Government, and he appears indisposed to undertake any great measures for improvement or reform in the internal administration of his State, until he is actually installed in due form. At the same time it may be as well to remark that proofs are not wanting, in matters of lesser moment, of his eagerness and solicitude to promote the welfare and security of his subjects in general.

(18.) The Kookies wear little clothing about their persons. Some of the men wear a piece of cloth, about eighteen inches deep, girth round their waists. A few have jackets also, which are generally dyed blue. Others use only a sheet, and nothing else. The women wear simply a cloth fastened round the waist, like the men. Perhaps, in the cold weather, they may wear the sheet also. Both men and women part their back hair, and tie it in a knot behind the head, like native women in Bengal. From their general appearance it is difficult for a stranger to distinguish one sex from the other. The Kochak Kookies wear their hair with the knot tied in front, across the forehead.

(2.) Out of cotton the Kookies manufacture coarse sheets and pieces for wearing apparel, and with the oil they make oil on a small scale for anointing their heads and for their poujeh. They are also said to cut the seed.

(3.) Cotton uncleaned is sold by the Kookies at Koilesnar at 1 Rupee, 1 Rupee 8 annas, and 2 Rupees per long basket, according to its size. It is also bartered for fowls, dried fish, tobacco, rice, arrack, betel nut, betel leaf, salt, and cotton fabrics, especially chintzes. Cleaned cotton used to sell at 10 Rupees, but now fetches 20 Rupees the maund. The duty levied by the Maha Rajah is 14 Annas to 1 Rupee on the purchases effected by banias and native traders, and 1 Rupee 2 Annas per maund on retail transactions.

(19.) The weapons used by the Kookies are dows, bows and arrows, guns, old flint muskets, and some percussion muskets are also said to have been carried to them by native traders. The Kochaks use dows, takawars, spears and muskets. The takawar is a straight blade, like that of a sword, with a handle at one end of it, without any joining.

(20.) Most of the Kookies I have yet seen are more or less infected with leprosy, elephantiasis, secondary symptoms, cancers, or some inveterate skin disease. The elephantiasis is often found accompanied with grapes at the angle between the foot and leg. Some have issues which, in general, are expressly made, as vents for bad and superfluous humours, to ward off diseases. Others have incipient elephantiasis clearly discernible. In all my travels through various parts of India, I have never yet seen so much disease, nor even a tenth of it, among any class or community of natives, as among these poor Kookies. The want of cleanliness, the bad water, as well as the feeding on dog's and elephant's flesh, snakes, the goh, and poisoned fish and water, must be the principal causes of much of their diseased condition. There is a certain tree in the jungles, branches of which are cut down and thrown into the first pool of water, natural or artificial, having fish; these, in a little time die, and both the fish and the stagnant water, which is of course rendered more or less deleterious, are used by the Kookies and Tipperahs. The proportion of the diseased to the apparently healthy among the Kookies is fully eight to two. In their hamlets, which are few, and frequently far apart, and are shifted from one locality to another every two to five, and six, years, there are from twenty to one hundred souls, and of these eight to thirty, but seldom as much as thirty-five, are adult males. The huts of both Kookies and Tipperahs are constructed on platforms elevated about four to seven feet above the ground. Some of these are thatched with grass, others with bamboo leaves, and some with a description of date leaf\* found in the jungles, whichever, in fact, happens to be procurable in the vicinity of the locality; whilst the walls are generally made of a coarse kind of bamboo mat. The contrivance of having the huts well raised above the ground is most excellent; but, like the Cossyas, all these people keep their pigs, and also fowls, underneath their habitations, which of course creates noxious gases, and must be the cause, more or less, of sickness. There are no cows in the hill districts of Independent Tipperah, owing to want of pasture for cattle.

\* There is besides a broad leaf which is used, but only for covering huts intended for temporary shelter.

(21.) The Munneepoories are settled in hamlets along the skirts of these hills. They are a clean race; and, judging from those met with, appear to enjoy immunity from bad diseases. They are particular with their diet, abstain from all flesh, and live on vegetables and fish, and take their meals at regulated periods of the day.

(22.) The Tipperahs are a stronger built race than the Kookies, but less industrious and energetic. The majority live on almost the same diet, and labor under similar diseases, but in less proportion where their hamlets are situated far away from the Kookies. There are fourteen castes among the Tipperahs, two of which were formerly Kookies. Further particulars regarding these people will, it is hoped, be furnished next year, at the close of Field Season 1863-64.

(23.) Independent Tipperah extends Eastward, as far as the territories of the Burmese, to West of Ava; but, excepting the Kochak races, and other wild tribes, of whom scarcely anything is known, the country is at present utterly waste and useless, and must continue so as long as there is no population forthcoming to occupy it. \* \* \* \* \*

(Signed)

C. LANE, *Chief Civil Assistant,*

*Great Trigonometrical Survey.*

*Dated Chittagong, 4th August, 1863.*



# REPORT

By Capt. J. P. BASEVI, R. E., 1st. Assist. G T. Survey of India,

**IN CHARGE COAST SERIES,**

*ON A RECONNOISSANCE OF A PORTION*

*of the Jeypore Territory:*

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**MUSCOOTIE :**

PRINTED AT "THE HILLS" PRESS.

MAHOMED SHUFFER.





From CAPTAIN J. P. BASEVI, R. E.  
1st Asst. G. T. Survey of India,  
In charge Coast Series,  
Great Trigonometrical Survey,

To MAJOR J. T. WALKER, R. E.,  
Superintendent G T. Survey of India.

SIR,

I have the honor to submit my report, on a reconnoissance of a portion of the Jeypore territory, executed, in accordance with your instructions, during the latter part of the past field season.

2. On the completion of the measurement of the Vizagapatam Base Line, I left the main party of the Series, on the 10th of February, taking with me, Mr. J. O'Neill as Assistant, a small detachment of classies and berkandazes, twelve in all, and the Instruments

1-7	Inch Theodolite by Troughton and Simms.		noted in the margin. With
1	Perambulator		the compass and perambu-
2	Chronometers mean Time, }	No. 3569, Parkinsen and Frodsham.	lator, I kept up a traverse
		No. 472, McCabe.	from Kasipuram at the
1	Mountain Barometer by Troughton and Simms.		foot of the hills to Jeypore
1	Aneroid. Do. " Dent.		city, and from Jeypore to
1	Thermometer " Newman.		Bhadrachellum, on the Godaveri. I took observations with the Theodolite for time and Latitude,
1	Prismatic Compass " Troughton and Simms.		whenever the weather permitted, in order to correct my traverse, which after Jeypore could not

be carried on very rigorously, owing to the dense character of the jungle. I recorded regularly the readings of the Barometers and Thermometers, to obtain data for computing the heights above the Sea Level.—The Chronometers were compared daily.

3. I first visited two of our Principal Stations, viz., Jerakonda and Kap. Hill Stations near Madagula, and made a rough survey of a small portion of the country to the west, which is not given in the published atlas sheets. Then marching to Singvarapukota, and on to Kasipuram, I entered the Jeypore district on the 24th of February, and proceeded towards Jeypore, by the new road over the Galikonda hills.

4. At Padawah, five marches from Kasipuram, Mr. O'Neill became so ill that I was obliged to send him back; he had suffered daily from fever ever since entering the hills. Here too fever commenced among my men, and henceforward my small camp was never perfectly free from it, every one, not excepting myself, suffering more or less.

5. I reached Jeypore city on the 8th of March: here I was detained ten days. Lieut. Smith the Assistant Agent, was out in the District, and I was anxious to see him before proceeding further.—My men however were so weak, that I could not have moved earlier than I did. My original plan had been to take a Southwesterly course from Jeypore, until I gained the parallel of 18° and then to strike off Westwards to Sironcha; but I was obliged to give this up, my men were all ailing and the Jeypore Rajah objected to send his men or Elephants out of his own territory. With the Elephants I might have dispensed, but without the men I could have got neither coolies nor supplies. So, rather reluctantly, I decided on limiting my trip, to making for the Godaveri at Bhadrachellum or Dumogulam.

At Lieut. Smith's request, the Rajah lent me a Jemadar and two peons to get supplies &c., and three Elephants, one for riding, and two for my tents. I paid the men batta and defrayed the keep of the Elephants; these though undoubtedly the best description of carriage for the country, were in such bad condition, that they rather hampered me: the riding Elephant was so lame that I was obliged to send it back the second day, and neither of the other two carried even a camel's load. I loaded my own bullocks with rice, a very necessary precaution, for though supplies are procurable at the large villages, and at the smaller ones, almost always, a little rice and "biri" grain can be got, they were always of inferior quality. Indeed, a party travelling in these districts, should, if possible, bring rice from the plains, as the hill rice, generally disagrees with the natives from the Coast.

6. I left Jeypore on the 20th of March, and marched via Ramgir, Malkagiri, (or Malkangiri), Isunkom Poreh, and Moat to Rakapili, and thence up the Godaveri to Bhadrachellum, where I arrived on the 9th of April. The river was unluckily too low to

permit my going down to Rajahmundry by boat, as I had planned. To do so, would have taken at least ten days—so I marched to Ellore, where I took the canal boat to Rajahmundry, and thence dawked to Waltair, where I arrived on the 23rd of April.

7. My route in detail, and some general observations on the country passed over, together with a tabular statement of the marches, heights above Sea Level, &c., are given in a separate memorandum. A route map is also appended, and I have added a memo of routes obtained from native information. The route from Madagala to Sôgaru is compiled from reports by Captain Vertuo R. E., and Captain Owen, Principal Assistant Agent.

8. The Latitude of Jeypore, I have deduced from ten pairs of observations to Polaris, and one pair to Canopus, each consisting of one observation, Face right, and one Face left. Observations for Latitude were also taken at 14 other places.

9. The Longitude of Jeypore, I have deduced from observations for time, compared with transits taken at the North end of the Vizagapatam Base Line, using a rate obtained from these latter observations, and observations taken to the sun immediately on arrival at Waltair. I took observations for time also at 19 other places.

10. The heights have been computed from observations taken as nearly as possible at the same hours of the day, those previous to Jeypore being referred to the South end of the Vizagapatam Base, where observations were taken for several days early in December, and those after Jeypore, with Jeypore itself—this course was compulsory, as the Mountain Barometer got out of order on the march between Kasaram and Nellipaka.

I have used the formula given in Cape, Vol ii, viz.

$$\text{Diff. in height, in feet} = 60345 \left\{ 1 + \frac{t+t'-64}{900} \right\} \log \frac{H}{h \{1 + .0001 (T-t)\}} + 0.002695 \text{ Cos} 2\lambda$$

in which H, t, T, are the readings of barometer, attached and detached thermometer at the lower station, and h, t', T', the same quantities at the upper;  $\lambda$  the mean latitude. I adopted this formula being more convenient for computation than Table xviii of Boileau's Tables, and Table xvi was useless, the quantity (t+t') being only tabulated up to 162°.

11. I hope to despatch to you my map early in July.

I have the honor to be, Sir,

Your most obedient servant,

JAMES P. BASEVI, *Captain R. E.*,

*1st Asst. G. T. Survey of India,*

In charge Coast Series.

WALTAIR, VIZAGAPATAM,

26th June 1863.

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## MEMORANDUM OF ROUTE.

1. *Kasipuram to Roywalsa, 9.08 miles.* For the first five miles, the road is fair, and tolerably level, passing along the bottom of a narrow valley, after which, about 1 mile beyond the small village of Kottur, is a long zigzag ascent of 2½ miles, to a watershed called Damoku, where there are some coolie sheds. Thence on to Roywalsa the road is very good. The new trace leaves the present track at Kottur, and rejoins it again at Damoku, making a considerable circuit to the South, but necessarily has a much easier gradient. Roywalsa is a small village: plenty of wood and good water near, and fair encamping ground—but supplies are not procurable.

2. *Roywalsa to Galikonda, 5.96 miles.* A good road all the way, keeping along the watershed. About 2½ miles from Roywalsa the road passes by the hill village of Anantagiri, near which the Maharaja of Vizianagram has recently commenced a coffee plantation. Galikonda was recommended some years ago as a sanitarium, and three houses have been built here by the officers of Walbair. It is situated on the west face of a narrow valley, at a height of 4,250 feet above the sea. There is no village or encamping ground. The best place for a camp is at "Harris'" valley, 1½ miles further on, where a Detachment of H. M. 105th Regiment was quartered for a short time. In the neighbourhood of the houses, the hills are rather bare of trees, except in the ravines, where wood and water are plentiful, and a beautiful tree-fern grows. The new road will avoid Galikonda, passing to the east of it through a village called Bondam.

3. *Galikonda to Aruku, 12.09 miles.* The road passes along the East side of the valley, and after half a mile, reaches a watershed called the "Saddle," standing at an elevation of \* 4,352 feet above the sea. It then winds down a deep ravine, gradient easy, to Harris' valley, about 600 feet below "the saddle." This part of the road is infested with tigers, many people having been killed quite lately: one man was carried off two days before our arrival. Leaving Harris' valley, on the right, the road descends another five hundred feet, into an open valley, about 1½ miles broad, and covered with cultivation (chiefly jowar) which extends for nearly 8 miles in a N. West direction. Through the centre of the valley runs a large nullah, which is one of the sources of the Sileru. From the foot of the ghat, where a track branches off to the large village of Madagada, 2 miles distant, the road is excellent to Aruku, except in four places where nullahs are crossed, which are unbridged, and have very steep banks. Aruku is a large place situated near the northern extremity of the valley; a Deputy Magistrate is stationed here. There are several other large villages near; Padonapuram, 2 miles to East, Tsompi 1½ miles to South, and Khurdeh 1½ miles to South West, all in the Panch-Pentah estate. Coolies and supplies are to be got here, and there is good encamping ground. Bison are found on the high range of Turram Konda, 7 miles to the East.

4. *Aruku to Durbah, 6.84 miles.* The road follows the course of a large nullah (the Sileru) nearly the whole way, crossing it in two places, near together, where it is about 50 feet wide, bank to bank, and about a foot deep; the new road will eventually avoid crossing this nullah altogether, keeping throughout on its right bank. Near Durbah, the road passes through a defile, the boundary of Panch-Pentah and Jypore, into a more wooded country. Two other smaller nullahs are crossed, but the road is generally good. Durbah is only a small village, and we could get no coolies or supplies here. The encamping ground is good, being about half a mile East of the village, and there is abundance of good water close by.

5. *Durbah to Padawah, 7.99 miles.* The first mile or two of this march is through a rather jungly country, but it soon enters a fine valley, well cultivated; thence it follows the course of the same large nullah the rest of the way, keeping on its right bank. Only one stream of any size is crossed, and that close to Durbah. About 2 miles from Padawah, the road, still following the course of the nullah, turns round abruptly into a narrow valley, and comes out very suddenly on the broad plain, on the East side of which Padawah is situated. This plain, or rather valley, is about two miles in breadth, and six or seven miles in length, having a direction nearly North and South. The soil is reddish in color, and appears good; very little however is cultivated. Padawah is rather a large village. About 2 miles West of it on the opposite side of the nullah (the Sileru) here called "Pattal-gedda," is a large village named Auwaradah (Owarah in Scott's map), from which is a road to Madagula, passing through Wandragedda and Ugampett; there is also a route from Auwaradah to Malkagiri, passing through Kondakamru, and following most probably, the course of the Sileru, but I could not ascertain anything about this route, but the fact of its existence.

\* By Major Strange's observations with the aneroid, in 1859.

6. *Padawah to Kamtor, 6.40 miles.* The regular march is to Sogaru, but I broke it in two on account of the sickness of some of my men. The road crosses a small nullah coming down from the village of Barlri, and then takes a northerly direction, up the valley, past the villages of Subalar and Maliput, about one mile beyond which it crosses a low water shed, and then descends gradually into a broad valley, through the centre of which runs one of the principal sources of the Kolab (Saveri). The road is good throughout. Near Subalar another rather large nullah is crossed. Kamtor is only a very small village, but there are a number of villages all round, from which we got supplies;—a little rice, and "biri," grain.

7. *Kamtor to Sogaru, 6.58 miles.* General direction North West. The road is very good, passing over an open country, covered with dwarf dale,—but partly cultivated with jowar. Sogaru consists of two villages of about 30 houses each, situated half a mile apart, on rising ground, near the head of a broad valley, which drains northwards into the Kolab. One or two small watercourses have to be crossed on this march, but their banks are not steep. The road passes near several large villages, Bedzar, Kauti, Barell, Musiri. Supplies and coolies were furnished, but not willingly.

8. *Sogaru to Lantarpur, 8.31 miles.* Direction North. Road very good, and free from obstacles, country open. Lantarpur is only a small village, but near it are two larger ones, Konur (pronounced Quonur) and Sankhai, from whence we obtained coolies and supplies. Several villages are passed on the road, viz, Kanchaua, Burampur, Budhparao, and Tuswah—none large.

9. *Lantarpur to Pettah, 9.04 miles.* Direction North. For the first five miles, the road passes over an open country, similar to the preceding, but after a large village called Dabaguda, situated in a hollow on a deep ravine, the country becomes less open, and more hilly and wooded. Two ridges are crossed, down the first of which, the descent is considerable, though rendered easy by the windings of the road. There are two rather large nullahs to be crossed, which contain little water, but have very steep banks; the Dabaguda one, is the larger of the two. Pettah is situated in a narrow valley, and is but a small village. Supplies and coolies are obtainable, but to a limited extent only.

10. *Pettah to Kottah 5.02 miles.* About a mile beyond Pettah, commences the ghat leading down into the low country; on the Pettah side there is scarcely any ascent, and that little very easy. The first mile and a half of the descent is good, the new road having been so far completed, but the remainder is bad, and very steep in parts, passing through tall forest the whole way; there is also a good deal of bamboo jungle. There are tigers about this ghat, and the people will not travel until broad daylight. Kottah is situated immediately at the foot of the ghat, and nearly surrounded with hills; it consists of two villages, half a mile apart, separated by the river Ko'ab, which enters the plains close by. The Sappers and Mines were encamped here when employed on the road, but were removed shortly before my arrival, having lost their European Officer, and a large proportion of men from fever. Coolies and supplies were furnished here without any difficulty. The made portion of the road ends at this ghat, the roads beyond consist of mere village tracks.

11. *Kottah to Jeypore, 7.01 miles.* We crossed the river Kolab, which is here 30 yards broad, and 3 to 4 feet deep, by a raft, formed, of two hollowed trees, joined by a bamboo framework. This is the only description of boat to be met with in the country. The first two miles from the river, are through thick jungle, but after passing between two low ranges of hills, the road enters upon a rather open country, and skirts along rice fields, nearly the whole way into Jeypore. Jeypore, although the chief place in the country, and the residence of the Rajah, is a miserable town, consisting of about 1000 houses, of mud and thatch—there are no paka houses (brick or stone), and a few only are tiled. There is, I was informed, no lime in the country. The town, which is about 2000 feet above the sea, is close to, and partly surrounded by hills, the country being open only to the West. Northward of the town, and about 4 miles distant, is a large flat-topped hill, called Ramgurh rising abruptly about 1000 feet above the plain, on the summit of which, are the ruins of an extensive stone fort. On the West side of the town, there is a large tank, more than a mile long, and nearly half a mile in breadth, with fine mangoe trees on its banks. There is a second, and much smaller tank, to the North of the town. The Assistant Agent and Assistant Superintendent of Police, who have been recently appointed, live here: there is also a small police force located here.

12. *Jeypore to Gosella, 7.15 Miles.* Direction South West. The road or rather track, passes along a low ridge for the first four miles, when it crosses a large plain, covered with rice cultivation, in the middle of which a large nullah (a feeder of the Kolab,) is crossed, at a village called Balar. Thence it passes over more cultivation to the Kolab, about 2 miles on, which is also crossed by a ford. The stream is here of the same breadth and depth, as at Kottah, but has steeper banks. There were no boats here. Gosella is a small village; however a few coolies and supplies were obtained, as there were other villages near. Along the first part of the road, there were a good many Mhowa trees and a few Sal.

13. *Gosella to Sontepur, 9.28 miles.* Direction W. S. W. Our route for the first two miles was over open ground, mostly covered with rice cultivation, flanked on either side by low hills covered with brushwood. Passing by the villages of Khurpi and Gumar, we crossed a low watershed, and entered an undulating country covered with tall forest, chiefly Sal, which lasted the rest of the way. Sontepur is a small village containing 16 or 20 houses. We encamped a short distance beyond it, on the bank of a small stream, the Karlugara, which runs from a large village, named Dasmatpur, and enters the Kolab or Saveri at a place called Bakderi. There is a good deal of rice cultivation here, dependent, as is generally the case in Jeypore, on the rains, and not on irrigation. Supplies are not procurable except in small quantities. In most villages, however, a little rice and dry grain, "biri," can be got.

14. *Sântepût to Râmgir, 11-00 miles.* Direction W. and a little North. The road passes for the first 2½ miles through rice fields, on each side of which is tall Sâl forest, to a village named Mûdalwâlî containing, about 20 houses. Thence on to Râmgir there is not a village to be seen, nor a drop of water to be got, the road lying through tall Sâl forest the whole way. The track is however broad and well cleared. Râmgir, the chief place of the District named after it, is situated on gently rising ground, and contains 50 or 60 houses, almost all of bamboo matting plastered over with mud, and thatched with grass. What is called the Fort is merely a rather large mud building, in which the head man lives. There is a broad sheet of cultivation in front of the village, which is irrigated from a large tank to the South—there is a small tank for drinking water rather nearer, between which and the village are some young mango groves. There is a road from Râmgir to Bustar passing through Bâkdâri. Supplies and coolies are procurable, but neither are plentiful.

15. *Râmgir to bank of Kirchigâra near Kuttanâpâlî, 11-55 miles.* Direction South. Road winds through dense Sâl jungle, up to the top of the ghat, a distance of nearly seven miles. At about a mile from the ghat there is a cluster of small villages Phonaspût, Bezapodora, Raûhpût; here the ascent commences, it is slight, but the ground is broken. Around these villages there is a good deal of rice cultivation. The descent beyond is very steep, and the road is bad, though practicable for laden cattle. The Sâl tree entirely ceases on the ghat, being replaced by bamboo jungle. Kuttanâpâlî is a large village containing about 40 houses, it is distant about one mile from the foot of the hills. The encamping ground is 1½ miles South of the village, on the left bank of a small stream called Kirchigâra, which, joining a larger, called Rôngapanî, enters the Savêri at Timispût. The water here was brackish, probably owing to its being stagnant, and only procurable from holes in the bed of the nullah. There is a good deal of cultivation about, generally of rice, but not irrigated. We got supplies and coolies here without difficulty.

16. *Mânjigûda, 11-46 miles.* Direction S. S. W. The Sâl tree, which had disappeared on and below the ghât, again reappeared close to our camp, and the road was again through Sâl forest all the way. For the first two miles it pursued a course nearly due East, to a large village called Bîmanâpâlî, situated under some low hills; it then turned round abruptly to the South. Two large nullahs are crossed, one the Rôngapanî, at 2 miles from Bîmanâpâlî, where its bed is about 40 yards broad, and very rocky, though not deep—the breadth of the stream being 10 paces, with a depth of a foot of water. The other nullah, the Gariagâra, is crossed near Mânjigûda; it is rather the larger of the two, its bed is broader and deeper, but contained less water; both would be very serious obstacles in the rains. The Rôngapanî is the boundary of the Râmgir and Malkagiri Districts; the village of Nanlipî, containing 20 or 30 houses, is on its South bank, surrounded by rice cultivation, as usual not irrigated. A rather smaller village, called Matolî, is passed "en route" about 2½ miles further on; from it there is a road to Jeypore, which is more direct than the Râmgir one, but being nearer the hills, is probably much more difficult. It passes through a village named Kolêr—said to be large. Mânjigûda is a small village containing 10 or 12 houses. We were encamped on the South side of the Gariagâra but the best ground is on the North bank. The water here is good.

17. *Mânjigûda to Kotameta, 8-41 miles.* Direction South West. For the first 3½ miles, the road passed through Sâl forest, but on reaching a rising ground, the Sâl suddenly disappeared, and the jungle became much lower and thinner, consisting principally of a tree called, in Uriah, "Saj" (Tel Jâbira.) One or two small villages were passed. Near one, called Salângûda, there was some rice cultivation. Kotameta is a very small village, containing only 3 or 4 log huts; nothing whatever was procurable here, but as there is no village on the road to Malkagiri within 10 miles, I was obliged to encamp here. The water is not very good, coming from a small nullah not running, but dammed up at every fifty yards, or so, and probably partly artificial.

18. *Kotameta to Malkagiri, 11-85 miles.* Direction S. W. After passing over about 4 miles of tolerably level ground, covered with jungle not very dense or tall, the road descends for a mile, and is rather steep and bad, passing through some low hills, the sides of which were covered with tall trees and bamboo jungle. After this descent the road became better, but the jungle was very dense for another five miles, as far as a small village called Sâmpakari, situated close under a range of hills. Here there is a rather large tank. From thence the route wound along under the hills for a mile or two, and then, crossing them through a low narrow pass, descended into the broad valley in which Malkagiri is situated. Water is only found in one place between Kotameta and Sâmpakari—about 9 miles from the former; it is however good, and is apparently stored up by a dam in the Satigâra, a small nullah which runs into the Potêru. Malkagiri is a large and important village, containing over 100 houses; it is the residence of a Rajah subordinate to the Jeypore Chief. It is situated at the head of a fine valley, in the re-entering angle of a range of hills, which rise 800 or 900 feet above the country, at the distance of about a mile. It is surrounded with cultivation, chiefly rice, has some fine mango groves, and is supplied with water from two tanks, of which the largest is South of the village, and appears to be natural. There is a route from this to Rajahmundry, passing through Kondahkuru, Darakonda, and Kôtalî in Rampalî, said to be impracticable for laden bullocks. From Darakonda there is a route to Guddam and Narsipatam.

19. *Malkagiri to Tsunkom, 18-71 miles.* Direction due West. Tsunkom is a large zemindari, on the right bank of the Savêri, in the Bustar territory. The road passes over an undulating country, covered with tall jungle; there is not a single village between Malkagiri and the river, a distance of 15 miles. On the bank of the Savêri the "Kâsi" tree grows to a great size. The River here is about 100 yards broad, from bank to bank, and is crossed by a ford, water scarcely knee deep, near a village named Tsupatanah; it is fordable however in but

few places, and only in the dry season. "Old Tsunkom" is situated five miles lower down, but is now almost deserted, and contains but one small hut. The present village is in two portions, about  $\frac{3}{4}$  mile apart, each containing 50 or 60 houses: between them is a large natural tank. Thence there are roads to Bastar, Chintalaár, Beji, and Dumogúdam—one also to Dantiváran used by the Brinjaries going to Malkagiri, and thence to Cocanada, viâ Môt and Rákapi. The upper classes are Telugu, but the common people are Koels, who speak a language called "Ulevi." Supplies and coolies were willingly furnished here. There is a good encamping ground near the tank, with several mango groves around.

20. *Tsunkom to Jirapili, 10.49 miles.* Direction South East. For the first 7 miles, as far as Rámáram, a rather large village in the Tsunkom District, the road follows the course of the Saveri, at a distance of about a mile from its bank, and is generally good, except in one place where it passes through a low rocky range of hills. At Rámáram we crossed the river, which is not fordable, by a raft similar to the one already described at Kottah. The rest of the march was along the left bank. The bed of the river at Rámáram is very broad, and covered with large rocks: there are rapids the whole way from Tsunkom. The country throughout the march was, as usual, covered with dense jungle. Near Góngel, a village 2 miles from Tsunkom, there were a few teak trees, but very small, stunted, and worthless as timber. Palmyra trees are common now about the villages. Jirapili is a very small village containing only two or three wretched log huts—it is close to the river.

21. *Jirapili to Pórch, 8.90 miles.* Direction South. Road fair, through tall jungle all the way; one low range of hills is crossed. Only two small villages, Pegarapili and Chingagúdam were passed. Pórch, called also Porwah, is a large village, in the Malkagiri District, situated a few miles west of a long low range of hills, and about  $1\frac{1}{2}$  miles distant (east) from the Saveri. It is supplied with water from two tanks north of the village. The inhabitants are all Telugu. Supplies and coolies were procurable. I met here a Soucar from Yeragúdam, a village near Rajahmundry in the Ellore District, who had come to receive money lent by him to the village; he had also brought with him a little merchandise in the shape of cotton cloths.

22. *Pórch to Murwápili, 18.04 miles.* The direct distance is about 10 miles—direction S. E. By a mistake of the guide a considerable circuit was made, for we went along the Môt road for about 9 miles as far as a small village named Kúrti, and there finding out our error, turned back to Murwápili, by a more village track. As far as Kúrti the road was good, though circuitous, and for a considerable distance from Pórch the country was cleared and cultivated. Kúrti is a small village, on the bank of the Saveri, containing 4 or 5 houses. I noticed some rapids in the river a little above. The path from Kúrti to Murwápili was bad, passing between some low hills. Murwápili is a small village, containing 10 log huts; water comes from the Potéru, a rather large nullah which joins the Saveri 5 or 6 miles below Kúrti. At this season (April) there was very little water in it, and that stagnant and brackish. The nullah bed is fifty or sixty yards broad and very stony.

23. *Murwápili to Tárowah, 10.63 miles.* Direction S. E. The road first crosses the Potéru, and then traverses a wild jungle country to Pináibai, a small village on the left bank of the Potéru, containing about 10 log houses, thatched with grass. It is about 7 miles from Murwápili; there is no other village between them. There is a good deal of dry cultivation, chiefly jowar—the water here is indifferent. Tárowah or Tarnowat contains about 15 houses, is situated on rather high ground under a low hill covered with scrub jungle, has good water, but no supplies.

24. *Tárowah to Pettah, 7.11 miles.* Direction S. W. The road makes direct for two low hills about 3 miles distant, between which it passes, with a slight ascent over broken ground. Thence to Pettah the road is good, crossing one rather large dry sandy nullah. Country covered with jungle all the way, dense but not tall. Pettah is a very small village containing four or five houses, log and thatch, on the edge of the Saveri, which here has a much narrower bed, barely 50 yards wide, and has scarcely any current, being a succession of deep pools, separated by rocks dipping at a very high angle. The villagers make a neat kind of grass mat; nothing in the shape of supplies can be got here.

25. *Pettah to Môt, 8.67 miles.* Direction S. S. W. The route follows the course of the river the greater part of the way; the first two miles are through jungle, but the remainder is tolerably open. Two villages are passed, one very small, called Múrigúdam, about 2 miles from Pettah, and the second named Tuipáram, situated at a sudden turn in the Saveri, about 5 miles from Pettah, and containing about 15 houses. Several small watercourses are crossed, but none of any size. Around Tuipáram there is a great deal of cultivation, rice chiefly. Môt, though a small village, is rather important from its position. It is the last village in the Jeypore territory, and is situated between the rivers Saveri and Siléru, about 1 mile from their junction. A market is held here weekly (?) which appears to be attended from considerable distances, as I met some villagers in their way to it with rice from a village several miles North of Malkagiri. The Brinjaries pass through on their way to Cocanada, and hence routes diverge to Dumogúdam and Bhadrachellum, and to Beji; there is also a route into Rampah, passing through a village named Lakwaram (Rákapi District) and crossing a very steep ghát said to be impracticable for laden cattle. The river Saveri is here very broad, probably 200 yards from bank to bank, and is at this season fordable, being about 4 feet deep; its banks are 30 feet in height. About the village there is a considerable patch of cultivation on which jowar is raised. Supplies are procurable to a small extent, but coolies are scarce, the few I required, only five, were obtained with difficulty, and after much delay. Throughout the Malkagiri District, although I was everywhere treated with civility, the Rajah's authority appeared to be somewhat limited.

26. *Môt to Ulanáru, 10.95 miles.* Direction a little West of South. We crossed

the Silern in a Catamaran near its junction with the Saveri; there was a ford, but passable for elephants only, being about 5 feet deep. An island has been formed here; the deeper of the two channels is on the right bank, but is only 20 to 30 yards broad. The breadth of the bed from bank to bank measured 200 yards. The current is strong, running at least 4 miles an hour. Immediately across is a large village called Kiler, between which and Ulumuru there are several large villages. The river formed by the junction of the Saveri and the Silern is known as the Saveri; we followed its left bank, down to its junction with the Godaveri. Several large and deep ravines were crossed, two only contained water. The largest, called the Sokaluru, runs from a considerable distance in the hills past a large village called Lakwaram; its bed when crossed was about 20 yards broad, and banks 30 feet high. It enters the Saveri beside a village called Mukunur. The other stream runs into the Saveri a little above the former, and is much smaller, but had very steep banks. Neither contained more than a few inches of water. Ulumuru contains about 30 houses, built in one long street along the river bank, which is here more than 40 feet high. There are several other large villages near one; Kodur is about 1 mile to East. Supplies and coolies are easily procurable. East of, and about 7 miles distant is a high hill, part of the main range called Bandard; Durgam; there is said to be an old fort on the summit. Immediately opposite to Ulumuru is a rather high range here known as Kottalghatu: this name is however not general. The best known peak, though not the highest, is about 7 miles to the S. W., and called Manchellam Konda. The Saveri is 300 to 400 yards in breadth, bank to bank.

27. *Ulumuru to Rakapili, 11.74 miles.* Direction nearly South. For the first six miles the path lies along the Saveri, passing through several large villages, and over open country extensively cultivated with jowar. At a village named Raigadam the road leaves the river bank, and traverses a jungly country to Rakapili, passing through two small villages Patipuka and Gundugadam. Between them and Rakapili, for a distance of 4 miles there is not a drop of water to be got. Rakapili is a large village containing over a 100 houses, chiefly of bamboo matting, a few of mud and all thatched with grass. It is surrounded on all sides with jungle, and there is no cultivation to be seen near the village. It is situated a little North west of a prominent conical peak called Kookonda, and is about  $1\frac{1}{2}$  miles from the junction of the Godaveri and Saveri. It is the chief place in the Rakapili District, which is a zamindari under the control of the Deputy Commissioner of Sironcha. Water is supplied here from two tanks on opposite sides of the village, and is not good. The Brinjaries come down by this place in tolerable numbers on their way to Cocanada, bringing grain which they exchange for salt. There are two roads to Rajahmundry, along either bank of the Godaveri, both said to be very hilly and bad, especially that on the left bank.

28. *Rakapili to Kasaram, 10.10 miles.* Due West. Until close to the Saveri, the road was through dense jungle, but south of the road, in the direction of a large village called Wudugadam, there was a great deal of cultivation. The Saveri is crossed just above its junction with the Godaveri, opposite to Konarem. At this season (April) the river is fordable, about  $3\frac{1}{2}$  feet deep; my baggage however crossed in catamarans. The banks are at least 40 feet high and  $\frac{1}{2}$  mile apart, the breadth of the stream was however only 110 or 120 yards. The road up and down the banks is steep and bad. Konarem is a large village situated at the salient angle between the Saveri and Godaveri; to the North on a low hill, is a small paka temple. Immediately opposite Konarem on the right bank of the Godaveri is a large place named Andram Kottah. From Konarem to Kasaram the road is along the left bank of the Godaveri the whole way, generally a few hundred yards distant from it, except in one place, where it passes round a low hill, descending into the river bed. There are several large villages on the route, and the country is open and cultivated for a mile or more from the river. Jowar, a little oil, cotton and tobacco are almost the only articles of produce. Kasaram consists of two villages  $\frac{1}{2}$  of a mile apart, situated on rather high ground, 100 feet or more above the river. Coolies and supplies are procurable here.

29. *Kasaram to Nellipaka, 15.32 miles.* Direction West and a little North. The first two miles were rather jungly, but thence to a large village named Kompella, 4 miles on, the country was open, and similar to that passed over on the preceding march. The road is good, but repeatedly obstructed by large deep ravines, which though generally dry, and extending probably but a short distance into the country, are very troublesome. From Kompella to Nellipaka there are two roads; one, winding along the river's bank, crosses a little stony ridge between the villages of Gogupaka and Devuripili and is rather circuitous; the other road is more direct, and avoids the ridge, and is the better of the two, but passes only one village. Both roads are rather jungly, except near Nellipaka where the country is open. The villages along this march are built, like those before described on the Saveri, in one long street overlooking the river. The houses are generally of bamboo mats and thatched. Nellipaka is a large village situated on high ground nearly half a mile from the river. A number of spacious sheds, of bamboo frame-work, covered with grass, have been built here for the coolies employed on the Godaveri works. A trainway from Dumogadam strikes the river, at the neighbouring village of Golagadam.

30. *Nellipaka to Bhadrachellum, 8.66 miles.* Direction West and little North. The road is good the whole way, and the country open and tolerably free from jungle. A few villages are passed, two large ones close together, called Pimpili and Gundalla, situated near the river. Bhadrachellum is not a very large place, but is well built, containing several paka houses, and two or three temples on a small hill in the middle of the town. There is a police station, and a post office in charge of the Police. A large canal is in course of construction, which commences at Dumogadam, where an aqueduct is being built, and enters the Godaveri a short distance below Bhadrachellum. This will turn what is called the 1st barrier of the Godaveri. The river opposite here is fordable now (April.)



31. *Bhadrachellum to Ellore, 77 miles.* There is a good bandy road the whole way. The marches are Pogalapali 8 miles, Kōi Gangāram 10 miles, Jaggāvaram 9 miles, Mustimanda 10 miles, Chintalapūdi 12 miles, Durmajegūdān 14, and Ellore 14 miles. At the first four, which are in the Hyderabad territory, the water is not good, the villages are very small, and no supplies procurable. The other two are in the Godaveri District, and are large villages.

JAMES P. BASEVI, CAPTAIN R. E.  
 1st Asst. G. T. Survey of India,  
 In charge Coast Series.

## GENERAL REMARKS.

The country visited on this tour is divided naturally into two districts. *First*, the hilly tract between the Vizianagram plain, and the low country of Jeypore, comprising parts of the Pauchpentak estate, and of the Nandapur district of Jeypore; and *Secondly*, the plain country containing Jeypore proper, the Districts of Rāmgir and Malkagiri, and parts of the Rākapili and Bhadrachellum Zemindāries.

2. The first consists of an elevated plateau, about 40 miles in breadth, separated from the populous districts of the coast by a range of hills, which extend in a direction generally parallel to the Coast line, from a considerable distance Northwards, down to the Godaveri. The higher peaks of this range reach an elevation of more than 5000 feet above the sea; the Eastern and Western slopes are clothed with tall tree jungle, while the bamboo grows luxuriantly in the valleys. This range forms as it were the backbone of the country, all the drainage on the East side being carried off into the sea, by numerous nullahs between Calingapatam and Cocanada, while the drainage to the West falls into the Godaveri, either by the Indrawati, or by the Saveri and Sileru rivers. The course followed by the new road from Vizagapatam to Jeypore, crosses one of the highest parts of this range, where it is known as Galikonda or Gāliparvatham, meaning the "Hill of the Winds;" the highest peak is, by Trigonometrical measurement, 5398 feet above the sea. West of the Galikonda hills, which rise above it like a wall, is the plateau above mentioned, itself 3000 feet above the sea, with a slight fall to the North West. The country is open, rather populous, the villages being numerous, though small, and tolerably well cultivated; but owing to the red color of the soil, it has a desolate appearance. High hills do occasionally rise up in it, but usually the hills are little above the general level, having a rounded outline, and being frequently covered with low jungle. The valleys, when not cultivated, are covered with long grass and dwarf date. Jowar is the cereal chiefly grown; rice is also raised, generally in the beds of the smaller water courses, which are widened and terraced for the purpose. Near the ghāts leading into the low country, the valleys are much narrower and the hills higher and more thickly wooded, but the plateau generally is very bare of trees; mango trees are most rare, the tamarind is a little more common, and on the hill sides near villages there are often a few sago palms. Some of the principal villages are Mūlagada, Arukū where a Deputy Magistrate is stationed, Auwaradah, Wāudragedda, Sōzaru, and Nandapur, said to be as large as Jeypore. The houses are built chiefly of mud, or of brushwood plastered over with mud; they are invariably thatched with grass. The people are Uriahs, and are strong and muscular, but not tall. They appear well off.

3. The lowlands of Jeypore, which are separated from the coast by the elevated plateau above mentioned, and further South, by the hill districts of Goldgonda or Gūddam, and Rampal, are divided into two parts by a range of hills running East and West from the main range; which extends across the Savēri, and is known by the Bustar people as the Toolsee Dūngri; its highest peak is 4,188 feet above the sea. These plains extend northwards to the Indrawati, and westwards to Bustar, comprising the districts of Koteṛāl, Jeypore proper, and part of Rāmgir, the average elevation being about 2000 feet above the sea; the immediate vicinity of the Indrawati is said to be very fertile, but the rest is a perfect wilderness, having an undulating surface, covered with tall dense jungle. For several marches North and South of Rāmgir, our road lay through tall Sāl forest, through which the sun scarcely penetrates. There is a very abrupt descent of nearly 1200 feet from the plains North of the Toolsee Dūngri to the Southern plains; the latter are of vast extent, 100 miles in length, and 30 in breadth, having a south westerly direction, and sloping from a height of more than 800 feet (above the sea) under the ghāts, to a height of about 320 feet at the Godaveri. They comprise part of Rāmgir and the Malkagiri Districts lying between the Savēri and Silēru, the Tsūnokom and Beji Districts, on the West of the Silēru, and South of these, the Districts of Rākapili and Bhadrachellum. The river Savēri runs through the plain, forming the boundary of the Jeypore and Bustar territories, save between the Toolsee Dūngri hills and the river, where a small tract is under Rāmgir. The whole country is undulating and covered with dense jungle. Near Malkagiri it is hilly, where an off-shoot from the main range juts out into the plains; there is also rather a high range of hills in the Rākapili district, West of the Savēri. On both banks of the river in the Rākapili district, and along the Godaveri, villages are numerous, but with this exception the whole low country, from Jeypore to the Godaveri, is very thinly populated, the villages small, far apart and of the most wretched description. The houses are built of bamboo matting often plastered with mud, or of logs, and always thatched with grass. In the Jeypore and Rāmgir districts the people are Uriahs, in the hilly country about Malkagiri, Gonds, and

South of that, Telugu. They are generally miserably poor, and wear a minimum of clothing. They are much given to drinking a liquor made from the Mhowa berry; at more than one village a sober man could not be got to answer questions; this was at the end of March when the Mhowa berry ripens. The people have no idea of distance; they can only say that the sun will be at such a height on arrival at a place; consequently it is not easy to obtain information about places off the road. Weekly markets are held at many of the principal villages, generally in a neighbouring mango tope; rice, liquor, tobacco &c. are the staple articles of commerce. Rice, and a kind of vetch called "Biri," are chiefly cultivated; they are grown in hollows between the low ridges, often at considerable distances from the villages, the crops being generally dependent on the rains, very rarely on irrigation. In the Southern part of the Malkagiri district, and throughout Rákapiñi and Bhadrachellum, jowar is chiefly grown, and but little rice; the rice for the coolies employed on the Godaveri works is brought from Ellore. Supplies consequently are very scarce. In most of the villages, a little rice, and biri grain, can be got, and the people keep a few fowls, but there are no sheep, and scarcely any goats in the country; any large party travelling through would be obliged to make its own commissariat arrangements. Carriage is not easily procurable, if at all—the people keep a good many bullocks and buffaloes, but are averse to their being hired, and do not appear to use them themselves for purposes of carriage. No cart of any description is to be seen in the country, indeed the roads are quite unsuited to them. There are no Komtis (bunneahs) between Jeypore and Bhadrachellum. The principal villages in the country are, to the North of Jeypore, Kotepid and Nowrangpur, and South of it, Rangir, Malkagiri, Poreh; on the west of the Savéri, Tsúnkóm, Beji; and near the Godaveri, Rákapiñi and Bhadrachellum.

4. The principal rivers are the Savéri and Siléru, which drain the whole country. The Savéri, called by the Uriahs "Koláb," has one of its main sources near Pádawal, and after receiving several feeders from Sôgoru, Naudapur &c., descends into the plains at Kottah, where it is a large stream averaging 80 yards in width and from 3 to 4 feet in depth (in the month of March.) From Kottah, it follows a northwesterly course to a place called Bákderigarli where it is joined by a small nullah called the Kúrlugára. Thence its course is Southwesterly, and after being joined by another stream called the Supnéru, it runs through the hills into the low country. At a village called Timispüt it is joined by a considerable stream called the Rôngapani, and a little lower down, at Sálmi, by the Garin-Gara. In March these streams contain barely a foot of water; their beds are from 40 to 50 yards broad and generally deep. Between Sálmi and the junction with the Siléru, a little below Môat, there is but one affluent worthy of mention, viz, the Potéru, which enters a few miles above Pottah; the bed of this stream was nearly dry in March. From Tsúnkóm downwards the river has a considerable volume of water, averaging 100 yards in width, the depth in midstream exceeding 6 feet. Its bed is much interrupted with large rocks, and parts are successions of deep pools connected by narrow rapids. Near Jirapili the river had quite an English look from the willow trees that grew along its edge. A little below Môat it is joined by the Siléru, a river of nearly if not quite equal size, which rises at the back of the Gálikoná hills, and flows through the Aruku valley, and afterwards past the villages of Ichurdeh, Auwaradah and Kondahkamra. Soon after its confluence with the Siléru the Savéri widens out, its breadth averaging 200 yards, with very high banks, which, at Ulumuru, are as much as 50 feet above the river. One more large nullah joins it, namely, the Sokaléru, which runs in at Múkonúr. The Savéri enters the Godaveri at Konárem, immediately opposite to Rudramkollah, in the Hyderabad territory. In the upper country between Kottah and the hills, the stream is sluggish, but between Tsúnkóm and the Godaveri, the river falls nearly 450 feet. Nearly the whole of this fall occurs in the first fifty miles between Tsúnkóm and Pottah. The river falls 100 feet between Tsúnkóm and Jirapili, a distance of not more than 14 miles. Its bed at Rámurám, which is very broad, (8 miles above Jirapili) is covered with large rocks often piled up one above another. In the month of March the river was low, but the sound of it could be heard all along the road from Tsúnkóm; during the rains it must be a torrent. Below Pottah its velocity does not exceed 3½ miles an hour, the fall is something less than 9 inches per mile, but the bed is much obstructed with rocks. The temperature of the water is very high. I measured it at three places, at sunset, in mid-stream, viz at Jirapili, 88°, Môat, 89°, and at Ulumuru below the junction of the Siléru 90·5°.

5. The principal forest trees are the Sál, Kúsm, and Sáj; the first is so well known that any description is unnecessary; it grows to a large size in the northern districts of Jeypore, but ceases abruptly a few miles below the Kattenapali Ghat, and is not subsequently found in the low country. The "Kúsm" (Uriah) is a very handsome tree, the leaf is natinate, something like a chestnut, and when young is of a red color; the tree bears a nut which I believe is eaten; the wood is exceedingly hard—it abounds chiefly in the Malkagiri District. The Sáj (Uriah) in Telugu Jabira, is a useful tree, and very common all over the country, attaining occasionally a considerable size; it bears a nut used by the natives in dyeing—the wood is good, and large quantities are yearly floated down the Savéri. The timber is dragged to the river's edge by bullocks, and then collected, and made into rafts ready for the freshes. Above Môat I saw no timber rafts on the river, nor any tracks through the jungles, so that it is very probable that the Sál forests are quite untouched. The teak tree may be said to exist, and no more; the few specimens seen near Tsúnkóm and Kúrti and Murwánili were very small and stunted, and quite valueless. At a place called Akúra, about 14 miles North of Malkagiri, I was told that there were trees, but these also from the description were of no better quality. The Mhowa tree is common, especially in the Northern part of Jeypore, where it appears to grow wild; further South it is less common and is evidently planted. It bears a small white berry, from which the natives extract an intoxicating beverage of which they are very fond; its wood is good, but rarely used, the tree being too valuable to be cut down.—The Palmyra is tolerably plentiful from Malkagiri southwards, but is not found above the Kattenapali ghat. The mango and tramariud

are grown about the villages; the former in particular is cultivated with considerable care. The bamboo is found chiefly on the hill sides, and on the banks of the ravines, and nullahs—it does not attain to any size in the low country. There are of course numerous other trees and shrubs, for instance the “ Dhak ” is common in the jungles, the Pipal and Baian are occasionally seen; but the above are the principal trees, which I was able to get the names of, or recognize.

6. I cannot pretend to describe the geological character of the country, as my knowledge of the subject is very slight. The main range is generally granite, and either granite or gneiss is the rock principally met with. Quartz rock is abundant and I saw occasionally schistose rocks. On the elevated plateau between Galikonda and the Pettah ghat there is a good deal of laterite. The soil in the upper portion of the Jeypore plain is rather black, but further South it is of a reddish color. I saw no black cotton soil until near the Godaveri.

JAMES P. BASEVI, *Captain R. E.*,  
*1st Asst. G. T. Survey*  
In charge Coast Series.

DEDUCTION OF THE LATITUDE OF JEYPORE, (LT. SMITH'S BUNGALOW,) IN MARCH 1863.

Instrument	No. of Observations	Date	Star observed	Sidereal Time	Observed Altitude	Refraction	Reduction	Corrected Altitude	Zenith Distance	Stars Declination	Latitude	Remarks		
7 Inch Theodolite by Troughton and Simms.	2	8th March	Polaris	H. M. S. 6-42-9	19-3-41	-2-27	* -9-24	18-51-50			18-51-50	* By tables in Nautical Almanac.		
	2	9th "	"	6-46-50	19-1-58	-2-27	-7-40	18-51-51			18-51-51			
	2	10th "	"	6-54-0	18-59-27	-2-28	-5-2	18-51-57			18-51-57			
	2	11th "	"	6-48-15	19-1-32	-2-27	-7-10	18-51-55			18-51-55			
	1	12th "	Canopus	6-40-12	18-25-26	-2-31	+7-21	18-30-16	}	0' "	0' "		18-51-60	
	1	" "	"	6-46-5	18-20-20	-2-32	+12-31	18-30-19		71-29-42	S 52-37-42		18-51-62	
	2	13th "	Polaris		7-20-20	18-49-46	-2-28	+4-44	18-52-2					
											Mean.		18-51-56-7	

JAMES P. BASEVI, CAPTAIN R. E.,  
1st Asst. G. T. Survey.

DEDUCTION OF THE LONGITUDE

OF JEYPORE (LIEUT. SMITH'S BUNGALOW) BY CHRONOMETERS FROM NORTH END OF BASE.

60

Station.	Date 1863	Days and Decimal parts of a day.	Interval Days	McCABE, NO. 472.				Parkinson and Frodsham No. 3569.				Remarks
				Error	Difference	Correction for rate	Difference of Longitude	Error	Difference	Correction for rate	Difference of Longitude	
North end of Base	Febr. 4th	34.696		+ M S 13.47.5	M S 2.53.4	M S -0.11.0	M S 2.42.4	+ M S 84.49.5	M S 13.1.8	M S -10.13.0	M S 2.48.8	
	March 6th	66.345	31.649	16.40.9	2.51.7	-0.11.8	2.40.4	47.51.3	13.18.4	-10.32.4	2.46.0	
	" 9th	67.346	32.650	16.39.2	2.52.8	-0.11.7	2.41.1	48.7.9	13.36.8	-10.51.7	2.45.1	
Jeypore—	" 10th	68.344	33.648	16.40.3	2.52.5	-0.12.0	2.40.5	48.26.3	13.53.5	-11.10.9	2.42.6	
	" 11th	69.336	34.640	16.40.0	2.54.0	-0.12.4	2.41.6	48.48.0	14.10.4	-11.29.7	2.40.7	
Lt. Smith's	" 12th	70.308	35.612	16.41.5	2.55.3	-0.13.3	2.42.0	48.59.9	15.0.6	-12.18.5	2.42.1	
Bangalaw,	" 14th	72.827	38.131	16.42.8	2.55.8	-0.13.6	2.42.2	49.50.1	15.20.9	-12.37.9	2.43.0	
	" 15th	73.830	39.134	16.43.3	2.56.5	-0.13.9	2.42.6	50.10.4	15.40.8	-12.57.1	2.43.7	
	" 16th	74.821	40.125	16.44.0	2.57.5	-0.14.8	2.42.7	50.30.3	16.29.3	-13.46.6	2.42.7	
	" 19th	77.376	42.680	16.45.0				51.18.8				
				Mean				Mean				
				-2.41.72				-2.43.86				
				General mean, in time,				General mean, in time,				M S -2.42.79
				do.				do.				In arc -0° 40'.42"
				Longitude of North end of Base				Longitude of North end of Base				88.16.11
				Longitude of Jeypore,				Longitude of Jeypore,				82° 35'-29"

JAMES P. BANEVI, CAPTAIN R. E.,  
1st Asst. G. I. Survey.  
In charge Coast Series.

## MEMORANDUM OF ROUTE. 61

Marches. Names of Villages.	Miles	District	at 8-0 P. M.		Height above Sea	Remarks
			Barometer Mountain	Therm		
Kasipúrám,			29-759	83-0	251 feet	
Roywala,	9-08	Tàneh Pentah	27-334	78-5	2392 „	Ascend ghât—fair road.
Gálikonda.	5-96		25-954	81-5	4213 „	
Ábuka,	12-09		26-698	84-7	3156 „	Descend ghât—4 nullahs crossed.
Dúrbah,	6-84	Jeypore	27-116	85-3	3002 „	Large nullah crossed twice.
Padawah,	7-99	„	{ 27-166	90-5	2983 „	
Kamtór (small village),	6-40	„	{ at 2 P. M. 26-952	92-3	3202 „	
Sógarú,	6-58	„	26-991	92-5	3155 „	
Lamptrápít,	8-31	„	27-210	92-6	2914 „	
Pettah,	9-04	„	27-284	87-2	2832 „	Two nullahs crossed.
Kottah,	5-02	„	28-108	97-5	2006 „	Descend ghât—read bad.
JEYPORE,	7-01	„	27-990	91-7	2019 „	Cross Koláb or Savéri.
Gosella,	7-15	„	28-170	92-7	1836 „	Cross nullah and Kolab.
Sónlepút,	9-28	Rámگیر	28-072	92-5	1928 „	Cross small nullah Kúrlugára.
Rámگیر,	11-00	„	28-028	81-6	1957 „	
Nr. Kottenapali,	11-55	„	29-198	91-3	774 „	Descend steep ghât—bad road.
Manjigúda,	11-46	Malkagiri	29-234	100-2	750 „	Cross Rougapani and Gariagara.
Kotameta (small village),	8-41	„	29-102	97-0	842 „	
Malkagiri,	14-86	„	29-336	91-7	669 „	Rather bad road
Tsunkom,	18-71	{ Bustar Tsun- kom	29-257	91-5	758 „	Cross Savéri—ford.
Jirapili (small village),	10-49	Malkagiri	29-390	100-1	595 „	do. ... boat.
Póreh,	8-90	„	29-464	94-0	619 „	
Múrwapili,	17-04	„	29-550	98-0	412 „	
Tarowah,	10-63	„	29-492	102-5	499 „	Cross Potora—nearly dry.
Pettah,	7-11	„	29-602	101-1	954 „	
Móat,	8-67	„	29-590	99-5	382 „	
Ulúmúru,	10-98	Rákapili	29-670	102-2	305 „	Cross Siléru—boat.
Rakapili,	11-74	„	29-650	100-6	327 „	
Kasuram,	10-10	„	29-652	104-5	+ 327 „	Cross Savéri—boat and ford.
Nollipáka,	15-32	Bhadrachellum	*	103-2	+ 345 „	* Barometer injured.
Bhadrachellum,	8-65	„		101-4	268 „	+ By aneroid—Stn. about 40 feet above the river.
South end of Base,			29-724	81-5	* 311	* By Spirit Leveling.

Note. Captain R. E., in his report on the route from Madagala to Jeypore gives the heights of ( Sogara 2300 feet ) but does not state how they are obtained. ( Jeypore 1533 „ )

JAMES P. BASEVI, CAPTAIN R. E.,  
1st Asst. J. T. Survey of India,  
In charge Coast Series.

ABSTRACT OF OBSERVATIONS TAKEN AT LT. SMITH'S HOUSE AT JEYPORE FROM 9<sup>TH</sup> TO 19<sup>TH</sup> MARCH INCLUSIVE.

No. of Observations	Mean Time	Barometer	Thermr.	Remarks.
10	7-30 A. M.	28-039	74-7	Barometer in house near door but out of draught. Thermometer in verandah against S. wall.
12	10 A. M.	28-103	84-4	
9	Noon	28-078	89-6	
2	1-0 P. M.	27-992	93-0	
7	2-0 P. M.	28-030	90-7	
8	3-0 P. M.	27-990	91-7	
	5-0 P. M.	27-943	90-6	
1	8-0 P. M.	27-990	78-6	

JAMES P. BASEVI, CAPTAIN R. E.,  
*1st Asst. G. T. Survey of India,*  
 In charge Coast Series.



MEMORANDUM OF ROUTES,  
FROM NATIVE INFORMATION.

Village	District	Miles	Remarks.
<i>Tsunkom to Eustar</i>			
Sindigádi,	Tsunkom	12	These are all large villages; the road is said to be difficult between Umrigádi and Sindawára, where there is a steep ghát.
Umrigádi,	"	12	
Sindawára,	Bustar	12	
Maringa,	"	14	
Bustar,	"	10	

*Tsunkom to Bustar, 2nd, and better Route.*

Gologúdam,	Tsunkom		These are small villages, about 2 miles apart.
Múrtonda,	"		
Atkargúdam,	"		
Nénár,	"		
Góril,	"		
Kúnar,	"	12	The road is said to be better than the preceding one. Between Kimar and Katikalára-Garhi, [Katikalliah in Captain Stewart's map] there is a ghát.
Katikalára—Garhi	Bustar	12	
Pakunár,	"	8	
Chitapúram,	"		
Kurma,	"		
Rájúr,	"	12	
Tokapili,	"		
Sosanpili,	"		
Maringa,	"	12	
Bustar,	"	10	

*Tsunkom to Chintaluár.*

Pátungúdam,	Tsunkom		This road is evidently very circuitous, as Chintaluár cannot be more than 35 miles, as the crow flies. There is one ghát between Maukapili and Púrdim, and another between Arpúram and Gúmarsaki. A man unencumbered goes in three days. The road is said to be very jungly.
Sil azúdam,	"		
Túrapili,	"		
* Kúramarka,	"	12 or 13	
Maukapili,	"		
Púrdim,	"		
Pótel,	Khokonda	16	
Kúlári,	"		
Arpúram,	Chintaluár		
Gúmártáki,	"	8 or 9	
Bikrapili,	"		
Chintaluár,	"	10	

*Tsunkom to Dantiwára.*

* Kúramarka,	Tsunkom	12 or 13	There is said to be no ghát on this road.
Khokonda,	Khokonda	12	
Dantiwára,	Bustar	12	

Villages.	District	Miles	Remarks.
<i>Tsünhom to Dümogüdam</i>			
Gougel,	Tsünkom	2	The road is said to be good throughout and free from ghâts.
Rámárám,	"	5	
Kirapili,	"	6	
Pina Beji,	Beji	6	
Nagalgunda,	"	5	
Aragatta,	"	4	
Beji,	"	7	
Korásgüdam,	"	6	
Kantapúram,	"	6	
Rámárám,	"	6	
Chintagüpa,	Bhadrachellum	8	
Dümogüdam,	"	6	
<i>Ramaram to Chintalnár.</i>			
Golagüdam,	Tsunkom		Road said to be tolerably good; there is a ghât, between Wágarakonda, and Kotapili.
Ekarú,	"		
Quona Beji,	"	7	
Párlár,	Chintalnár		
Wágarakonda,	"	6	
Kotapili,	"	"	
Chintalnár,	"	14	
<i>Beji to Chintalnár.</i>			
Pámaru,	Beji		Villages all small—the largest, Korapili, containing only 8 houses.
Kórapili,	"		
Godetgüdam,	"		
Gámglowa,	Chintalnár		
Chintalnár,	"		
<i>Malkágiri to Rajahmundry.</i>			
Potru,	Malkágiri	10	Road described as very difficult. The Sileru is crossed at Koudahkamru. Between that place and Darakonda there is a steep Ghat. There is probably a second Ghat to be descended near Kólah, as that place is not more than 400 feet above the sea.
Koudahkamru,	Gúddum	10	
Darakonda,	"	16	
Gartern	"		
Bhinávaram,	"	20	
Kólah,	Rampah	10	
Gokuáram,	Godaveri		
Rajahmundry,	"	40	

ROUTE FROM MADAGULA (COMMONLY CALLED MADAGOLE) TO SOGARU, FROM REPORTS BY CAPTAIN VERTUE, R. E., AND MAJOR OWEN.

Villages	No. of Marches	Distance Miles.	Size of Village &c.	District	Remarks.
Madgula				Madagula	
Tatapari		5		"	Ghat, road very steep and stony, commences 1 1/2 miles beyond Takapati, resting and watering place 4 miles East of watershed.
Mabrapulalu		5	No village	"	3 miles West of watershed.
Minuagalur	1	7	9 huts.	"	
Tuapada		4	15 "	"	Paderu—large village (and police station) 2 miles to West (Dng. 80° from South.)
Ugampett	2	4 1/2	Rather large.	"	Road over a plain 1 to 2 miles broad, wet and dry cultivation, much long coarse grass, one large stream and 3 smaller nullahs crossed. Road through plain for 2 miles, afterwards through hills and jungly.
Tadupa		12	Not stated.	"	
Waudragedda	3	4	60 houses.	Jeypore	3 large stony water courses crossed—road through jungle and along hill sides.
Aucoradah or Auroda	4	7	Large	"	A small ghat crossed 2 miles from Wandragedda—road stony. Remainder good through plain.
Wontura		3	Small.	"	Pattalgedda (Sileru) crossed and Huringygedda.
Sogaru	5	7	60 houses.	"	Road good, over open ground.

JAMES P. BASEVI, CAPTAIN R. E.  
*1st Asst. G. T. Survey,*  
 In charge Coast Series.

Office of Superintendent G. T. Surbey,  
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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Captain Nasmyth, who was expected to reach Dehra about the 20th 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.

77  
No.  $\frac{51}{509}$  OF 1864.

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 *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.

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 Nepal; for, unfortunately, the Nepalese 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. BETERLEY, Esq.,  
Civil 2nd Assistant.  
Mr. L. H. CLARKE,  
Senior Sub-Assistant.  
Mr. C. J. NEUVILLE,  
Senior Sub-Assistant.

## TOPOGRAPHICAL.

*Military.*  
Cpt. H. H. GODWIN ATSTEN,  
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. REALL, 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 Yaghistan 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 Harimoshi range, and in the ranges beyond Hunza and Nugair. 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 11,000 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 Khagan. 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 Khagan was brought to a successful termination on two peaks north-east of the Loloosur Lake, and just to the south of Chitias. 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 Boonce, 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 Tagling-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 3,300 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 Jummoo 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 Karakoram 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 550 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. McGill 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. DONOHOE,  
3rd Class ditto.  
Mr. A. D. CHRISTIE,  
3rd Class ditto.

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

*Assistants.*  
None.

*Sub-Assistants.*  
Mr. A. DESOTZA,  
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. McGill 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. McGill commenced by breaking up the large triangles of the quadrilaterals Bhownuggur Palitana, and Palitana Itrin, 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 Anniadi Nall Baoli Anniadi, Siani-Siani, Rallol and Siani Jaunri. 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. McGill 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.†

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\* 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 Bhoj, a few years ago, and some masons', and other, tools. The steamer ultimately stranded at the mouth of the Taptee, 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 duty 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 Barasat, 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 shown 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. ROSSENRODE, Esq.,  
Civil Assistant.  
H. BEVELLEY, 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, Annatawaram-Gornatlar, 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 Rahoon 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° 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° 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 circum-polar 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, Peychers 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 Haori H. S. and marched for Haori 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 Haori 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 Haori, or Aouri.

"It is in the jungles in which the three last stations of the Gaourdhusa 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, Peychers 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 malfaria, though there is a good deal of forest and jungle.

**ASTRONOMICAL PARTIES.**  
No. 1.

*Executive Officer.*  
J. W. ARMSTRONG, Esq.,  
Civil Assistant.

*Sub-Assistant.*  
Mr. G. W. ATRINSON,  
2nd Class.

No. 2.

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

*Sub-Assistants.*  
Mr. J. WOOD,  
2nd Class.  
Mr. G. BELCHAM,  
3rd Class.

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.

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 Bhuorgara, 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 Kahumar 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. L. 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) Mily. Dept. Letter, No. 822, dated 23rd 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° 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 Delhra, 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,  
 HERRA 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 Joosee, 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 Scronj, 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 Sultanganje, 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. HERSCHEL, R.E.,  
1st Assistant,  
In Charge.

Baboo BHOLANATH MO-  
JUMDAR,  
Deputy Computer.

*Computers.*

Baboo CHEETER MULL,  
GUNGA PERSHAD,  
LUCKHYNARAIN GONO,  
GOPAL CHUNDER SIRCAR,  
KISTODHUN CHATTERJEE,  
TARAFODD MOOKERJEE,  
WODAY CHUNDER DEB.

63. During the past year Lieutenant John Herschel, whose scientific ac-quirements 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 expecta-tions, 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.

Dated 18th August, 1864.

"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 ability 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 Dahan, 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	...		
Azimuths 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	606		
" 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	7		
Area Topographically Surveyed, 1 mile to } 1 inch, . . . . .	...	...	...	...	...	333	333		
" Do., do., 4 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:—Koilesbar, Sarwa-Dharamnagar, Kamalpur, part of Asampara, part of Bamattia, Choraibari, Bisalgar, Udepur, (the former capital of Hill Tipperah, but now only a ruin), Billenia, Chaopar—(but, in reality, the people of this thana reside near Chaucham, 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, gámbàr, 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 palanquins 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; nágésri, sometimes called iron wood, owing to its excessive hardness; sisú, used for planks and posts; bándárlàti, 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; lohujori, 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-nda, harina-gokhur, sial-shuis, zahar-

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\* This fruit, found with a single natural line or streak on it, termed “ckmákh,” 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), kutchika, chawal-mugra, ghila, gaud-lhadra, zer-mul, tal-muli, indru-jao, isaph gele, topchini, bagdar, sukehini, and nirlis.

(7.) There are also wild vegetables, and some kinds of fruit in Hill Tipperah, viz. :—Thorai (Bengali katchu), tha (Bengali mukhi), thadák (Bengali gatch-ahu), thaktoi (Bengali mo-ahu), tha-bolong (Bengali jungly ahu), 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° 3' and longitude 91° 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° 9' and longitude 91° 36', and Tulamura H. S., in latitude 23° 11' and longitude 91° 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° 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, Totavam, 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,—Kaifeng, 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, Kháklo, Moiching, Kéma, 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 Jama-tias, 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 goboi; 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.	Height of Rails above Howrah Dock Sill.	DIFFERENCES.
		Railway Values.	G. T. Survey Values.	
	Miles from Calcutta.			
Serampore, . . . . .	13	36.40	32.552	+ 3.848
Pundooah, . . . . .	38 $\frac{1}{2}$	58.40	54.031	+ 4.369
Mymaree, . . . . .	51 $\frac{1}{2}$	82.97	78.330	+ 4.640
Burdwan, . . . . .	67 $\frac{1}{2}$	116.40	111.958	+ 4.442
Kanoo Junction, . . . . .	...	137.47	133.172	+ 4.298
Ghooshkarak, . . . . .	87 $\frac{1}{2}$	127.47	122.137	+ 5.333
Biddiah, . . . . .	94 $\frac{1}{2}$	149.47	143.903	+ 5.567
Bulpore, . . . . .	99 $\frac{1}{2}$	176.47	171.268	+ 5.202
Ahmudpore, . . . . .	111 $\frac{1}{2}$	148.47	145.846	+ 2.624
Synthea, . . . . .	119 $\frac{1}{2}$	185.47	179.963	+ 5.507
Mullarpore, . . . . .	129 $\frac{1}{2}$	159.77	155.342	+ 4.428
Rampore Haut, . . . . .	137	135.45	128.443	+ 7.007
Pakowr, . . . . .	169 $\frac{1}{2}$	121.47	116.025	+ 5.445
Teenpahar, . . . . .	196	121.39	115.412	+ 5.978
Colgong, . . . . .	246 $\frac{1}{2}$	135.39	130.050	+ 5.340
Ghoga, . . . . .	252 $\frac{1}{2}$	138.39	127.003	+ 11.387
Bhagulpore, . . . . .	265 $\frac{1}{2}$	163.39	155.336	+ 8.054
Sultanganje, . . . . .	280 $\frac{1}{2}$	141.39	135.387	+ 6.003
Burriarpore, . . . . .	291 $\frac{1}{2}$	139.51	138.094	+ 1.416
Monghyr, . . . . .	303	148.39	139.407	+ 8.983
Burrheca, . . . . .	336 $\frac{1}{2}$	165.39	159.917	+ 5.473
Mokamch, . . . . .	347 $\frac{1}{2}$	168.19	154.700	+ 13.490
Barr, . . . . .	363 $\frac{1}{2}$	172.99	161.375	+ 11.615
Bukturpore, . . . . .	374 $\frac{1}{2}$	177.09	168.792	+ 8.298
Puttooha, . . . . .	389 $\frac{1}{2}$	184.65	174.500	+ 10.150
Patna, . . . . .	396 $\frac{1}{2}$	188.99	183.372	+ 5.618
Bankipore, . . . . .	402 $\frac{1}{2}$	186.57	177.872	+ 8.698
Dinapore, . . . . .	408 $\frac{1}{2}$	194.51	184.407	+ 10.103
Bilta, . . . . .	419 $\frac{1}{2}$	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, . . . . .	433 $\frac{1}{2}$	208.37	200.294	+ 8.076
Beehea, . . . . .	446 $\frac{1}{2}$	224.37	214.528	+ 9.842
Deedunugger, . . . . .	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.

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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.
2 Copies.	Sheet No. 2 "Baltistan, or Little Tibet, with the adjacent districts of Ladak," 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, Diagram showing the order and arrangement of the sections for the new Kashmir Map, scale 32 miles = 1 inch, ...	Do.
Original & Copy.	Preliminary Chart of the Cherrapoonjee, Sylhet, and Cachar Series, ...	For Srvt. Genl's Office & Home Govt.
	Trace of Rahoon Series Chart, season 1861-62, scale 4 miles = 1 inch, Trace of ditto, 1860-61, ditto, ...	For the use of Gwalior Topl. Survey. Do.
2 Copies.	Section No. 7, new Kashmir Map, (for photography), ...	Copy for Surveyor General.
	Do. No. 8, do., do., ...	
2 Copies.	Chart of the Northern Trans-Indus Frontier Survey, season 1849-53, scale 4 miles = 1 inch, ...	For Home Government.
	Preliminary Chart of the Jogi Tila Meridional Series, season 1856-57, do. Section No. 9, new Kashmir Map, (for photography), ...	For the use of Gwalior Topl. Survey. } For Colonel Thuillier.
Extract from Calcutta and Great Longitudinal Series Chart, comprised between the Rahoon and Budhon Series (on vellum cloth), scale 4 miles = 1 inch, ...		
2 Copies.	Chart of a portion of the triangulation of the Northern Trans-Indus Frontier Survey, season 1849-53, scale 4 miles = 1 inch, ...	} Printing of names in progress.
	Sheet No. 3, (Jumoo territories), scale 2 miles = 1 inch, (for lithography), Sheet No. 2, do., do., ...	
2 Copies.	Sheet No. 1, do., do., ...	For Captain Montgomerie and Colonel Robinson.
	Section No. 4, new Kashmir map (for photography), ...	
Do.	Two Extracts from Major Walker's Triangulation Chart of the Northern Trans-Indus Frontier Survey, ...	For Home Government and Surveyor General. Do., do.
	Preliminary Chart of Minor Triangulation along the River Chenab, Sutlej Series, season 1861-62, scale 4 miles = 1 inch, ...	
2 Copies.	Do. Do. of the Rahoon Meridional Series, season 1862-63, scale 4 miles = 1 inch, ...	For Mr. Keelan and Mr. Shelverton.
	Two Extracts from Calcutta Longitudinal Series Chart (on vellum cloth), scale 4 miles = 1 inch, ...	
Do.	Sheet No. 4, (Jumoo territories), scale 2 miles = 1 inch, (for lithography), ...	Names to be printed. For the use of Computing Office.
	Made a reduction of Jogi Tili Chart, on the scale of 16 miles = 1 inch, Preliminary Chart of the Sutlej Series, season 1862-63, scale 4 miles = 1 inch, ...	
Do.	Do. of the Guzerat Const Minor Series, season 1862-63, scale 4 miles = 1 inch, ...	For Surveyor General and Home Government. Do., do.
	Do. of the Sutlej Series, seasons 1860-61 and 1861-62, scale 4 miles = 1 inch, ...	
2 Copies.	Do. of the Tiliial, Khagan, and Astor Triangulation, season 1861-62, scale 4 miles = 1 inch, ...	Do., do.
	Extract from the Skeleton Chart of the G. T. Survey of India, between the parallels of 16 and 22° and meridians of 78 and 80° (on vellum cloth), scale 32 miles = 1 inch, ...	
Do.	Preliminary Chart of the Eastern Frontier Series, scale 4 miles = 1 inch, Do. of the Kashmir Meridional Series, season 1861-62, scale 4 miles = 1 inch, ...	For Mr. Shelverton. For Srvt. Genl. and Home Govtmt. } For Srvt. Genl. and Office use, 3rd copy for Home Govt. (half finished). For Surveyor General.
	Two Copies of Synopsis of Heights, Sutlej Series, ...	
2 Copies.	Reduction of Rough Map of parts of the Bustar and Jeypoor territories on the scale of 8 miles = 1 inch, ...	Names to be printed.
	Section No. 3, new Kashmir Map, (for photography), ...	
2 Copies.	Preliminary Chart of the Jogi Tila Meridional Series, season 1856-57, scale 4 miles = 1 inch, ...	For Office use.
	Section No. 6, new Kashmir Map, (for photography), ...	
2 Copies.	Sheet No. 4, or Section No. 12, new Kashmir Map, for transmission to England, ...	Names to be printed. Half of outline & hill shading finished. Half of the printing finished. Do.
	Do., do., (for photography), ...	
2 Copies.	Section No. 5, new Kashmir Map, (for photography), ...	For Mr. Shelverton.
	Section No. 2, do., do., ...	
2 Copies.	Extract from Budhon Meridional Series Chart on the scale of 8 miles = 1 inch, ...	For Mr. Shelverton.
	Examinations of eighteen Preliminary Charts, ...	

W. H. SCOTT, Civil Assistant, G. T. Survey,  
In charge Drawing Office.