

REPORT

ON

THE TRANS-HIMALAYAN EXPLORATIONS

IN CONNECTION WITH THE

GREAT TRIGONOMETRICAL SURVEY OF INDIA,

DURING 1871.

DRAWN UP BY

MAJOR T. G. MONTGOMERIE, R.E.,

IN CHARGE TRANS-HIMALAYAN EXPLORING PARTIES.

OFFG. SUPERINTENDENT G. T. SURVEY.

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NO. XVI GEOGRAPHICAL.

TRANS-HIMALAYAN AND TRANS-FRONTIER EXPLORATIONS.

(112.) Explorations have been continued in various directions on our western, northern and north-eastern frontiers. On the whole great progress has been made and one continuous line of explorations beyond the frontier has been carried right round India. The route traversed, starting from Sindh, goes to Khelát in Belúchistán and thence by Kandahár to Kábul. From Kábul it crosses the Hindu Kush mountains to Badukshán and thence up the head waters of the Oxus and across the great Pámir Steppe to Káshgar and Yárkand in Eastern Turkestán. From Yárkand the explorations follow the route to the Kárákoram pass, and thence the connection is continued by the regular operations of this survey to the Pangong lake, and south to the Indus, where that river first enters Ladák near Demchok. From Demchok the line of the explorations is carried up the Indus and its large branch the Gartung-chu to Gartok and thence across the Kailás range to the Mánсарowar lake. From the Mánсарowar the line is continued across the Himalayas, then down the course of the great Nári-chu or Sang-po river (the Bráhmáputra) to Shigatze and thence to Lhása the capital of Great Tibet. This line with its branches is about 5,000 miles in length and is connected with British India by numerous cross lines, the details of which have from time to time been published in the reports of the Great Trigonometrical Survey. It must be remarked that these routes were all at great elevations above the sea, more than half being at over 12,000 feet, a fact which has of course added very much to the difficulties of exploration.

(113.) Very great progress has been made with a second line, inside the above line, in such places as it is required, the results of which will be published before long, though it is not convenient to do more than refer to it until the work is completed.

(114.) A commencement has been made with a third line of explorations exterior to the first line referred to, and at a very considerable distance beyond it; some progress has already been made with it, the first link being that from Yárkand to Khotan, determined by Mr. Johnson's exploration, and thence across the lofty Lingzitháng plateau to the Pangong lake. From the Pangong our explorers have extended the line by a traverse to Rudok, the capital of the Chinese districts of Pangong &c., and thence, over the very elevated plateaux north of the great Aling-Gangri peaks, to the Thok-Jálung gold field, passing through a succession

of gold and borax fields. From Thok-Jálung the line has been extended south-east through Májin to the Shellifuk lake, north-east of the Great Kailás Parbat over the most elevated plateaux in the world; the explorers having been for months at over 15,000 feet above the sea. This portion of the outer line is connected with the Mánсарowar lake. Farther extensions have been made to the west and north of Lhása, and I trust eventually that a junction will be effected between this and the portion near Shellifuk and thus open out a large portion of the geography of Central Tibet. On the west some extension has already been made with this outer line beyond the Oxus and I am hopeful that more will be forthcoming. In this report details are given with respect to one of the connecting lines between the inner and middle line of explorations, *viz.*, between Dárjiling and Shigatze in Great Tibet on the one side, and between Shigatze and Nepal on the other. These lines of exploration open out the geography of a very large tract of country as to which we previously had but the vaguest conjectural indications. The routes may be described as going right round the great Mount Everest, penetrating on the north, to the Sang-po or Bráhmáputra River and thence south-west over the well-known Tingri maidán, the most extensive plateau on the south of the Himalaya watershed that is drained by streams which flow direct into India.

(115.) From Tingri the line passes to the west of Mount Everest, and again connects with the work brought up from India.

(116.) The greater part of this work was done by one explorer; on a reference to the map it will be seen that his route for some distance corresponds at points with Doctor (Sir Wm.) Hooker's route west of Dárjiling, the new ground commencing from his most north-westerly points near the Wallanchun and Kanglachim passes, embraces a portion of the great eastern branch of the Arun river, then passes a large lake of which we had previously heard though its position has never, as far as I know, even been indicated on any map. The position of a number of peaks, north of those which are visible from the side of India, have been determined. The country has of course been crossed previously by the Ghurkas, Niwars and other natives of the adjacent countries, but as far as I know has never been even seen by an European. Amongst other places this route has fixed the position of the celebrated Sakya monastery second only to that of Tashi Lumbo. The route traversed is 844 miles in length of which 550 miles may be said to be over entirely new ground and the remainder, though close to a line which at least one European has gone along, has never been regularly surveyed before. This exploration with its bearings &c., opens out the geography of nearly 30,000 square miles of what has hitherto been all but *terra incognita*, it more especially elucidates the geography of the basin of the Arun or Arun Kosi river, the largest feeder of the great Kosi river, which drains the whole of Eastern Nepal. The courses of its upper feeders have been hitherto a puzzle to geographers.

(117.) The routes give an independent determination of the longitude of Shigatze and prove that the value which I adopted for that town, based on Turner's Route Survey, was a very close approximation. This point was fully discussed in my Trans-Himalayan report for 1865-67 on the Chief Pandit's exploration from the Mánсарowar lake to Lhása at page x, and it is gratifying to find that my reliance on Turner's work was not misplaced.

(118.) The explorer took latitude observations at 11 points upon which the work depends, and he determined the height of 31 places. His work has stood all the usual tests of comparison satisfactorily, and as it includes a considerable number of peaks &c., on both sides of his route: I think it will prove a valuable addition to the trans-frontier geography of India.

DEHRA DUN, }
November 1872. }

T. G. MONTGOMERIE, MAJOR R.E.,
Offg. Supdt. Great Trigonometrical Survey of India

Memorandum on the Trans-Himalayan Explorations for 1871, by Major T. G. MONTGOMERIE, R.E., Deputy Superintendent G. T. Survey, in charge of the Trans-Himalayan Exploring Parties.

The explorations which I have selected for this year's report have been made by explorer No. 9, during more than one expedition: it is not expedient to refer to him in any way that would lead to his identification, as any such indications are apt to be conveyed to frontier places, and in some cases have caused great inconvenience to the explorers by obliging them to start by out of the way routes &c., and occasionally have hindered them when far beyond the frontier by means of letters sent from our frontiers.

The explorer, for one portion of his work, made his way from Dárjiling, passing through Sikkim into Great Tibet; it is not however necessary to refer to his journey in detail until he got beyond what Sir William Hooker called the Wallangchoon pass, as up to that point Sir William has already given us an admirable description of the country.

The explorer, on trying to pass into Tibet, was as usual stopped and told that he would not be allowed to proceed farther, as he was not known to any one, nor able to give any satisfactory evidence as to his being what he stated. He was consequently rather in despair, but was fortunate enough to ingratiate himself with the chief official of a large Sikkim district whose wife happened to be very ill. I have always made my explorers take a supply of medicines with them, mostly of native kinds, with only a few ordinary European sorts to present to people on their journeys. In the present instance the explorer had also provided himself with a Hindi translation of a treatise as to using these drugs, and when he heard of the woman's illness he offered to give her some medicine if he was allowed to see her and hear as to her sufferings &c.; his offer was at once accepted and the explorer having seen her searched his book until he came across some disease with the same symptoms as she had and he then boldly prepared the medicines directed and gave them to the woman according to the instructions, and awaited the result in not a little trepidation. In a few days time the woman became wonderfully better and eventually a cure was effected very much to the astonishment of the amateur practitioner. The explorer was treated with marked kindness and hospitality from the day the woman began to improve; he then again urged his request to be allowed to pass into Tibet. The headman said he would be glad to give him permission but that it would be of no use as he would be again stopped by another official before he advanced very far unless he had some one to answer for him. The explorer however continued to urge his point and at last the official said he would himself be his security, and he finally sent one of his own men with the explorer who passed him through the places where he was likely to be stopped.

The explorer consequently marched on without any farther interruption, except the ordinary ones at custom houses, where his baggage was strictly searched; fortunately his instruments were so well concealed that they were never discovered.

From the Tipta-La—the Wallangchoon pass of Sir William Hooker, probably so named from the village south of it, which the explorer gives as Wallungsum—he made his way in two marches to Tashirak. The road was a difficult one, the ground north of the pass being very elevated and barren, so that both food and fuel had to be carried on yáks for the use of the party.

The Tipta-La was covered with snow; it is on the watershed of a very high range that runs nearly east and west forming the boundary between Nepal and Lhása.

Tashirak is a large standing Bhotia encampment on a feeder of the Arun river, which rises in a glacier to the west, and not on the main stream of that river as was formerly supposed; it is 15,000 feet above the sea. Marching north, the explorer crossed the Nila-La pass, and passing a large Láma monastery reached the Shara village of some 50 houses, which is under a Thánahdár of the Tinki or Tinka district, generally known as Tinkijong after its fort (jong). Here his baggage was very closely searched, and it was only by means of the man sent by the Sikkim official that he was able to advance farther. After many enquiries were made he got a pass to travel to Shigatze, and being fairly in Tibet he was never stopped again. He made his way first to Lámádong, a village of 50 or 60 houses, arriving there on the 4th September. Before reaching this place the explorer had latterly seen no cultivation except that of Indian-corn in small quantities, but at Lámádong itself there was a good deal of wheat and pease and round about several other villages could be seen equally well cultivated; all these villages were on or near the banks of the great eastern branch of the Arun river, called the Khantongiri river, which comes from the east.

The next day he arrived at another small village with plenty of cultivation, all tending to show that he had again reached a warmer climate, Lámádong being 13,100 feet above the sea.

On the 6th September he crossed the Tinki-La pass and after a trying march reached the village of Tasichirang on the bank of the Chomto Dong lake which is a fine sheet of water about 20 miles in length by 16 miles in breadth, at an elevation of 14,700 feet above the sea. This

A large Tibetan Lake.

lake has never been shown in any map that I am aware of, but we have notices of its existence in itineraries collected by Mr. Hodgson, Dr. Campbell, &c. The explorer found the water very clear and pure, and very good to drink: he and his party used it and were told that the inhabitants took it in preference to that of the two or three streams which were seen to run into the lake. The explorer was unable to go completely round it, but he could see it fully as he passed along its northern shore and yet could discover no signs of an outlet; the inhabitants declare that it has none: the sweetness of the water, however, is against there being no outlet and if so it must be somewhere to the south-east. The lake forms a portion of the boundary between Sikkim and the Lhása Territories. The Sikkim Territory lying to the east, that of Lhása to the west of the lake. Several very high snow peaks were visible from the lake to the east and south.

On the 7th September he arrived at Ningzi, a Sikkim village which, though it has but 50 houses, boasts of a wonderful number of dogs, the explorer declaring he himself saw at least 200, and was certain that he never met with such a large proportion in a Tibetan village where they are proverbially numerous.

On the 9th September he reached Chajong (or Tatápáni) hot springs where he took latitude and thermometer observations, the latter making it 15,000 feet above the sea. Four reservoirs, each about 30 feet in circumference and 3 feet deep, have been built to catch the water of these springs which appeared to be sulphurous and have a high reputation for their curative properties, being visited by numbers of people. The place swarmed with Tibetan (Hodgsonian) antelope which are quite tame being never disturbed, as they are considered to be dedicated to the deity of these hot springs. The next day the party encamped in a ravine and the day after crossed the Lagulung-La pass which has quantities of glacier ice close down to it, being itself 16,200 feet above the sea. This pass forms the boundary between Sikkim and Lhása, the march terminated at the village of Thak. On the 15th September he passed the village and part of Sai Jong which is surrounded by cultivation and has numerous other villages round about, encamped at Chota-Tápu or Darcha village on the banks of the Sai Jong stream, which comes from a great distance, rising in Sikkim. The next day crossed the Gyaling mountains by a pass covered with snow, and reached the Bálu Koti village of 20 houses; this place has a good deal of cultivation, and numerous other villages are visible round about it. Passing thence through a level and well cultivated country, the explorer reached Shigatze on the 17th of September.

The explorer paid the usual homage to the Láma of Tashi Lambo, making an offering of two rupees. He found the city of Shigatze in much the same state as described by the chief Pandit, he however heard of the serious rebellion which had been raised against the great Láma of Lhása in April 1871, during which hundreds of people were killed.

The explorer remained in Shigatze till the 29th of September, he then made his way south-westwards, towards the Dingri maidán, resuming his route survey on the 30th September from a point he had previously visited. By evening he reached the village of Shimrang and the next day crossed the Shabki-Chu river which was 65 paces wide and 4 feet deep, flowing down into the Sang-po (Bráhmáputra), numbers of villages were seen on and off the road. The harvest was being reaped.

On the 2nd of October he reached the great Shakia monastery (*Gonpa*) which is only second to that of Tashi Lambo. The explorer was unfortunately not able to stop at Shakia to examine the place more closely. He says the Shakia monastery is on a low spur, it is inhabited by about 2,500 monk Lámás ruled by a great Láma called Shakia-Gangma (king or above all others); he is looked upon as a diety. His Lámás are the only ones in this part of Tibet that are allowed to marry, they are called *Dhukpás*, other Lámás who are not allowed to marry being called *Gálupás*. The town of Shakia lies at the foot of the monastery and is about half the size of the city of Shigatze. About fifty of the shops in the town are kept by Niwars from Nepal, all the other shops are kept by Bhotias. There is a large amount of cultivation around Shakia though it is about 13,900 feet above the sea.

On the 3rd of October the explorer crossed the Dongo-La feet above sea, and again got into ground drained by the Arun river, and on the 5th October reached the Chokuar village, on the left bank of the Phungtu or Dingri-Chu river, the great western branch of the Arun river.

Continuing westwards along the Dingri-Chu river, the explorer reached the Sakar-Chu river a branch of the Dingri-Chu. The Sakar-jong (fort) is about 8 miles north of the junction, and is the residence of a Lhása magistrate. The Ghurkas in 1854 advanced as far as this point when they invaded Tibet.

On the 8th of October the explorer reached the town of Dingri which is generally known as Dingri Maidán from the large open plain in which it stands, it is also sometimes called Dingri-Ganga. The town has but 250 houses supplemented with tents on occasions of fairs &c., it is 13,900 feet above the sea.

Five miles above the junction of the Shakar-Chu river, the explorer crossed the Dingri-Chu river by a wooden bridge 75 paces in length. Showing that even at that point this great eastern branch of the Arun is a very large stream as might be expected from its draining the great Dingri table-land.

North and quite close to the Dingri town stands the Dingri Khar (fort) on a low isolated hill. A high Chinese officer called a *Daipon* who is the chief military and civil officer, resides in the fort, he has a small garrison of Bhotia soldiers with but one gun.

From Dingri there is a very good road which runs north-east to Jong-ka-Jong and thence by Kirong town to Katmádu. Officials are however the only persons who are allowed to travel by this route, traders and all others taking the one followed by the explorer to Nilam, &c.

The explorer did not make any stay in Dingri, being afraid that he might be cut off from India by an early fall of snow, he accordingly pushed on as fast as he could. At first he passed through a wide all but level tract, and then getting into rougher ground reached the Thung-lung-La on the 10th of October; he found the pass covered with old ice and snow, it being 18,460 feet above the sea.

On the 11th October he reached the town of Nilam 13,900 feet above the sea which has about 250 houses. It is ruled by a couple of *Jongpons*, the Lhása Government sending two there so as to be a check on one another. Nilam being the first Tibetan town on the road from Nepal, is considered to demand extra vigilance and consequently the explorer and his party were very closely examined and their baggage was carefully searched before they were allowed to go on.

From Shigatze to the Thung-lung-La pass, the explorer had passed through a moderately level tract though at a very great elevation, but from the Thung-lung-La, where he crossed the Himalayan watershed he again entered on very rugged ground much more difficult than even that south of the Tipta-La (or Wallungsum pass).

Between Nilam and Listi Bhansár he followed the general course of the Bhotia-Kosi river, and though it is but some 25 miles direct distance between the two places, the explorer had to cross the Bhotia-Kosi river 15 times by means of 3 iron suspension, and 11 wooden bridges each of from 24 to 60 paces in length. At one place the river ran in a gigantic chasm the sides of which were so close to one another, that a bridge of 24 paces was sufficient to span it. This was just below or south of the village of Choksum. Near this bridge the precipices were so impracticable that the path had of necessity to be supported on iron pegs let into the face of the rock. The path being formed by bars of iron and slabs of stone stretching from peg to peg and covered with earth. This extraordinary path is in no place more than 18 inches (775 paces) along the face of the cliff, at some 1,500 feet above the river which could be seen roaring below in its narrow bed. The explorer who has seen much difficult ground in the Himalayas, says he never in his life met with any thing to equal this bit of path. It is of course quite impassable for ponies or yáks, and but very few sheep and goats even go by it though it is constantly passed by men with loads.

There are several other smaller pieces of paths between Nilam and Listi Bhansár which are nearly as bad but they are fortunately not continuous.

From Listi Bhansár the explorer's route does not call for any special notice here being much the same as that in any other part of the mountains south of the Himalayan watershed, being rugged in the extreme for a considerable distance and then becoming easy in the valleys or Dúns. It may however be noted that the explorer crossed the Indrawati feeder of the Kosi which has 5 small tarns near its source called Panch Pokri. The source is in the snowy mountains to the west as shown on the map.

The lower ground, though not at all noteworthy in itself, had never been surveyed in any way previously, the only land marks being the few great peaks in its neighbourhood that have been fixed from a distance by the Great Trigonometrical Survey; and I consequently consider the survey of it and other portions of the lower ground a very valuable addition to the geography of that part of the mountains.

On reference to the map it will be seen that by this exploration the position of the great Himalayan watershed has been determined in three different places. In each case it proves to be far behind or north of the lofty peaks that are visible from Hindustán, such as Mount Everest, Kanchinjinga, &c.

The explorer it will be seen went completely round Mount Everest, but his route was so hemmed in by great mountains that he never got a view of Mount Everest itself; it seems to have been invariably hidden by the subordinate peaks which are tolerably close to it. Possibly it may have been seen but never continuously so as to be able to recognise it again and to fix it by bearings with a moderately long base. The Kanchinjinga and Junnu peaks were, however, seen from the west of Taplang Jong but only a short base could be secured. The explorer was much impressed by Kanchinjinga (28,150 feet); it is known to the natives near Taplang as *Kumbh Karan Langúr*. The people south of the Himalayas, in Nepal, call all snowy mountains *Langúr*, by which they mean the highest points. They call the peaks that have no snow *Banjung* and the low ground under the said *Banjung* they call *Phedi*. The term Himalayas is not used by uneducated people who only talk of the snowy mountains as "*Barfáni Langúr*."

Neither the Bhotias nor the Ghurkas seem to have specific names for remarkable peaks; the explorer asked all sorts of people but with the exception of the case of Kanchinjinga referred to above, he never got any name for a peak, though in a few cases they gave that of the nearest village.

Several of the other peaks fixed by the explorer were very lofty ones covered with perpetual snow to a great distance below their summits, those north of Mount Everest and Kanchinjinga are perhaps the most interesting as being beyond the Himalayan watershed. One to the north of the road between Shakia and Dingri, the explorer thought was very much loftier than any others.

The explorer's route survey may be said in a rough way to give us a general idea as to how the mountain drainage runs between the Himalayan watershed, north-west of Kirong, and the point where Turner crossed it near Chumalári up to the Bráhmáputra, or Sang-po river on the north from west of Junglache to Shigatze. The route between Kirong, Jong-ka-Jong, and Dingri Maidán is still a desideratum as we are in the dark as to the size of the Palgucho lake, which however it now appears will lie somewhat to the south of the approximate position which I gave it in my map showing the chief Pandit's route to Lhása.

A glance at the map at once shows what a large river the Arun must be, the area it drains being so very great. It is one of the few Himalayan rivers which has its source beyond the Himalayan range as seen from Hindustán, the others being the Indus, Sutlej and Karnáli. The length of the eastern and western upper sources is very remarkable, extending on the one side to the north and east of Kanchinjinga, and on the other to the north and west of Mount Everest.

In the route survey made by explorer No. 9 from Dárjiling to Shigatze, and from Shigatze by Shakia, Dingri Maidán, Nilam &c., to Katmánda, the value of his pace has in the first instance been derived from the differences of latitude between the various places at which star observations for latitude were taken. A mean value of pace *viz*; 2.45 feet, derived from a mean of the values of each section, was adopted, and this mean value was applied to the number of paces showing the differences of longitude for each section and the value of the same in degrees and minutes was deduced therefrom in the usual way.

Taking the longitude of Dárjiling at $88^{\circ} 18' 41''$ as determined by the triangulation of the G. T. Survey, and applying the differences of longitude as determined above, the longitude of Shigatze, by Tatápáni, Chota Tápu, &c., *vide* map, *i.e.*, by the most direct route would be $88^{\circ} 46' 44''$.

Taking the longitude of Katmánda at $85^{\circ} 17' 45''$ and applying the differences of longitude as above between it and Shigatze by Nilam, Dingri, Pil &c., the longitude of Shigatze would be $88^{\circ} 32' 45''$.

On examining the map, however, it is at once apparent that the longitude of Shigatze, as determined by a route survey from Dárjiling, is likely to be more reliable than that derived from Katmánu, because the difference of longitude, between Dárjiling and Shigatze, is but $0^{\circ} 21'$, while the difference between Katmánu and Shigatze, is $3^{\circ} 11'$, or in other words the longitude of Shigatze would be very much more affected by an error in the value of the pace in the latter case than in the former. I have consequently decided upon using only the value as determined from Shigatze.

At page x of my report on the chief Pandit's exploration to Lhása, I explain that the longitude of Shigatze was determined by the route survey which Mr. Turner made during his journey to Shigatze, combined with the route of the Pandit, Shigatze was computed to be in longitude $88^{\circ} 48'$, a very close agreement with the value as determined above independently by explorer No. 9 viz., $88^{\circ} 47'$. It may consequently be concluded that the longitudes of Shigatze and of Lhása which depends on Shigatze, as given in my first map, are very close approximations, and it is gratifying to find that my reliance on Turner's route survey was not misplaced.

The explorer's work has stood all the usual tests satisfactorily, the average value of his pace, 2.45 feet as determined from the differences in latitude, is about what might be expected from a man of his stature. His latitude observations agree very well *inter se* considering that he used but a small pocket sextant. His observations at Shigatze give much the same latitude as that derived from the chief Pandit's observations with a large sextant at that and other places.

His heights are the weakest part of his work, as owing to the larger thermometers originally sent with him having been broken, he was reduced to take his boiling point observations with a very small thermometer. The heights however are probably fair approximations, and give a good general idea of the great elevation of the upper part of his ground.

His bearings to peaks on either side of his road were more numerous than usual, and on the whole he was fairly successful in fixing the more conspicuous.

The exploration with its bearings &c., opens out the geography of nearly 30,000 square miles of what has hitherto been in many portions *terra-incognita* and in others nearly so; the indications on our maps having been of course mostly conjectural. The exploration more especially elucidates the geography of the basin of the Arun or Arun-kosi river, the great eastern feeder, if not the main source of the great Kosi or Kosiki river, which drains the whole of eastern Nepal. The courses of the upper feeders of the Arun have hitherto been a puzzle to geographers. The explorer's work also defines the course of the great western tributary of the Kosi river viz., the Bhotia Kosi of which we had previously no survey.

His route survey is 844 miles in length of which 550 miles may be said to be over entirely new ground, and the remainder (though close to a line along which one European has travelled) had never been regularly surveyed before.

The explorer took latitude observations at 11 points upon which the work depends and determined the height of 31 places. His work I think will prove a valuable addition to the Trans-Frontier geography of India.

T. G. MONTGOMERIE, MAJOR R.E.,
Offg. Superintendent G. T. Survey of India,
and in charge Trans-Himalayan Exploring Parties.

*List of positions of the chief places as determined from the Route Survey
of explorer No. 9 in Nepal and Great Tibet.*

	Latitude		Longitude		Height	Remarks
	°	'	°	'	feet	
Dárjiling.	27	2	88	19	7253	From G. T. Survey.
Tatápáni.	28	36	88	8	15025	
Chota-Tápu (or Darcha village).	28	57	88	27	14558	
Shigatze (Tashilumbo).	29	17	88	47	11822	
Pil.	28	37	87	54	13259	
Dingri-Maidán town.	28	35	86	40	13865	
Nilam-Jong (or Kuti).	28	9	86	5	13911	
Katmáandu.	27	41	85	18	..	From Crawford's to G. T. S. Peaks.
Kabirí River, Bank of. . . . .	..	..	87	33	..	No astronomical latitude.
Narharia (Naria).	26	26	86	45	..	
Dhankuta.	26	56	87	21	2927	
Lámádong.	27	10	86	52	..	
Amtia on bank of Arun River.	27	12	87	12	1798	

The longitude of Shigatze is derived from Dárjiling by the route survey passing through Tatápáni and Chota-Tápu. In the map accompanying this memorandum, $88^{\circ} 40'$ was assumed to be the longitude, using a mean between the values derived from Katmáandu and Shigatze. In future compilations the positions as given on the map, will require to be corrected to those given above.

Observations for Latitudes taken in Nepal and Great Tibet by explorer No. 9, with a pocket sextant.

No. of Observation.	Astronomical Date.		Watch Time.	STATION.	Object.	Double Altitude.		Index Error.	Deducted Latitude.		Mean Latitude.	REMARKS.
	1871. Sept.	Day				°	'		°	'		
1		11th	h m s 12 0 0	Tatááni.	Fomalhaut.	62	14 30	"	28	35 44		On Meridian.
2	"	"	13 0 0	"	β Ceti.	85	28 30	"	28	34 52	° ' "	Ditto.
3	"	12th	12 0 0	"	Fomalhaut.	62	14 0	"	28	35 59	28 35 33	Ditto.
4	"	"	13 0 0	"	β Ceti.	85	27 0	"	28	35 37		Ditto.
5	"	15th	12 0 0	Chota-Tápu.	Fomalhaut.	61	32 30	"	28	56 44	28 56 56	Ditto.
6	"	"	13 0 0	"	β Ceti.	84	44 0	"	28	57 8		Ditto.
7	"	28th	12 0 0	Shigatze.	Fomalhaut.	60	53 30	"	29	16 14		Ditto.
8	"	"	13 0 0	"	β Ceti.	84	4 0	"	29	17 7		Ditto.
9	"	29th	12 0 0	"	Polaris.	61	23 0	"	29	17 44	29 17 1	Ditto.
10	"	30th	12 0 0	"	"	61	24 0	"	29	18 16		Ditto.
11	"	"	12 0 0	"	Fomalhaut.	60	54 30	"	29	15 44		Ditto.
12	Octr.	4th	11 0 0	Pil village.	"	62	15 0	"	28	35 26	28 37 16	Ditto.
13	"	"	12 0 0	"	β Ceti.	85	20 0	"	28	39 6		Ditto.
14	"	7th	11 0 0	Dingri-Maidán,	Fomalhaut.	62	18 0	"	28	33 55	28 34 30	Ditto.
15	"	"	12 0 0	"	β Ceti.	85	28 0	"	28	35 5		Ditto.

Observations for Latitudes taken in Nepal and Great Tibet.—(Continued.)

No. of Observation.	Astronomical Date.		Watch Time.	STATION.	Object.	Double Altitude.	Index Error.	Deducted Latitude.	Mean Latitude.	REMARKS.
16	1871 October	11th	h m s 11 0 0	Nilam or Kutti.	Fomalhaut.	63 4 0	' " -1 0	28 10 54	° ' " } 28 9 24	On Meridian.
17	"	"	12 0 0	"	β Ceti.	86 17 0	"	28 10 34		Ditto.
18	"	"	12 0 0	"	Polaris.	59 1 0	"	28 6 44		Ditto.
19	1872 January	3rd	11 0 0	Katmandu.	Orionis Rigel.	107 50 0	"	27 44 2	27 43 29	Ditto.
20	"	"	12 0 0	"	Sirius.	91 30 0	"	27 42 55		Ditto.
21	"	17th	11 0 0	Lámádong.	Orionis Rigel.	108 58 0	"	27 10 1	27 10 11	Ditto.
22	"	"	12 0 0	"	Sirius.	92 35 0	"	27 10 21		Ditto.
23	"	22nd	10 30 0	Amtia village on bank of Arun River.	Orionis Rigel.	108 54 0	"	27 11 59	27 12 25	Ditto.
24	"	"	11 30 0	"	Sirius.	92 30 0	"	27 12 50		Ditto.
25	"	20th	10 0 0	Dhankuta Bazar.	Orionis Rigel.	109 28 0	"	26 54 58	26 56 23	Ditto.
26	"	"	11 0 0	"	Sirius.	93 0 0	"	26 57 48		Ditto.
27	February	7th	9 0 0	Narharia Bazar.	Orionis Rigel.	110 42 0	"	26 17 56	26 18 21	Ditto.
28	"	"	10 0 0	"	Sirius.	94 18 0	"	26 18 45		Ditto.

Observations of the Boiling Point taken in Nepal and Great Tibet by explorer No. 9.

No. of Observations.	Month and date.	Watch time.	Station.	THERMOMETER.			Deducted Height above Sea in feet.	REMARKS.
				No.	Boiling Point.	In Air.		
1	1871 August	8 A.M.	Dárjiling ...	7	201·15	64·25	} 7,253	West wind.
2	"	...	Ditto ...	10	201·5	"		} 10,575	A point in Dárjiling 7170 by G. T. S.
3	"	7 A.M.	Phalialung Lek ...	10	195·2	55·2	No wind and rain.	
4	"	...	Ditto ...	7	196·0	"	Ditto.	
5	"	6 P.M.	Suria Lek ...	7	198·0	63·0	9,190		South wind and rain.
6	"	9 A.M.	Bank of Kabiri River...	7	211·0	78·0	1,677	West wind.
7	"	8 A.M.	Walungangola ...	10	195·3	60·0	} 10,564	No wind.
8	"	...	Ditto ...	7	196·0	"		Ditto.
9	"	1 P.M.	Tipta-La ...	7	187·0	46·0	15,618	No wind.
10	"	10 A.M.	Tashirak village ...	7	188·0	47·0	15,025	North wind.
11	September	9 A.M.	Shara village ...	7	190·0	68·0	13,983	Ditto.
12	"	3 P.M.	Lámádong thanka ...	7	191·5	67·0	13,071	Ditto.
13	"	7 A.M.	Tashichirang village at bank of Chomto Dong Lake.	7	188·5	48·0	14,734	East wind.
14	"	...	Ta ápáni or Chajong ...	7	188·0	47·0	15,025	Ditto.
15	"	11 A.M.	Lagulung-La ...	7	186·0	44·0	16,201	South wind.
16	"	4 P.M.	Chota Tápu or Darcha village	7	189·0	64·0	14,558	East wind.

NOTE.—Lek signifies a pass.

Observations of the Boiling Point taken in Nepal and Great Tibet by explorer No. 9—(Continued).

No. of Observa- tion.	Month and date.		Watch time.	Station.	THERMOMETER.			Deduced Height above Sea in feet.	REMARKS.
					No.	Boiling Point.	In Air.		
17	1871	September	19	11 A.M.	Shigatze	...	...	...	No wind.
18	"	"	23	7 A.M.	Ditto	...	...	11,822	East wind.
19	October		3	5 P.M.	Shakia near Tachuk	...	...	13,859	South wind.
20	"	"	4	7 A.M.	Pil village	...	...	13,259	Ditto.
21	"	"	9	6 A.M.	Dingri maidán	...	...	13,865	West wind.
22	"	"	10	8 A.M.	Thung-lung-La	...	...	18,460	South wind.
23	"	"	13	7 A.M.	Nilam or Kuti...	...	...	13,911	Ditto.
24	"	"	15	5 P.M.	Tata Bhansár	...	...	5,002	No wind.
25	December		7	8 A.M.	Katmánu	...	...	...	...
26	1872	January	8	7 A.M.	Tribeni bank of Sun-kosi and Tamba-kosi River.	...	...	...	...
27	"	"	9	6 A.M.	Hilia Lek	...	...	4,620	West wind.
28	"	"	11	10 A.M.	Kanjia Lek	...	...	4,620	Ditto.
29	"	"	17	"	Kumdia Lek	...	...	6,302	No wind and rain.
30	"	"	18	7 A.M.	Lamkhu village	...	...	4,622	North wind.
31	"	"	...	2 P.M.	Chakuwa Lek	...	...	6,869	Ditto.
32	"	"	22	7 A.M.	Amtia V. on bank of Arun River	...	...	1,798	East wind.

Observations of the Boiling Point taken in Nepal and Great Tibet by explorer No. 9—(Continued).

No. of Observa- tion.	Month and date.		Watch time.	Station.	THERMOMETER.			Deducted Height above Sea in feet.	REMARKS.
					No.	Boiling Point.	In Air.		
33	1872. January	26	0 P.M.	Chuwa Lek	7	°	44·0		Data incomplete.
34	"	28	7 A.M.	Sudab village	7	208·0	50·0	3,493	South wind.
35	February	1	9 A.M.	Dhankuta bazar	7	209·0	52·0	2,927	Ditto.
36	"	3	7 A.M.	Barah chetr	7	...	55·0		West wind.
37	"	7	7 P.M.	Naria bazar	7	...	55·0		South wind.
38	June	19	0 P.M.	Masúri G. T. Survey office ...	7	201·75	75·0		
39	August	12	11½ A.M.	Ditto.	7	202·00	70·5		Mean of six. Cloudy and calm.

NOTE.—The preceding heights above Sea level are computed differentially from height of Masúri observatory taken at 6937 feet to which the observer's boiling point 201°83 and temperature 72°75 have been assumed as corresponding.

Route Survey from Dárjiling (Thánah) to Shigatze (Market Place).

No. of Station.	Name of Station.	Bearing to forward station.	Distance in paces to forward station.	REMARKS.
		° ' "		
1	Dárjiling	.. 294 30	13963	
2	..	.. 275 30	4152	
3	Kainchalia	.. 334 30	7279	Thánah.
4	..	.. 285 0	2350	
5	Hamaphong	.. 281 30	10340	Village.
6	..	.. 292 0	15100	
7	Phalialung Lek	.. 274 0	2871	
8	..	.. 240 0	8100	On boundary between British and Nepal Territories.
9	..	.. 285 0	13010	
10	Nablang	.. 297 0	9580	Village.
11	Suriabhanjan	.. 320 30	5425	Hill.
12	Suria Lek	.. 299 0	7085	„
13	Shikárpur	.. 290 30	15140	Village.
14	Kabiri	.. 340 0	4566	Stream.
15	Phuwa Village	.. 311 0	13850	200 yards from.
16	Taplang Jong	.. 17 30	16807	Village.
17	..	.. 42 0	6608	
18	..	.. 66 30	3859	
19	Tabkia Thok	.. 55 0	11150	Village.
20	..	.. 66 0	17097	
21	Ebangkhola	.. 301 0	7270	Stream.
22	Tambru	.. 11 0	8511	River, on bank of.
23	..	.. 18 30	11800	
24	..	.. 320 0	8010	
25	..	.. 335 0	18001	
26	..	.. 360 0	5938	
27	Tashirak Chu	.. 21 0	10200	Stream, on left bank of.
28	..	.. 345 0	12100	
29	Nila-La	.. 20 0	9910	Hill, on top of.
30	Shara	.. 40 30	34030	Village.
31	..	.. 90 0	4700	
32	..	.. 65 30	28530	
33	Tashichirang	.. 270 0	2288	Village.
34	Chomto Dong	.. 22 30	2500	Lake, on bank of.
35	..	.. 67 0	21225	
36	Nangji	.. 358 0	6065	Village.
37	Chajong	.. 67 30	5450	„ Latitude observed.
38	Tinki-La	.. 75 0	6684	Hill, on top of.
39	..	.. 35 0	20104	
40	Lagulung-La	.. 345 0	11670	Hill. Boundary of Sikkim & Lhása.
41	..	.. 16 30	18194	
42	Ruksum	.. 0 0	8955	Stream, on bank of.
43	..	.. 53 0	7715	
44	Chota Tápu	.. 26 0	8010	Village. Latitude observed.
45	Gyaling-La	.. 67 30	5000	Hill, on top of.
46	..	.. 25 30	6393	
47	..	.. 35 30	9600	
48	..	.. 30 0	16896	
49	..	.. 33 30	12000	
50	Shigatze	.. ....	....	City. The Market Place. Latitude observed.

From Changma (Village near Shigatze) to Katmándu.

No. of Station.	Name of Station.	Bearing to forward station.	Distance in paces to forward station.	REMARKS.
1	Changma ..	250 30	14765	Village—10996 paces from station No. 48 on the line from No. 48 to No. 49 of foregoing Numbering.
2	..	252 30	10850	
3	..	235 0	4300	
4	Nangla ..	225 0	15125	Hill, on top of.
5	Sab-Chu ..	280 0	1280	River, on right bank of.
6	Lingbochen ..	175 0	6800	Temple.
7	Puksum ..	235 0	11383	Stream, on bank of.
8	..	212 0	12095	
9	Chong-La ..	266 0	13790	Hill.
10	..	200 0	2500	
11	Ata-La ..	270 30	11350	Hill.
12	..	194 30	6500	
13	..	224 30	7500	
14	Dongo-La ..	212 0	11100	Hill.
15	Sinas-Chu ..	183 30	19880	Stream, on bank of.
16	Pil village ..	206 0	13300	Latitude observed.
17	..	230 0	9118	
18	..	215 30	14712	
19	..	280 0	13000	
20	Chaiokor ..	295 30	30760	Village.
21	Phungtu ..	267 0	7600	River, on bank of.
22	Ditto ..	275 0	6500	Do.
23	Ditto ..	270 0	10294	Do.
24	..	250 0	9690	
25	..	265 0	17400	
26	Chakor ..	260 30	25100	Village.
27	..	279 30	11235	
28	Dingri Jong ..	232 0	32016	Town, at entrance to. Latitude observed.
29	..	294 0	6500	
30	Thungla ..	269 30	17181	Hill.
31	..	225 0	8500	
32	..	204 0	7870	
33	Palgu ..	235 30	4050	Stream, on bank of.
34	..	205 0	5820	
35	Thakialing ..	195 30	21921	Village.
36	Nilam Jong ..	210 0	4800	Do. Latitude observed.
37	Kosi River ..	135 0	5170	On right bank of.
38	Ditto ..	190 30	3200	Do.
39	Ditto ..	176 0	3540	On Bridge.
40	Choksum ..	184 30	2870	Village.
41	..	195 30	12197	
42	..	152 0	2775	
43	..	209 0	13017	
44	..	207 0	4045	
45	..	215 0	6182	
46	Kanglank ..	230 0	3800	Hill, on top of.
47	Listi ..	252 0	3325	Do.
48	Listi Village ..	190 30	8725	
49	..	215 0	2600	
50	Bisinkhar Lek ..	255 30	4942	

From Changma (Village near Shigatze) to Katmánda—(Continued).

No. of Station.	Name of Station.	Bearing to forward station.	Distance in paces to forward station.	REMARKS.
		o ' /		
51	..	240 30	5480	
52	Balefi	200 o	5470	Stream, on bank of.
53	..	248 30	3210	
54	Banspati	241 30	3600	Village.
55	Choutra	228 30	3425	Do.
56	..	231 30	5900	
57	Ghetar	271 30	3360	Village.
58	Sipa	241 30	4065	Do.
59	Jherkola	260 30	3826	Stream, on bank of.
60	Dhankola	271 30	7100	Do.
61	..	251 o	9310	
62	Chautaria Lek	226 o	2300	Hill, on top of.
63	..	221 30	3890	
64	..	270 o	5635	
65	Kalitar	252 30	8210	Village.
66	Chabeli	225 o	6170	Do.
67	Katmánda	..		At Indar Chaok (centre of city.)

From Katmánda (Asan Tol) to Taplang Jong (Station No. 16 of Route from Dárjiling to Shigatze).

1	Katmánda	..	112 o	7575	Asan Tol. Latitude observed on this line, 1025 paces from starting point.
2	Dimi Village	..	110 o	2250	
3	..	..	106 o	3710	
4	..	..	115 o	6300	
5	Bist Village	..	109 o	2335	
6	Burapa "	..	129 o	4060	
7	..	..	113 30	5660	
8	Nabna Lek	..	126 30	4700	
9	Dabchia Village	..	122 o	3230	
10	.	..	118 30	4850	
11	..	..	66 30	2500	
12	..	..	123 30	4415	
13	..	..	135 30	6825	
14	..	..	112 o	5200	
15	..	..	110 o	4910	
16	..	..	127 o	7800	
17	Jhangajholi	..	105 o	4786	Village.
18	Mulkotar	..	127 30	6400	Do.
19	..	..	74 o	2415	
20	..	..	144 o	5500	
21	Tribeni	..	92 o	7200	Junction of two streams.
22	Bedana	..	110 o	3950	Village.
23	..	..	100 o	5700	
24	Hilia Village	..	32 o	3000	
25	..	..	35 o	3500	
26	..	..	112 o	2000	
27	..	..	60 o	1900	
28	..	..	93 o	4000	

From Katmánu (Asan Tol) to Taplang Jong (Station No. 16 of Route from Dárjiling to Shigatze.)

No. of Station.	Name of Station.	Bearing to forward station.	Distance in paces to forward station.	REMARKS.
		° ' "		
29	..	103 0	6190	
30	Kuwapáni	72 0	4770	Village.
31	..	122 30	4500	
32	..	149 30	3900	
33	..	107 0	11000	
34	Kanjia Lek	60 0	6400	
35	Kanjia Village	87 0	6615	
36	Bungnung	95 0	3400	
37	Gahatiatar	42 30	2200	Village.
38	..	126 30	3715	
39	..	95 0	10146	
40	Charkhu	74 30	5870	Village.
41	..	117 30	5481	
42	Dudh-kosi	55 0	6225	River, on bank of.
43	Rakola Pasal	120 0	9680	Shop.
44	Kumdia Lek	45 0	4726	
45	Do.	117 0	6500	
46	Nerpa Village	136 30	5790	
47	Dorpa „	85 30	8500	Latitude observed at Lámádong Village 5600 paces from Dorpa on line from Dorpa to Station 48.
48	Lamakhu	100 0	7025	Village.
49	Chakuwa Lek	77 30	5900	Hill.
50	Dilpa Village	61 30	4400	
51	..	140 30	10780	
52	Bhojpur Village	82 0	6597	
53	..	37 0	4600	
54	..	40 30	5210	
55	Soria Village	57 30	5425	
56	..	48 0	4600	Latitude observed on line 56 to 57 at Village Amtia, 2500 paces from station 56 towards 57.
57	Arun River	74 0	7290	On bank of.
58	Chainpur Lek	55 0	5700	Hill.
59	Do. Village	77 30	8590	
60	..	92 0	10610	
61	Nundhakia	65 30	6400	Pati. Small Bazar and Dharmśála.
62	..	110 0	4200	
63	Milkia Lek	87 30	4410	
64	Do.	70 0	8625	
65	..	62 30	13645	
66	Taplang Jong	..		Same as Station No. 16 of Route from Dárjiling to Shigatze.

From Kabiri, Dharmśāla (Station No. 14 of Route from Dārjiling to Shigatze) to Naria Bazar (Kotwāli).

No. of Station.	Name of Station.	Bearing to forward Station.	Distance in paces to forward station.	REMARKS.
		° ' "		
1	Kabiri	.. 125 °	3900	
2	Tamru River	.. 199 30	7310	On left bank of.
3	Chua Pahār	.. 267 30	7600	
4	Sambua	.. 210 30	5300	Village.
5	Tukma	.. 135 °	2700	Hill.
6	Do.	.. 216 °	7520	
7	Majhwa	.. 210 °	4525	
8	..	.. 201 °	9470	
9	Kalamati	.. 225 °	4597	Hill.
10	..	.. 172 °	2000	
11	Sudab Hill	.. 225 °	3370	
12	Do.	.. 241 °	3800	
13	Telia khola	.. 201 30	7820	Stream.
14	Hamjung Hill	.. 249 30	8315	
15	Dhankuta	.. 187 °	6660	Bazar, Latitude observed.
16	..	.. 246 °	5670	
17	Tamru River	.. 211 °	8860	On bank of.
18	..	.. 241 30	4370	
19	Dhārapāni	.. 272 °	6040	Village.
20	Barah Chetr	.. 191 °	8466	Worshipping place.
21	Chatria	.. 215 °	23400	Thānah.
22	Megjin	.. 177 °	23300	Ka Thānah.
23	Chapri Village	.. 275 °	4100	
24	..	.. 206 30	11476	
25	Kotia Village	.. 220 30	8170	
26	Thakia Village	.. 261 °	5210	
27	Sikrata „	.. 251 °	5676	
28	..	.. 272 °	10085	
29	Dhānsia Village	.. 267 °	6650	
30	Arāha „	.. 251 °	4270	
31	Naria	.. ..	..	Bazar, Thānah. Latitude observed.