II.

Journal of a Survey to the Heads of the RIVERS, GANGES *and* JUMNA.

BY CAPTAIN J. A. HODGSON, 10TH REGT. N. I.

AS I have had it in my power to explore and survey the course of the *Ganges* within the *Himálaya* mountains, to a considerable distance beyond *Gangautri*, and to the place where its head is concealed by masses of snow which never melt, I hope, that an account of my journey may be acceptable to the Asiatic Society. I must premise that, as Captain RAPER's account of Captain WEBB's survey in 1808, has already appeared in the XIth Volume of the Researches, I have nothing to add to that officer's able and faithful description of the mountainous country, passed through in the route of the survey from the *Dún Valley* to *Cajani*, near *Reital*, where the survey towards *Gangautri* was discontinued in consequence of the serious obstacles which impeded it. I shall therefore only give an account of the course of the river above the village of *Reital*, where I halted to make arrangements for my progress through the rugged regions before me, in which I found I had no chance of getting any

supplies of grain for my followers: I was consequently obliged to buy grain and to send it off before me, so as to form little magazines, at the places I intended to halt at; and as I learnt that several of the *Sangas* or spar bridges over the river had been destroyed by *avalanches* of snow, I sent a large party of labourers to re-establish them.

Considering *Reital*, as a point of departure, it will be satisfactory to know its geographical position. By a series of observations with the reflecting circle of Troughton, and also by his astronomical circular instrument, I found the latitude to be 30° 48′ 28″ N. and having been so fortunate as to get two observations of immersions of the first satellite of Jupiter and one of the second, I am able to give a good idea of the longitude of the place; and the more satisfactorily, as two of the immersions are compared with those taken at the *Madras* observatory on the same night, and with which I have been favored by Mr. Goldingham, the astronomer there.

The telescope used by me in observing the satellites was a Dollond's forty-two inches achromatic refractor, with an aperture of two and three-quarter inches and power of about seventy-five applied, having a tall stand and rack work for slow motion. The watch was a marine chronometer, made by Molineux of *London*, and went with the greatest steadiness on its rate, as nightly determined by the passage over the meridian of fixed stars observed with a transit instrument. The time of mean noon when required was always found by equal altitudes.

	H.	M.	S.		H.	M.	S.	
12th May, 1817.—Observed immersion of γ 1st satellite at mean time,	10	42	56	0				
The same observed at the *Madras* observatory,	10	49	59	9				
Differences of meridians in time,	0	7	3	9				
Established longitude of *Madras* observatory,	5	21	14	0				
Longitude of *Reital* deduced,					5	14	10	1
By the calculation in the nautical almanack, it was anticipated that this immersion should happen at *Greenwich*, at	5	29	33	0				
It took place as above at *Madras*, at	10	49	59	9				
Which would make the longitude,	5	20	26	9				
But it is known to be,	5	21	14	0				
Difference,	0	0	47	1				
Therefore the error of the tables at this time is to be applied to the following immersion:								
10th May, 1817.—I observed an immersion of the 1st satellite, at	16	14	21	1				
There is no correspondent observation at *Madras*, but the nautical almanack, gives for *Greenwich*, 11h. 1m. 5s.								
The above error of the tables			47	1				
	11	0	17	9	11	0	17	9
Longitude of *Reital* deduced,					5	14	3	2
Mean,					5	14	6	6

Both the observations were made under favorable circumstances, the air being still and clear. On the 10th, the satellite began to lose lustre about 44; and on the 12th, 50 seconds before its disappearance.

	H.	M.	S.	
11th May, 1817.—I observed the immersion of γ 2d satellite, at *Reital*,	14	13	35	7
Same was observed at *Madras*,	14	19	41	1
Difference of meridians,	0	6	5	4
Established longitude of *Madras* observatory,	5	21	14	0
Longitude of *Reital* deduced	5	15	8	5

THIS was a very distinct observation, and I followed the satellite deep into the shadow, it gradually losing light for 76 seconds before its total disappearance—yet it gives a longitude almost a minute East of the first satellite, the preceeding night, which leads me to suspect, that though I know the seconds were rightly counted and noted, that the minute may have been inadvertently noted 13^m instead of 12^m. As there is this uncertainty, I will reject the observation: nevertheless it may be interesting to know, supposing that the case, what the longitude could come out:

	H.	M.	S.	
Suppose at *Reital* the immersion took place at	14	12	35	7
Madras	14	19	41	1
		7	5	4
Madras	5	21	14	0
	5	14	8	6
Mean of 2 nights—1st and 2d satellite			6	6
	H.	M.	S.	
By the nautical almanack the immersion was expected at *Greenwich*, at	8	57	42	0
It happened at *Madras*	14	19	41	1
Giving a longitude of	5	21	59	1
But the longitude is	5	21	14	0
Correction of the tables			45	1

BY a mean of several observations taken at *Madras* about the time of 4 *Emersions* of the first satellite, which I observed at Mr. GRINDALL'S house near *Seharanpúr*; Mr. GOLDINGHAM finds $5^h\ 10^m\ 24^s$ for the longitude of *Seharanpúr*.—A snowy peak called *Srí Cánta* is visible both from *Reital* and *Seharanpúr*, its position is determined by means of a series of triangles instituted by me for the purpose of taking the dis-

tances and heights of the snowy peaks. I find the angle at the pole or difference of longitude between *Seharanpúr* station and *Srí Cánta*, to be 1° 14′ 47″—the peak being East, and at *Reital* the difference of Longitude of that village, and the peak, is found to be 12′ 6″—the peak being East, consequently the difference of longitude of *Seharanpúr* and *Reital*, is.....1°, 2′, 41″ in Time=0h. 4m. 10s. 7

Longitude of *Seharanpúr* by the emersions of the first satellite, ...	5	10	24	
	5	14	34	7
But the mean of the second immersion of first satellite gives	5	14	6	6
Mean of emersions and immersions, ...	5	14	20	6

Four sets of distances of the sun and moon with the reflecting circle, on the 8th May, gave 5h. 14m. 25s.

On the whole I think $5^h\ 14^m\ 20^s\ 6$ or $78^\circ\ 35'\ 60''\ 7$ may be safely taken for the longitude of *Reital* East of *Greenwich*.

Reital, contains about thirty-five houses and is esteemed a considerble village; as usual in the upper mountains where timber is plentiful, the houses are large and two and three stories high. When a house has three stories, the lowest serves to shelter the cattle by night; the second is a sort of granary and in the upper the family dwells; round it there is generally a strong wooden gallery or balcony, which is supported by beams that project from the walls. The roofs of the houses are made of boards or slates; they are shelving, and project much beyond the top of the walls, and cover the balcony, which is closed in bad weather by strong wooden shutters or pannels. These houses are very substantial and have a handsome appearance at a

distance, but they are exceedingly filthy within, and full of vermin. The walls are composed of long cedar beams and stone in alternate courses, the ends of the beams meet at the corners, where they are bolted together by wooden pins. Houses of this construction are said to last for several ages, for the *Deodar* or *Cailon* pine, which I suppose to be the cedar of *Lebanon** is the largest, most noble and durable of all trees.

THE situation of this village on the east side of a mountain, the summit of which is covered with snow, and the foot washed by the *Bhágiráthí* is very pleasant. It commands a noble view of the *Srí Cánta* and other adjoining peaks of the *Himálaya* on which the snow for ever rests. Snow also remains until the rains on all the mountains of the second order, which are visible hence, both up and down the river. Many cascades are formed by the melting of the snows on the foot of the surrounding mountains. One in particular descends in repeated falls of several hundred feet each, from the summit of a mountain across the river and joins it near *Batheri*.

THE azimuth of the *Srí Cánta* peak (determined from the elongation of the pole star) is 50° 49′ 29″ N. E. and its altitude 9° 14′ 3″ 5. It is needless here to insert the observations of azimuth and altitudes of the other peaks seen hence and at other places on the route. In the following account of my progress up the river, I have put down such remarks as occurred at the time, and they were written on the spot, and are here in-

* It is the pinus *Deodára* of ROXBURGH; the *Dévadáru* of *Sanscrit* writers. H. H. W.

serted with very little alteration. Though, I am aware, that such minute descriptions of localities must appear tedious, and that many repetitions occur, I hope, they will be excused by those, who feeling interested in the subject, may have the patience to read the detail. To give *general* descriptions of such rude regions is difficult, if not impossible, and I trust that particular ones, though often tedious, will be found more faithful, and to give more precise ideas, of those remote recesses of the *Himálaya*, which I visited. For this end, and that those who are so inclined, may be able to know the positions of the places, in my journey, I have put down the bearings, and distances in paces, of each portion of the Route, with the remarks noted at the time and also the latitudes of the halting places, and these simple data will enable any one to trace the distance and direction from *Reital* to the end of my journey. I have only put down the bearings in single degrees; they are reckoned from North, which I call 360: thus, 180° is South, 270° West, and so on—except in very steep ascents and descents, the paces may be taken at 30 inches.

On the 19th May, I was joined at *Reital* by Lieutenant HERBERT, of the 8th Regt. N. I. who had been appointed my assistant, and from his skill and zeal the survey has received much benefit.—Mr. HERBERT came direct from *Calcutta* and brought for me a pair of Mountain Barometers, but the tubes filled in *England* had been broken ere they arrived in *Calcutta:* there were some spare empty tubes which we filled and used as hereafter mentioned, but we could not succeed in boiling the mercury in the tubes, to free it entirely of air.—The height of *Reital* above the sea as indicated by our barometers is 7108 feet.

HAVING received reports, that the *Sanghas* were repaired and that the grain I sent forward was lodged in the places I directed, I left every article of baggage I could possibly do without, and having given very light loads to the *Coolies* that they might proceed with less difficulty, we marched from *Reital* on the 21st May, as follows:

		Paces.	Brg. from N. Degrees
	21st May, Reital to Tawarra, Thermometer at Sun rise, 52°.		
1	Slight oblique descents through fields. Cross a torrent, 10 feet wide, ...	1510	328°
2	Along hill side, slight ascent and begin descent. Flag staff at *Reital* 8°. *Wudár* 138°. The great water fall across the river joins it, at 143	1052	66
3	First 200 paces 315° along side of hill. Top of *Sálang* mountain covered with snow 95°.....	592	69
4	Ascent rocky and rough. Observed some *Micaceous* iron ore. *Pollang* 13°: river below to right, 1 mile distant, ...	632	45
5	Leave *Pollang* 1 furlong to right. *Sálang* mountain 112. *Sálang* a large village across the river 90°.....	1040	353 & 45
6	Descent and cross the *Soar* river on a *Sangha* 5 paces in length. It falls in a fine cascade from a great rock. The scenery very picturesque; course of the *Soar* down 100° where it joins the *Ganges*, ...	1020	316

7	Very rough, along steep side of the rocky mountain of *Narantah*; last 400 paces, steep ascent by short zig-zags. *Pollang* 169°; *Sálang*	1328	5
8	Oblique and rocky ascent, open to right, high precipices above to left. *Sálang* 125°	1830	67
9	Crest of the ascent to it a very bad and rocky broken path, difficult and some what dangerous in some places, where a false step would be fatal. *Sálang* 137°; *Sálang* mountain 124°; *Reital* 203°; *Pollang* 208°; course from the *Sangha* generally 57°; Mouth of the *Soar* 159½. *Ganges* 1½ mile right and about 2,000 feet below,	883	
10	Descend and cross *Cajani Nadí* rivulet 4 paces, oblique descent and better path,	1320	341
11	*Cajani* or *Kujnah Hamlet*, ascent,	350	92
12	Rocky oblique ascent; *Reital* 206°; *Sálang* 172°	2090	72
13	More heavy ascent of the same kind, over fragments of granite mixed with large proportions of quartz and feld spar,	805	67
14	More ascent but not quite so rough.—Here slight descent, *Reital* (my Flag Staff there) 209°. Depression of top of the mast 4°, 23; Bottom 4°, 30; *Pollang* 214° 42; Depression 8° 14; *Sálang* 187° 44; Depression 12° 44; *Bús* or *Sálang*		

peak 144° 03'; Elevation 11° 09 5; *Húrí* 46° 20'; Depression 4° 31'; Direction of *Dangal* 36¼°; Highest point of *Srícánta* 55° 4' 7; Elevation 10' 32; *Tátú Gawana* 334° 31'; Elevation 17° 55'. Second point 335° 19' 8; Elevation 17° 56'. Third point 355° 06'; Elevation 17° 55.		
Tawarra, a ruinous village of 10 houses, ...	600	12
Marched the distance in 5 hours and 38 minutes,		
	15,052	

FROM the *Soar* river to immediately above *Tawarra*, the path is exceedingly rugged, over broken masses of rock; the whole is an ascent; and in some places very steep open precipices to the right and high rocks above to the left; precaution is required in the footing, and some places are very unpleasant to turn, where it is adviseable to go bare footed.

THE mountains are of granite, with various proportion of quartz and feldspar, of which I have specimens. Heavy rain both on going and returning, could not get a latitude. Water boiled at 198°; the temperature of the air being 67°.

AT the village of *Tawarra*, direction of the small lake called *Cailac Tál*, whence the *Dinni Gárh* river issues 71°. It is said to be 50 yards in diameter, but deep, and is formed by the melting snow; there is a small piece of level ground near it, to which the villagers drive their sheep to pasture in August.

		Paces.	Brg. from N. Degrees
	22d May, Tuwarra to Dangal, Thermometer sun rise 48°		
1	Descent through the fields and down the *Dell* steep and slippery. *Rhoh* (or *Rhai*) pines and the *Mohora* a species of oak grow here, ...	1310	3
2	Descent to the *Elgie Gárh* torrent.—Cross it by a *Sangha* 15 feet long. Granite rock in large blocks, with quartz nodules and bands in the bed of the stream, ...	1320	70
3	Descent by the torrent side, leave it and cross a crest or ridge. *Búci* 160°, ...	1630	71
4	The path is along the steep and broken sides of a mountain, &c. very bad, last 500 yards difficult; turn some what dangerous corners, mouth of the *Dinni Gárh* 100°. The stream about 20 feet wide, and is a sheet of foam falling at an angle of about 20° to the *Ganges*. Direction of the small lake at its head 130°; *Reital* 210°; *Ouri* 40°; *Buci* 179°, ...	1810	42
5	Oblique descent to rivulet and water fall of 20 feet,	1010	350
6	Oblique rocky ascent, ...	1320	35
7	Along the side of mountain rocky: one difficult place: here begin descent towards the river—*Reital* 208°; *Buci* 198°; *Salung* 206°; *Ouri* 45°; angle of depression of our path to the river 17°. It is 4 furlongs direct to right and deep below, ...	1600	43

8	Cross *Camaria Gádh* (rivulet) 8 paces wide,.....	1710	50
9	Down the narrow glen of the rivulet to its junction with the *Ganges;* the whole a descent, and in many places bad and difficult, over large blocks of rock which have fallen from above, and overturned and shattered all the trees, in their course. The granite precipices, which confine the river at this place, have split and fallen in large masses into the bed of the stream,	1360	50
10	Path along the side of the *Ganges*, but above it. A cascade opposite falls 800 feet, but not in one sheet, river up to 6°; path rocky, ...	1860	42
11	Across the river and on its steep bank is a range of hot springs; they throw up clouds of steam, and deposit a sediment of a ferruginous colour; these are the first hot springs I have observed on the *Ganges;* the river not being fordable, we cannot go to them,.....	1000	6
12	Huge blocks of rock fallen to left,.....	560	6
13	Climb over and under the ruins of a most tremendous fall of the precipices; blocks of granite from 100 to 150 feet in diameter are thrown on each other, in the wildest and most terrific confusion: the peak whence they fell is perpendicular and of solid rock. This fall took place 3 years ago, ...	2120	350

Path better, ...	320	352
Cross the *Ganges* by a *Sangha* made of two stout pine spars, laid from rock to rock. It is a good bridge of the kind and about $3\frac{1}{2}$ feet wide; the space between the pine spars is overlaid with small deal shingles which are tied together so as to form a platform.—Like all the rest, this *Sangha* is open on both sides, and unpleasant to pass, being from the length and elasticity of the pines, so springy as to re-bound to every step the passenger takes.—The river below the *Sangha* was deep, and very rapid, being confined by rocks. Its breadth under the *Sangha* as measured by a chain was 50 feet, height of the *Sangha* above the stream 30 feet.—The river is more expanded above and below — *Sanghas* are always placed in the narrowest parts, ...	400	20
Tent at *Dangal*, a small flat so called, on the left bank of the *Ganges*, and at the confluence of the *Limea*, a large torrent—No village here. The halting place is surrounded by high and steep rocky mountains and mural precipices: observed some bears climbing among the rocks.	230	31
	19,569	

Time of marching 5 hours and 48 minutes, a very laborious journey. The path is very rough and merely a succession of steps from one broken crag to another; some places were very difficult. To the *Ganges*, was descent, then we passed along its bank, and at no great height above the stream, which though not wide is deep, and impetuous, falling from rock. In the less rapid parts pools are formed, where the breadth may be 200 feet, but generally it appears from 100 to 120 feet wide; several rills besides those noted above, fall into the river; it is needless to say, that they fall in cataracts, the sides of the river, being every where bounded by high cliffs. The rocks are granite, of much the same composition, as on yesterday's march. The dip of the *Strata* is about 45° towards N. E. as usual, and the whole line of inclination is visible from the river to a great height above. Water boils at 202°—The temperature of the air being 54°. On our return, the Barometer was deranged at this place. It is to be remarked, that on going up we did not fill the Barometers, fearing they might be broken, and the Mercury spilt, of which we had very little; our store of it having been diminished, by those various accidents to which every thing that can be lost, or broken, in these rough regions is subject. Of these Barometers more hereafter.

Latitude Observed.

M. A. Spica. Reflecting Circle, HODGSON's	30°	54	32	8
Lieutenant HERBERT's....			28	8
Mean.....	30	54	30	8

T

23d May, Dangal to Súoi.

		Paces.	Degrees
1	Lofty cliffs on both sides of the river; path generally a slight ascent but rocky and difficult,...	1005	14
2	Along the bank of the river. On Rocks. *Narai* peak crowned with snow, 43°. *Kanouli Gádh*, torrent falls in cataracts from right bank 15°; *Bús* peak 18°,.....	800	3
3	Path rocky and rough above the river, ...	1005	10
4	Path ditto, granite rocks, steep and high on all sides,.....	1010	18
5	Cross the river on a *Sangha* at *Deoráni Ghâti*, it is a new and good bridge of the kind, but long and very elastic; height above the stream, 40 feet, breadth of stream under the *Sangha* 30 paces or about 60 feet. The high flood mark of the stream when swollen appears to be about 14 feet, above the present level. A wild and savage looking place. Precipice around, granite and some black and grey rock of a laminar texture.—Rocky path from last station.—Pines of various kinds, and the true deal fir grow here: immediately on passing the *Sangha*, the path leads over an *Avalanche* of snow which reaches to the river's margin; it is many feet thick, and has fallen this year, and brought down all the trees in its path. This		

is the first snowbed we passed over on the *Ganges*.

6 Path along right bank. The river a bed of foam falling from rock to rock. Five hundred yards further on, are the falls of *Lohari Naig*, where the river is more obstructed than in any part of its course and tears its way, over enormous masses of rock, which have fallen into it from the mural precipice which bounds its left shore. This frightful granite cliff of solid rock, of above 800 feet high, appears to have been undermined at its foot by the stream, and the lower and middle part have fallen into it, while the summit overhangs the base and the river—The vast ruins of this fall extend for about a quarter of a mile; the river has now forced its way through, and partly over the rocks, with a noise and impetuosity, we thought could not be surpassed, but on our return in June, when the *Ganges* was doubled in depth, the scene was still grander. It then just covered the tops of the rocks, and one of the falls of the whole stream, we estimated at 25 feet perpendicular, and below it were more, close to each other of little less height. The scene is full of sublimi-

ty and wildness, and the roar of the water is astounding.

On the right Bank also, there has been a recent large slip of the mountain, but the above mentioned on the left bank, is for its height, the most formidable fall I ever saw. It is not recent.

7 Cross the *Ganges* by the *Sangha* of *Lohari Naig* 16 paces long and 25 feet above the stream; which is here narrow, deep, and has a great fall; the ends of the *Sangha* (which is very narrow) are supported on each side on 2 great tabular granite rocks. That on the right bank is circular, and 150 feet in circumference. It is of a coarse brown granite, with quartz intermixed, and is decomposing in some places. The mountains on both side of the river are very steep. On the left bank of the river observed a rill, impregnated with calcareous matter, which is so abundant as to incrust every thing it touches very strongly, and we collected large pieces of this lime, which is pure, like that at *Sansár Dhára*—This is a singular thing in a region of granite..... 1410 26

8 The *Lot Gárh* river joins the *Ganges*, cross it by a good little *Sangha*. This river is 20 feet wide. This last station has been almost level, and a good and pleasant path, along a flat of 150 yards wide by the river side, shaded by *Cáksi*, *Mírei*, *Omil*, and other trees. From the edge of the flat, the rock rises in a gigantic mural precipice of about 1500 feet perpendicular, and the same across the the river. *Strata* much inclined. The *Lot Gárh* river, comes from the snow to the right, and is very rapid. *Ganges* here expanded and the scenery beautiful. *Lot Gárh* up 120..... 1500 25

On our return breakfasted here,

Barometer.....23 144

Thermometer attached 53

Detached..... 56

9 Pleasant path and good by the river side, which is more expanded, and the channel not so rocky. Breadth 150 to 200 feet, a snow *Avalanche* here, leave the low bed and begin ascent,.... 1008 8

10 Strong ascent, first 500 paces, East, then 5°; here begins very steep ascent,..... 1392 90 50

11 Very steep and difficult descent, open to the left, and the river deep below, a mural precipice,

	across the river with well defined strata, at an angle of about 45°. The strata are so arranged in these regions, which are the feet of the *Himálya*, but I have observed, that near the tops of the *highest* peaks, the layers of rock are *nearly horizontal*. Name of above mountain *Baldera Lúru*; steep as it is and nearly devoid of soil, the pines nevertheless contrive to fix their roots in many parts of it,.....	510	300
12	Bad and narrow path overhanging the river. The *Soan Gádh* (river) joins the *Ganges* below, to West; course from snowy peaks 286°, appears to be 30 feet wide and not fordable, very rapid,.....	548	360
13	Oblique descent, not steep, but difficult over lumps of broken rock, the ruins of a slip of the mountain,.....	792	5
14	100 feet of ascent, at an angle of 70°, rest, descent of the very steepest kind; in the worst part, the path is narrow, and over hangs the river, 2 or 3 places are unpleasant to pass,.....	592	5
15	Last 1000 paces an agreeable change, being a good path where one may walk at ease, *Avalanche* of snow to right, and a large slip of the mountain, the ruins of which obstruct the path,	2500	8

16	Bad and rough, here cross the *Ganges* on a *Sangha*, about 45 feet above the stream, breadth of the roaring stream below 17 paces, or 42 feet. The bridge about 2½ feet wide, ill secured and unsteady, it extends from one large rock to another. The current extremely violent, and the fall of the river great, ...	1270	5
17	A Torrent from the *Suci* mountain falls in here, at this *Sangha*, on return, barometer 22in. 90. thermometer, 52.....		
18	Long ascent to *Suci*, a decaying village of 9 houses, of which 3 only are inhabited. It is on the West side of a mountain, and surrounded on all sides, by the *Himálya* rocky precipices, crowned with snow. The river is about 1,000 feet below, foaming in a confined channel, ...	3000	5
		19,394	

As to the march, it was very long and laborious, we performed it in 7 hours, propably ⅓ of it was hand and foot road. The rest except the two places of flat mentioned above as usual, a succession of long strides or little careful steps from one broken crag to another. The three *Sanghas* over the river, having been lately repaired are not dangerous, but too high, narrow, and elastic, to be pleasant to cross: the people from the

plains passed them very well (three persons excepted) but many of the mountain coolies, were obliged to be led over, with their eyes shut, as well as some of the *Goorkha* sepoys. To get well over then, it is proper to take careful steps (but not to go too slow) and to keep ones eyes steadily fixed on the platform, and by no means to look over the side, at the foaming gulph below, or to stop or hesitate when on the *Sangha*. The scenery to day was in nature's grandest and rudest stile, wall like precipices of compact granite bounding the river on both sides, to the immediate height of 2 or 3,000 feet: above these cliffs is snow.

Latitude Observed.	M. A. Spica.	Hodgson; Circle,	30°	59' 40" 5
		Herbert; Sextant,	30	59 40
			30	59 40 25

24th May, Súci to Deráli, Thermometer O. R. 45.

		Paces.	Degrees
1	Road along side of mountain, moderate ascent.....	742	46
2	Crest of rise—*Ganges* up 14.....	510	46
3	Descent and cross the *Ganges*, by a *Sangha*, length of the Bridge 115 feet, breadth 3 feet—breadth of the river: below, 82 feet—depth to the surface of the water, from the *Sangha* 19 feet (measured by the chain,) This is the best *Sangha*, on the river and the water below is not so rapid as usual—*Jhala* village of 5 Houses, 340; above *Jhala*, the country is		

not at present inhabited, ... 1300 18

4 A fine view up the river which for several miles above this, flows in a more expanded bed in a narrow valley; the feet of the mountains bounding it, are less steep, and are clothed with cedars. Good path along sand and pebbles in the river's bed, the current of which more gentle though very swift. The bed is about 600 yards wide, and will be overflowed when the river is at its height. Lower line of snow, generally, 2000 feet, above the river, though several *Avalanches* reach down to its margin, *Jhala* 220°; *Soan Gádh* river (mouth of) 6°. The air is very cold, ... 2000 11

5 Ascent and descent of a rocky point above the river. We have now turned the snowy range, seen from the plains, and brought it to our right, as will be seen by the change in the course; the march from *Dangal* to *Suci*, and on to this place, may be considered, as in that gorge of the *Himálaya*, through which the river forces its way, to the foot of those mountains of the second order, which are the beginning of the spurs of the grand range. We have now the great snowy peaks on both sides of the river, and it is henceforward bounded by them; those to the right, are visible from *Hindustan;* those across the river, or to our left, are not visible from the plains, being hid by the southern

ridges. The line of the outlet of the river is very perceptible from the plains, and the *Sricānta* peak, the western foot of which it washes here, is conspicuous from *Seharanpur*, and the *Doab*. From hence onward, the course of the *Ganges* is to be considered, as being within the *Himálaya*, differing from the *Jumna*, in as much as that the source of the latter river, is at the south west feet of the snowy peaks, seen from *Seharanpur*, and not within the *Himálaya*.

6 Pleasant and level; a snowy peak towards *Barrasah* shews itself up the *Soan Gádh*: it is called *Dumdara*, and is very white with snow; mouth of the *Soan Gádh* 322. Down its bed the plunderers from *Barrasah*, and the western districts of *Rawaien* penetrate in the latter end of the rains. As far as *Barrasah*, the country is uninhabited for six days journey except at *Leuh panch Gong*, which is three *Coss* on this side of *Barrasah*. Those districts are on the *Tonse* river, and are the seat of numerous gangs of plunderers and murderers, who much infest this part of the country, ... 595 50

7 Pretty strong ascent, but good path, in the cedar forest, obliquing up and down, from the river, ... 2200 51 88

8 Pleasant in a forest of many pines, ... 438 78 3

9 Ditto; top of oblique ascent. Descent to dell, ... 350 90

10 Descent to brow of small precipice, overhanging the river which here falls at a considerable angle. Mouth of the *Harúl* large rivulet 345°, 7 furlongs, comes from 30°, from snowy peaks. Here forest of cedar and the true deal pine which is a tall and graceful tree, ... 600 100

11 Ascent and descent to precipice over the river. Across the river is a small plain of ½ mile wide, where there was once a village, called *Suor*, ... 415 80

12 Cross a torrent from the snow, ... 265 80

13 *Búghti Gádh* (torrent) falls in opposite at right angles. Here oblique descent, cedar forest, ... 335 ditto

14 Descent to the bed of the *Ganges*, and cross the *Til Ghár* a large torrent, which falls in a most beautiful and picturesque cascade of 80 or 100 feet, over a rock, bordered and shaded by high feathery pines and spreading cedars, ... 495 90

15 Flat, over sand and pebbles of the river bed, here expanded, ... 500 75

On our return we halted at this place to take the altitude of two very sharp snowy peaks, which now appeared to the south, or to our right. We measured carefully with the chain, a base of 165 feet, which was the greatest extent of level ground to be found; with this base we found a longer line of 1568 feet, and from its extremities, determined the distances of the two

peaks, and their heights above the east end of the base as follows:

First peak called *Sewmarcha Chaustal*, distance 16440 feet, bearing due south. Its angle of elevation 26° 43' 42" and height above the river 8278 feet.

Second peak no name, but it is a lower part of the *Sricánta* mountain.

Distance 15374 feet.

Magnetic bearing 170° 43'.

Angle of elevation 25° 55' 30".

Height 7473 feet above the river.

Barometer 22 inches, 249: thermometers attached 79°.

Detached 78°.

16	Last 700 paces 82°, and ascent first part flat,.....	1700	75	82
17	N. B. On our return we found gooseberries at this place: they were of the large hairy kind, and though not ripe, made good dumplins,.....	1090	63	74
18	Gradual descent, and cross the *Kheir Gádh* large rivulet, by a *Sangha*, at *Derali*, a village of 6 houses but now deserted, on account of the failure of the crops and incursions of banditti,.....	810	88	
	Miles by the wheel 7m 6f being 13200 yards for paces,	14345		

The road to-day, considered as a mountain path, was excellent, two or three places excepted. The north bases of the mountains which we passed

along, are moderately steep, and are clothed with noble cedars, and various sorts of large pines, of which the *Cshír* and *Rhai* or *Rher* are the largest; *Cshír* is a name indiscriminately given to several of the large leaved pines, but the tree so called here, is the true Deal; it grows to a great height, and bears a resemblance to the common *Cshír* or turpentine fir, which abounds in the lower hills, but which is never seen in company with the cedar, *(Deodár.)* I took some specimens of this Deal, it is light and has a fine grain: the *Rhai* is a lofty pine, it has a graceful appearance, the leaves are pendent. The wood of it is not esteemed for building, being heavy and knotty: the cedar is always preferred for that purpose. From the *Sangha* to *Deráli*, the *Ganges* flows in an expanded bed with a swift current over stones. Yesterday it was a succession of falls from rock to rock, and bounded by frightful precipices. To-day the scenery was very interesting, the river being bounded immediately to the north by the cedar forests; above which, towered the sharp snowy peaks, and many torrents and cascades fell from them. I never made a more delightful march; the climate is pleasant and the weather bright to-day. The village of *Deráli* is situated in a rocky recess and commands a fine view of the river, and of the north sides of the snowy peaks behind *Jamnautri*. There are three small temples of stone by the river side, they are of good workmanship. *Derali* was plundered last year by banditti from the westward.

Latitude Observed M. A. Spica. Reflecting circle,	31°	2′	25″	
Lieut. HERBERT, M. A. D. Sextant,.....			8	
Mean, ...	31	2	16	5

Pole star hid by the mountains as usual.

		Paces.	Degrees.
	25th May, Derâli, to Bhairo Ghâti. Thermometer, sun rise 54°		
1	Much rain here this morning, and snow above: steep and almost perpendicular ascent, from the village up a mass of rock, ...	310	85
2	Cross a torrent 7 paces wide on a *Sangha*; path in general level on the banks of the river but occasionally slippery and bad, ...	1400	78
3	Road generally level along bank in the cedar forest. Cross a large snow avalanche, ...	1300	89
4	Road as above, cross a large avalanche of snow. Cedar forest; rocky mountains across the river almost perpendicular, ...	1800	73
5	Crest of nearly perpendicular, and difficult short ascent: crags overhanging and threatening to fall. The river bed the whole way broad and strong current. *Derâli* 256°; lofty peaks on every side, rising immediately from the river. This place is 1000 feet above it. Cedars of great size here, ...	1210	68
6	Road generally level, on bank of the river: cross an avalanche of great magnitude, being a fall of lumps of snow like large rocks, it has brought down, and broke to pieces, all the cedar trees in its path; perpendicular, rocky precipices rise immediately from the river bed, to the height of 1500 and 2000 feet; high snow peaks on all sides, large cedars at their feet, ...	1900	103

7	Path as above in cedar forest. Wall like precipices of great height rise from the river bed, above them is snow,.....	1714	105
8	Cross *Licunga* a small river on a *Sangha*, a little above its mouth, falls from the snow to right and joins the *Ganges*,.....	837	138
9	An exceedingly steep ascent; river not visible but close below mountains with bare peaks, not a blade of herbage on their rocky sides. In front *Deeani* snowy peak 105°, to our left a mountain called *T'hui*, the S. side of *Decani* is washed by the *Baghiret'hi*, and the N. side by the *Jahni Ganga* or *Jahnevi*, their confluence being at *Bhairoghati*. This place is called *Ratenta*,	780	140
10	Another steep and toilsome ascent,.....	1065	110
11	Descent over broken fragments of peak. A rocky precipice nearly mural of 1000 feet, overhangs the right bank of the *Ganges*, which here as usual rushes over rocks with an impetuous and foaming current. In front is the gigantic peak *Decani* rising immediately from the bed of the river, on the left the almost equally high one of *T'hui*, below, immense masses of granite overhang the river. The scenery is very grand. Very large cedars here,.....	930	130
12	*Jahnevi* river 72°.....	343	102
13	A sweep from S. to E. brings us to that most terrific and really aweful looking place called *Bhairoghati*.		

The descent to the *Sangha* is of the steepest kind and partly by a ladder. The *Sangha* is inclined far from the level, and as seen from the height above it, cannot fail to inspire the beholder with anxiety as to his safe passage over it. It is indeed by far the most formidable *Sangha* I have seen; the height of the platform above the river, we measured by dropping the chain; it was 60 feet; one is apt at first sight to estimate it at much more, however this height, added to the circumstances of the narrowness of the *Sangha* (about $2\frac{1}{2}$ feet wide) its elasticity, and its inclined position, is sufficient to render its passage disagreeable, it being (like all the rest) quite open at the sides. It is laid from one side of the precipice to the other, the end on the left bank is the highest, the precipices in some places are quite perpendicular, in most, nearly so, rising to the height of 3000 feet above the stream, they are of compact granite; on some ledges there is a little soil, where the cedars fix their roots. The river below the *Sangha* is closely confined by the wall like rocks, which are perfectly perpendicular, and its course is thus bounded, nearly to *Gangautri*. The breadth of the stream is about 45 feet, and it is deep under the bridge, ... 600

14 Turn to the left by a rocky path to our tent, ... 280 60

13,769

WHICH is in a very strange place for a tent to be in, and one of the most curious sights among many here, is to see a little tent pitched under vast overhanging masses of rock, at the confluence of these two rivers, the *Bhágírat'hí* and its foaming rival the *Jáhni Gangá* or as more properly called the *Jáhnevi*, the strange and terrific appearance of this place (*Bhairog'háti*) exceeds the idea I had formed of it: no where in my travels, in these rude mountains, have I seen any thing to be compared with this, in horror and extravagance. Precipices composed of the most solid granite, confine both rivers in narrow channels, and these seem to have been scooped out by the force of the waters. Near the *Sángá*, the *Bhágírat'hí* has in some places scolloped out the rock which overhangs it. The base of these peaks is of the most compact sort of granite, it is of a light hue, with small pices of black sparry substance intermixed. From the smoothness of the rocks which confine the stream, and which appear to have been worn so by water, I think the stream must have formerly flowed on a higher level, and that it is gradually scooping its channel deeper, for it does not appear that the walls which confine the rivers, are masses fallen from above, but that they are the bases of the peaks themselves. Enormous blocks have indeed fallen, and hang over our heads in threatning confusion, some appear 200 feet in diameter, and here are we sitting among these ruins, by the fire side at noon.—Thermometer 52°. What are these pinnacles of rock, 2 or 3000 feet high which are above us like! I know not. To compare small with great, I think the aptest idea I can form of any thing that might be like them, would be the appearance that the ruins of a Gothic cathedral, might have, to a spectator within them, supposing that thunder bolts, or earthquakes had rifted

its lofty and massy towers, spires and buttresses; the parts left standing, might then in minature give an idea of the rocks of *Bhairog'háti*.

THE great cedar pines those gigantic sons of the snow, fringe these bare rocks and fix their roots where there appears to be very little soil, a few also of the larger deal pine, are seen, but inferior trees do not aspire to grow here. The day is dull and rainy, and I cast my eyes up at the precipice overhead, not without awe, a single fragment might dash us to pieces. Avalanches of snow and rock such as we have passed to-day, and indeed for these three last days, shew by their effects, their vast powers of destruction, for they bring down forests, in their overwhelming course, and dash the cedars into splinters. These avalanches have all fallen this season, they have in places filled up the dells and water courses to a great depth with snow, and extend from the peaks to the margin of the river.

A PAINTER wishing to represent a scene of the harshest features of nature, should take his station under the *Sánga* of *Bhairog'háti* or at the confluence of the *Bhágírat'hí* and *Jáhnevi* rivers, here it is proper to take some notice of this latter river hitherto little known. Though the *Bhágírat'hí* is esteemed the *holy and celebrated Ganges*, yet the *Jáhnevi* is accounted, to be and I think is, the larger stream. From a *Bráhman* who officiates at *Gangotri*, and who has been up it, I collected some particulars which though perhaps far from correct, may serve to give an idea of it. By the course of the river is a pass to *Bhoat* or *Thibet*, by which the people from *Reital* and the upper villages of *Rowaien*

go to get salt, blanket cloth and wool, in exchange for grain. The trade is trifling, and not more than 100 people go yearly, in the latter end of the rains the road is open. They carry their goods on sheep and goats. The *Bráhman* has been at the frontier village called *Neilang*, it is four long, and very difficult days journey. The first three days are up the course of the river, high above its bed, for the most part, but occasionally descending to it. It is exceeding steep and difficult.

1st Day.—They go along the high precipice on the right bank of the river—a *Sángá* at the end of a long march. Very bad path—no village.

2d Day.—Having crossed, very bad path to *Cartchá* a halting place—no village. Cedar pines here.

3d Day.—On same bank of the river to *Handouly*, a halting place, but no village. Not a very long march.

4th Day.—The frontier or *(Do-bhá-shiás)* village called *Neilang* in the district of *Tungsah*, at this village, the river seems (they say) but little diminished in size, and there is a *Sángá* over it. This man can give no account of its origin, except that he believes it comes from some hills in *Bhoat*. The first part of the course of the river upwards, so far as can be seen from *Bhairog'háti* is 72° N. E. and from what I can understand, it appears that this river has its source to the north of that ridge of the *Himálaya*, which bounds the *Bhágírat'hí*, to the N. E. or on its right bank, and that, between *Bhairog'hátí*, and perhaps the third day's

march abovementioned, it forces itself through the range. The *Brahman* says that at the village, and for the last day's march to it the mountains are bare of trees, and that they are not the *Cylás* mountains (i. e. not what we call snowy mountains, but that the *Cylás* peaks towards *Gangotrí* are seen to the right, and so they would be, if we suppose the course of the *Jáhnevi* up, to be about N. 70 East; and the course of the *Ganges*, is, we know from hence considerably to the S. of East. By the way I may mention here, that *Cylás* is a general appellation for high ranges always covered with snow (in the same way as we say *Himálaya* or *Himáchul*, (which last indeed literally means snowy peaks). At *Neilang* the houses are built very low, on account of the high winds. Travellers suffer much from difficulty in breathing caused as they say by the *bic'h* or *bish* i. e. exhalations from poisonous herbs which grow on the high bare knolls. This frontier district of *Tungsah* appears to be considered to belong, to what they call here *Bhoat* or *Thibet*, and they pay their land tribute to a collector who comes from *Chaprang*, of the distance or size or direction of *Chaprang* I could not get any satisfactory account, but it appears to be a *Chinese* dependency. The district also gives to the *Rajá* at *Bassáhir* a blanket per man every third year, and a small complimentary tribute of *Dác'h* (raisins) to the *G'harwál Rájá*. The inhabitants are called *Do-bháshiás* from their speaking the languages of both *G'harwál* and *Bhoat* and they act as interpreters and brokers.

THE exports from *Rawaien* are, rice, *mandwá* and *páprá* (coarse grains) *Tobacco* and *Tamashas*; Imports, salt, and thick woolen cloth and wool.

THE *Rawaien* people go in the month of *Cártic*, because the wool is then ready, but in the month of *Sáwan* the road may be passed, and that would be the best time to go.

HAD the season been more advanced and if I had had grain I should have been tempted to go up this river, it is an interesting object of future research, but there are many others and one does not know which to attend to first, but it is my intention to explore this river next season.

LATITUDE observed. Confluence of the rivers at *Bhairog'háti*.

M. A. Spica, 4 sets 30°, 01', 38", ·7 cloudy weather and no other star visible.

WATER boiled at 198°. The air being 44°.

ON return June 3d.—We encamped in a much better place, a small piece of flat at the summit of the cliff which bounds the *Ganges* on its left side. It was a pleasant and secure situation and under the shade of the cedars. At this place, about 700 feet above the river, the barometer (unboiled mercury) stood at 21^{in} 524 tem perature of air 70°.

LATITUDE of this camp 30°, 01', 22", ·5 good observations, junction of *Bhágirat'hí* and *Jáhnevi* rivers 72° distant 1 furlong.

26th May—Bhairog'hati to Gangotri—Thermometer 40°

		Paces	Degrees from N.
1	A very steep and difficult ascent, we pass along the perpendicular face of the precipice by means of a scaffolding of two narrow planks, which appear very rotten and ill supported at the ends, under the scaffold is a chasm of 300 feet deep. Immediately afterwards ascend by ladders, the precipices bounding the river being here like walls and these scaffolds and ladders are laid from projecting points to enable one to pass,	330	170°
2	Three other passages along the precipices, and over chasms by means of rotten planks, then an exceedingly steep ascent by short zigzags to a flat, at the foot of *Decani* peak, here is a small temple of *Bhairo Lal* who is esteemed the janitor of *Gangotri*, at this place, pious *Hindús* leave their shoes, ...	475	21
3	Road tolerably level, winds rounds the South West side of *Decani* peak, the river is about 800 feet below to the right and rising from its bed is a wall of mountains of a height I find it difficult to estimate, below to the river steep precipices—*Sewri* peak 236° *Miánri* peak 150°, ...	700	140
4	Path very difficult, a few paces further on cross another frightful chasm by a platform of a foot or 18 inches wide—Road over masses of granite piled in confusion, they are fragments of a fallen peak. Looking up we		

		Patts.	Degrees.
	see the tower-like summits of *Decani* almost overhanging us. The whole way strewed with falls of rock from them. . .Many traces of bears—.....	630	160°
5	Wind round the brow of the hill, and come upon an opening where the eye is saluted with a full view of *Mulnri* peak, and in the distance the mountains of *Rudr-Himalaya*, crowned by the peak of *Dugdi* towering to a great height, the pure snows on it shine in the suns rays with dazzling brilliancy,.....	690	140
6	Bad and slippery path, as before high rock above to left, the river deep below to right cedars here,.....	310	126°
7	Ditto.....ditto.....ditto.....	230	133°
8	Rather better path, the river deep below foaming in its narrow and rocky bed, most fantastic great snow peak over *Gangotri* 119°,		
9	Black rocky peak across the river—Call it Iron Sides 125° 30',.....	1500	133
10	Better path but broken, and a torrent falls in from the snow across the river 200°—Iron Sides 129°—Cedars—Not much ascent or descent, path hence chiefly undulating and lying along the steep side of the mountain,	3900	127
11	A long steep side. River deep below in a steep confined channel of light coloured granite. Cedars here—Iron Sides 129°,.....	720	127
12	Path as before, across the river is a cascade falling through a large snow bed, the snow reaches in several places		

		Paces.	Degrees.
	from the river bed on the opposite side to the summit of the mountains which are very steep. We are almost in sight of *Gangotrí*, ...	390	95°
13	The river flows under beds of snow which have fallen into it, from the peaks, and cover it, ...	1692	96
14	Steep ascent and cross a torrent, ...	292	32
15	Pass above a Cascade falling over a precipice of grey granite with black sparry spots. Wonderfully steep precipices on both sides of the river, on this side the rocks are quite bare and shattery, ...	1082	92
16	Cross above a Cascade falling from a rocky gorge to the left—Path extremely bad. This river below foaming between walls of rock perfectly perpendicular. A *Sángá* (now destroyed) had formerly been laid over at this place, by the banditti who in the rains plunder the *Cédárnáth* districts to the Eastward. The rocks through which the river flows have horizontal strata and the light hue of *Portland* stone—They are as usual, granite—The cedars here are poor and starved—Very high bare rocks above to left. *Rudr Himálaya* a snowy peak 95°, ...	1510	96°
17	Descent. *Gauríound* a small flat space by the river side—On the opposite side the *Cédárgangá* falls into the *Ganges* from 107°. It has no claim to the title of a River, being merely a torrent from the snow, of 10 or 12 feel wide and shallow. It comes out of a rocky		

gorge, and its course cannot be longer than three or four miles,..... 1352 105°

18 *Gangotrí*. The small temple of *Gangá Máí* and *Bhágirat'hí*, on right bank of the *Ganges*,..... 575 Do.

16,378

THE path to-day was of the worst description, and is on the whole I think the most rugged march we have hitherto had, though there are not any long ascents. Nothing can be more unpleasant than the passage along the rotten ladders, and inclined scaffolds, by which the faces, and corners of the precipices, near *Bhairog'hátí* are made. The rest of the way lies along the side of a very steep mountain, and is strewed with rocks. The views of the snowy peaks which are on all sides, were very grand and wild.

THE rocks are of granite, but of a lighter colour than usual, and specks of a bright black sparry substance are interspersed in them, at the distances of from one to three inches.

THE rivers bed from *Bhairog'hátí* to *Gauricund*, was between mural precipices of 2 or 300 feet high; above them was the steeply inclined ground, along which our path laid.—Though very rocky, there were many places with soil, where the cedars grew, but not large—Above the path to our left were bare rocky precipices, on the summit of which the

snow lies: at *Gaurícund* and *Gangotrí*, the rivers bed becomes more open.—The temple at *Gangotrí*, is a *Mundup* of stone of the smallest kind; it contains small statues of *Bhágirat'hí*, *Gangá*, &c. and it is built over a piece of rock, called *Bhágirat'hí-Śilá*, and is about 20 feet higher than the bed of the *Ganges*; and immediately above its right bank, there is also a rough wooden building at a short distance for the shelter of travellers.—By the rivers side, there is in some places soil, where small cedars grow; but in general the margin is strewed with masses of rock, which fall from the precipices above—the falls do not appear recent.

Too much tired to attempt to boil mercury in the tubes to-day.—At night, having prepared the instruments to take the immersion of one of Jupiter's Satellites, we laid down to rest, but between 10 and 11 o'clock, were awakened by the rocking of the ground, and on running out, soon saw the effects of an earthquake, and the dreadful situation in which we were, pitched in the midst of masses of rock, some of them more than 100 feet in diameter, and which had fallen from the cliffs above us, and probably brought down by some former earthquake.

THE scene around us, shewn in all its dangers by the bright moon light, was indeed very awful—On the 2d shock, rocks were hurled in every direction, from the peaks around, to the bed of the river, with a hideous noise not to be described, and never to be forgotten: after the crash caused by the falls near us had ceased, we could still hear the terrible sounds of heavy falls in the more distant recesses of the mountains.

WE looked up with dismay at the cliffs over head, expecting that the

next shock would detach some ruins from them; had they fallen, we could not have escaped, as the fragments from the summit would have flown over our heads, and we should have been buried by those from the middle.

PROVIDENTIALLY there were no more shocks that night. This earthquake was smartly felt in all parts of the mountains, as well as in the plains of the N. W. provinces of *Hindustan*.

IN the morning we removed to the left bank of the river, where there is a bed of sand of about 150 yards wide; then is a flat of soil with trees of about 20 yards wide, and immediately above it are precipices with snow on them; here we were much more secure; in the afternoon, indeed, the effects of the snow melting, often caused pieces of rock to fall from above, to near our station, but we could avoid them by running over the sand to the river side, which could not be done on the right bank; besides only comparatively small pieces fell here, and in day light, so that this is much the best side to encamp on.—We had the curiosity to measure trigonometrically the height of the cliff, at the foot of which we were during the shock, and found it to be 2745 feet.

THIS day, the 27th, we had a slight shock of an earthquake, as well as so on the 28th.

Barometers.

Filled a new and full length clean tube with pure mercury, immediately after filling (unboiled), it stood at

	In.
20.	890

Thermometer attached..78°
Ditto detached.....68°

Having hung the Barometer up in the tent, and allowed it to acquire the temperature of the air and adjusted zero, the following heights we observed:

Thermometer attached 77½° } upper surface of the
Ditto detached 63° } Mercury..... Inch 20. 8320

Second reading an hour afterwards, } .....20. 8065 At. Th. 69°
Mercury upper convex surface }

Lower part of head of column { ..... 7335 Det. do. 67°
{ 7410

Ther.°
An hour afterwards upper convex.....20. 8255 72
Lower line..... 8080 61°

Afternoon, outside of the tent three hours after filling the tube;
Mean at 4 o'clock.....20. 7842 57°

There were very few and but small (Air) bubbles in the column, and the vacuum was evidently pretty good, as shewn by the smart cracking of the mercury against the top of the tube.

Water boils.....196°

We now begin to boil the mercury in the tube. The tube as usual broke. None but a professed artist can expect to succeed in this difficult business, once in ten times.—With the unboiled mercury, there must be an error, but it should not, I think, affect the heights more than 200 feet, and generally not 100 feet; and as under the present circumstances we *cannot do* more, we must be content with such approximate

altitudes: and I reckon it of some consequence, to have the heights of these places even within 200 feet, as *hitherto no idea* could be formed on the subject.

WHEN a tube is filled with unboiled mercury, which of course contains air, it stands at first *higher* than it ought, from the air dilating the column; but, after a short time, much of the air escapes into the upper part of the tube, where the vacuum ought to be, and there expanding, presses *down* the mercury in the tube, thus making it *lower* than it should be. The mean height will not differ very much, perhaps not more than two tenths of an inch, in moderate heats, from that shewn by a boiled tube.

THE barometers I had, were 2 out of 6 sent from England, to the Surveyor General's Office; they were made by BERGE, and are very fine instruments, but so little attention had been paid to their packing, that the tubes of them all were found to be broken, when they arrived in Calcutta, as well as most of the thermometers belonging to them: there were spare, but unfilled tubes sent with them, and some of these would not fit.

WHENEVER barometers are sent, there should be to each at least 6 spare tubes *filled in England* by the maker, and hermetically sealed, and these should be carefully packed in separate cases of copper or wood, lined with flannel, and the scale *downwards* should go to 13 inches: the

scale of these barometers only reaches to 19 inches. In instruments intended for *India*, *solidity* should be considered; we want those which will do their work *effectually*, and are not anxious that they should be *small* and easily *portable*, as we can always here find means of carrying them. The mean height of the column, by such observations as I thought most to be depended on, is 20. 837 inches; the temperatures of the air and mercury being 73° and 65°. From which, the height of *Gangautri* above the sea, calculated by M. RAYMOND's method, is..... 10319·4 feet

By Dr. HUTTON's method 10306.6

Latitude observed 27th and 28th May, 1817.

By me, reflecting circle, alternate faces, mean by A. and B. Libra.....	30°	59'	29"	
Large Sextant by BERGE—Lieutenant HERBERT, 4 sets ditto,			35	5
By me, reflecting circle—8 circummeridional altitudes of Spica, being 24 indexes, on alternate faces.....			27	1
Mean latitude of *Gangautri*..	30	59	30	5

THESE were good observations, and refraction is allowed on the altitudes, according to the barometer and thermometer; and all other corrections for precession, aberration, nutation, &c. are applied as usual.

THE pole star could not be seen on account of the height of the cliffs,

nor any star to the south lower than those observed.—The same cause most unfortunately prevented our being able to observe any eclipses of Jupiter's Satellites here, or the occultation of the star ♎ Libra by the Moon, and I was sorry to find that my chronometers could not be depended on to shew the difference of longitude in time: though they are of the best kind, and hung in gimbals, no method of carriage that I had *then* adopted could prevent them feeling the effects of the short and continually repeated jerks they received from the uneven steps, which the man who carried them on his back was obliged to make. Nothing except a staff can be conveniently carried in the hands, as they are so frequently employed in assisting the feet in difficult places.

THE *mean* breadth of the *Ganges* at *Gangotrí* was (measured by the chain) 43 *feet*, depth 18 *inches*, and nearly the same depth at the sides, as in the middle: the current very swift, and over large rounded stones.—*This* was on the *26th May*, the stream was *then* in one channel, but the effect of the sun in melting the snow was at that season so powerful, that it was daily much augmented; and on our return to *Gangotrí*, on the *2d June*, the depth of the main stream was 2 feet, and it was a few feet wider (but I did not then measure the width); several shallow side channels had also been filled in the interval, and on the whole, I estimate, that the volume of water was doubled.

THOUGH the frequency of the earthquakes made us very anxious to get out of our dangerous situation in the bed of the river, we resolved, as we had come so far, to leave no means untried to trace the stream as far

as possible, and accordingly set out on the morning of the 29th of *May*, hoping to arrive at the head of the river in the course of the day.—The two *Gangotrí Brahmins* could not give any information as to how far it might be distant; they had never been higher than *Gangotrí*, and assured us, that no persons ever went further, except the *Múnshí*, who appears, by the account in the *Asiatic Researches*, to have gone about 2 miles.

MR. James Frazer visited *Gangotrí* in 1815, and was the first *European* who did so.

May 29th. From Gangotrí, forward up the Ganges.

		Paces.	Brit. fran. Mi. Degrees.
1	Pass avalanche, and fragments of rock newly fallen, and which cover the path.....	600	88°
2	Ascend a snow bed, which covers the river, it is about 30 feet thick.....	524	ditto
3	Over the snow bed, and descend to the open stream. Here a gorge of huge rocks obstructs the stream; they have all fallen from above.....	397	ditto
	N. B. The *Brahmins* say, they never heard of any rock or place called the cows-mouth or *Gao muc'h*, or any thing like it, either in sound or signification.—We did not see or hear of any image whatever.		
4	River flows under a snow bed; a rill of water from the snow to right. High precipices on both sides, all the way.....	278	88

		Paces.	Degrees.
5	Alternate avalanches of snow and rock recently fallen.—River under an avalanche of 500 feet thick, the snow hard and frozen	900	80
6	In rocky bed of the river. Ascend a rock 35 feet high by climbing. River much confined, and the fall great	485	80
7	A great fall of the peaks.—River bed filled with fallen rocks, and difficult to pass.—The stream, a succession of cataracts. High peaks above	691	80
8	Over fragments. Here the river falls out of a snow bed, in a cascade of foam; ascend the great snow bed	500	ditto
9	Strong ascent of the snow bed, which is about 100 feet thick, over the river	221	80
10	Cascades of the river. Pass through masses of rock, difficult to climb: precipices above	1000	90 60 15
11	Cross a torrent 6 feet wide and 9 inches deep; it comes from a cleft in the peaks to the left. River here under a snow bed; from last station is a rocky path	969	82
12	River turns the foot of high snowy peaks to the right: precipices quite perpendicular to the left.—*Rudra Himálaya* peak 97°	853	82
13	Finding that the head of the river must be more distant than we expected, we sent back to *Gangotrí* for a small tent	50	103
14	High mural precipices rising immediately from the river		

		Paces.	Degrees.
	to the left: snowy peaks to the right, their summits about 6000 feet above us.....	340	110
15	Cross the river at some falls. We leaped from rock to rock with some difficulty.—Large rill to right: present general line of snow about 200 feet above us.—To the right, the face of the mountain has slipped.....	110	315
16	*Bhojpatra* (i. e. biroh) *jungle* to the right with some pines, but small and stunted.—Great mural precipices to the left.....	808	110
17	Begin to pass a great *snow bed*, from under which the river falls in a cascade.—Heavy slips of the mountain to the right.....	924	ditto
18	Ascend a very steep mass of snow, which covers the river; it appears to be 300 feet thick.....	340	360
19	Cross a rill.—To the right above us, are sharp snowy peaks 6 or 7000 feet high, at their bases is some soil, and loose stones, in which birch and small firs grow.....	752	110
20	Up the rocky bed of the river, and here ascend a very *large snow bed*, which reaches from the top of the peaks to the right to the river, and conceals it: the river bed here more expanded. The feet of the mountains to the right not so steep as hitherto. To the left are precipices. Saw some musk deer among		

			Paces.	Degrees.
the rocks.—From the top of the snow bed, a noble snowy peak (St. George) appears, bearing	132°	38′ 5″		
Altitude.....	10	40 5		
A snow peak behind us, distant about 20 miles, bears.....	284	24		
Altitude.....	3	02	1478	ditto
			Total Paces	12,220

ABOVE the left bank of the river, and by the side of the snow bed, are some birch trees and small long leaved firs, but no more cedars.—This being the only convenient or safe place we could see, we halted here. The river is perceptibly diminished in bulk already, and we hope that to-morrow we may see its head.—The march to-day was most toilsome and rough through the loose fragments of rock which daily fall at this season from the peaks on either side to the river, in the afternoon, when the sun melts the snow.—Travellers should contrive to gain a safe place by noon, or they may be dashed to pieces.

IT was very cold at this place, and froze all night, but we had plenty of firewood from the *Bhojpatra* trees.—The soil was spungy, and full of rocks.—The silence of the night was several times broken by the noise of the falling of distant avalanches.

BY the barometer, it appeared, we were 11,160 feet above the sea.—Water boiled at 193° of Fahrenheit.

A LITTLE tent, which one man carries on his back, came to us; but in this trip, we eat and slept on the ground, and were well pleased to have got so far beyond *Gangotrí*, hitherto the boundary of research on the *Ganges*.

Latitude observed.....30° 58' 59"

THE place we passed the night on is elevated above the left margin of the stream, being a sort of bank formed by the ruins of fallen peaks; but as the falls are not recent, nor the slope so steep, as in most places, the birch trees and various sorts of small pines and mosses have had time to fix their roots, and afford fuel and shelter.—A very long and deep snow avalanche reaches from the peaks above the left bank, down to the river, and conceals it. On the opposite side of the river, the cliffs are of great height and mural, except in one place where a tremendous fall has taken place, encumbering and obstructing the bed of the river. But these ruins are so frequent, that the traveller scrambles through them with little regard, except where the freshness of the fracture of the fallen masses of rock warns him to mend his pace, and get as soon as possible out of danger.

May 30th. Birch Tree, Halting place, forward. Ther. Sun rise, 32°

Set off from the middle of the snow bed.

		Paces.	Brs. from N. Degrees.
1	A torrent 8 feet wide, 5 inches deep, joins the river. Its edges are frozen.....	328	132°

		Feet.	Degrees
2	Cross a high avalanche of snow, which conceals the river; it is very hard frozen. The bed of the river begins to be wider; large isicles hang among the rocks	903	ditto
3	Ford a rivulet or torrent from the left 11 feet wide. Rocky and rough.—Gradual ascent.....	2412	ditto
4	Gradually ascending among rocks. To the left high cliffs of granite, but not so steep as before. To the right snowy peaks, their summits about 6 or 7000 feet high, distant about 2 miles. The river bed is here about 2 furlongs wide, and full of stones. River certainly diminished in size; it is very rapid, its bed being an ascent. We are now above the line of vegetation of trees, and past the last firs.—The birches remain, but they are only large bushes; laurels also are seen, and a sort of, I believe, *lichen*, which grows in the rocks.—The noble 3 peaked snowy mountain shines in our front, and is the grandest and most splendid object the eye of man ever beheld. As no person knows these peaks or their names, we assume the privilege of navigators, and call them St. George, St. Patrick, and St. Andrew: St. George bears 129, St. Patrick 132° 30.		
	N. B. On going further, we saw another lower peak between St. George and St. Patrick, which we called St. David, and the mountain collectively, the 4 Saints.		
5	A fall of the river of 12 feet over rocks, and a succession of smaller falls.—The inclination of the bed of the		

		Paces.	Degrees.
	river is considerable; it is filled with blocks of granite, white, yellow, and red, and we saw some flint. Very difficult moving here.—Great slips of the mountain to the left.....	980	132
6	Most difficult.—Over masses of rock, which have fallen from above to the stream.—This station is full of peril; being a very recent slip of the whole face of the mountain to the left.—The broken summits cannot be less than 4000 feet high; blocks threaten to fall, and are indeed now continually coming down: I have not seen so dangerous a slip.—The ruin extends about half a mile; every person made the greatest haste to get past this horrid place. The fracture of the rocks is so fresh, that I suspect this havoc must have been caused by the earthquake of the 26th, for we heard a great crash in this direction.....	1352	132 to 140
7	Over snow for the most part. An enormously high and extensive snow bed in sight, in front: it entirely conceals the river, but the stream is yet 20 feet wide....	615	180
8	Snow all round, and above and below, except where it has melted just here, on a convenient flat, between the river and the feet of the mountains to the left.—All beyond is an inclined bed of snow, as far as the eye can see, and there is no firewood; so we must halt here.—Call it halting place, near the *Debouche* of the *Ganges*	447	130
	Proceeded forward to reconnoitre, and returned.....	1034	

		Paces.	Degrees.
9	Up the river, and along snow.—Mount *Moira* 170, pyramid peak 200°	8071	
	Return to ⊙, 8 to halt for the sake of firewood. Deduct	1034	
		7037	

THIS is an excellent and safe place; no peak can fall on us; 5 companies, or even a battalion, might encamp here.—Sublime beyond description is the appearance of the snowy peaks now so close to us. The 4 Saints are at the head of the valley of snow, and a most magnificent peak, cased in snow and shining ice, stands like a giant to the right of the valley: this we named mount *Moira*. The snow valley, which hides the river, appears of great extent; to-morrow will shew what it is.

WE experienced considerable difficulty in breathing, and that peculiar sensation which is always felt at great elevations, where there is any sort of herbage, though I never experienced the like on the naked snow beds, even when higher.—Mountaineers, who knows nothing of the thinness of the air, attribute the faintness to the exhalations from noxious plants, and I believe they are right, for a sickening effluvium was given out by them here, as well as on the heights under the snowy peaks, which I passed over last year above the *Setlej*; though on the highest snow, the faintness was not complained of, but only an inability to go far without stopping to take breath.

BAROMETER.—The tube heated, and then gradually filled with mercury, half an inch at a time, and the bubbles which were perceptible driven out by gently beating against the places they were seen at:

Inches
The mercury stood at.....18. 854

Detached thermometer.....55

Attached ditto.....53

Height of the place above the level of the sea 12,914 feet.

Water boils at 192¼°; which, according to Mr. KIRWAN's table, answers
In.
to a barometer of 19. 5.

WE are about 150 feet above the bed of the river. By day the sun is powerful, although we are so surrounded by snow; but the peaks reflect the rays.—When the sun sunk behind the mountains, it was very cold; at night it froze. High as we are, the clouds yet rise higher.—The colour of the sky is a deep blue.—What soil there is, is spungy.—A few birch bushes are yet seen; but a large and strong ground tree or creeper over spreads the ground, somewhat in the manner of furze or brambles; and it is a curious fact that the wood of this, is, we think, that of which the cases of black lead pencils are made, being of a fine brittle, yet soft red grain; and the smell is the same as of that used for the pencils, and which has hitherto been called by us cedar. I have specimens of this wood; it is called, I think, *Chundun*: I saw it on the summit of the *Chour* peak, and in the snowy regions of *Kunaur*, but did not then examine it.—It will be found, probably, that the *Pinus Cedrus* or *Cedar of Lebanon* is the *Deodar* (or as it is called to the Westward, the *Kailou*), and no other.—Nor do our mountain cedars (24 feet in circumference) yield in size or durability;

to those of Lebanon. But this *Chandan* (miscalled Cedar) is not even a tree; it may be called a large creeper, growing in the manner of bushes, though it is very strong, and some of its arms are as thick as a man's thigh:—of this, and also of the great Cedar (*Deodar*), and of other pines, I will send specimens.

Latitude.

Lieutenant HERBERT.—5 observations, by Sextant, of Meridian Altitude, Pole Star, and β minoris.... 30° 56′ 37″.5

My observations, reflecting circle, reversed faces, M.

Alt. Polaris	0	0	32.5
Mean	30	56	34 .5

All good observations.—The particulars of them, as well as of all others, I have preserved.

The strata of rock, (where exposed), near the summits of the grand snowy peaks, was very nearly horizontal, as I observed it to be, last year, at the summits of the peaks above the *Setlej*; though in lower parts of the *Himálaya*, it is generally seen deeply declined, as observed between *Dangul* and *Sookie*, as well as at *Jumnotri*, &c.

THE colour of the high rocks on the four Saints, appeared to be of a light yellow mixed with brown or black. There being a small piece of level ground here, a primary base was measured on its longest extent; it was 319 feet; with it a longer base of 667.2 feet was obtained, favorably

situated for taking the heights and distances of the peaks in front. This base, being but short, and no other to be had, great care was taken in observing the angles and elevations; and they were repeated both with a fine theodolite, and reflecting instruments, (my circular instrument could not be safely brought beyond *Reital*). The angle of altitude of peak

St. George was			14° 07′
Its height above the present station		feet	9326 6
The station above the sea, according to the barometer			12,914
Height of the peak above the sea, feet			22,240 6

Distance of St. George 38,240 feet

Latitude	30°	52′	29″ 1

Bearing, corrected for variation, is 132° 20′ or 42° 20′ S. of E.

St. Patrick, height above the station	9471	0
Station above the sea		12,914
Distance 42,480 feet, and height above the sea, feet		22,385

Latitude	30°	51′	35″ 8

Corrected bearing S. of East 46° 44′

A sharp peak across the river;—call it the pyramid; angle of elevation taken with reflecting circle, corrected for the distance of the eye, to the mercury 32° 57′ 9″

Height of the peak above the station	8,052	
Station above the sea		12,914
Height above the sea	feet	20,966

Distance.....14,800 feet.
Latitude.....30° 54' 46" 7
Correct bearing.....77° 00 S. of E. or 167°

A ROCK on the great snowy bed, over which we are to pass, proved to be distant 9044 feet, and its height above this place 984 feet, the angle of elevation being 6° 15', which is the general inclination of the snow bed; as our progress was continued far beyond this rock, it will easily be imagined that the crest or summit of the bed, *then distant* 5 or more miles by estimation, must have a very considerable elevation.

WE had brought very few followers onwards from *Gangotrí*, but here we sent back every one we could possibly dispense with, that our small stock of grain might subsist the remainder, who were a few trusty fellows (*Musulmans*), 2 *Gorc'ha Sipáhís*, and a few *Coolies*, for two days or three if possible, in the event of our being able to get over the snow in front. And I sent orders to the people at *Gangotrí* to leave grain there, if they had any to spare, and if they did not hear of any supply coming from *Reital*, to make the best of their way back till they met it, and then to halt for us, and send some on to us.—Having made all the arrangements we could, on the important head of supplies, and made observations, we had leisure to admire the very singular scenery around us, of which it is impossible to give an adequate description.

THE dazzling brilliancy of the snow was rendered more striking by its contrast with the dark blue colour of the sky, which is caused by

the thinness of the air; and at night, the stars shone with a lustre, which they have not in a denser atmosphere; it was curious too, to see them, when rising, appear like one sudden flash, as they emerged from behind the bright snowy summits close to us, and their disappearance, when setting behind the peaks, was as sudden as we generally observed it to be in their occultations by the moon.

We were surrounded by gigantic peaks, entirely cased in snow, and almost beyond the regions of animal and vegetable life, and an awful silence prevailed, except when broken by the thundering peals of falling avalanches; nothing met our eyes, resembling the scenery in the haunts of men; by moonlight, all appeared cold, wild, and stupendous, and a Pagan might aptly imagine the place a fit abode for demons.—We did not see even bears, or musk deer, or eagles, or any living creature, except some small birds.

To form an idea of the imposing appearance of a snowy peak, as seen here under an angle of elevation of nearly 33°, and when its distance is not quite 5 miles, and yet its height is 8052 feet above the station, one should reflect, that if even when viewed from the plains of *Hindustan*, at angles of elevation of one, and one and a half degrees, these peaks, towering over many intermediate ranges of mountains, inspire the mind with ideas of their grandeur, even at so great a distance; how much more must they do so, when their whole bulk, cased in snow from the base to the summit, at once fills the eye.—It falls to the lot of few to contemplate so magnificent an object, as a snow clad peak rising to the height of

upwards of a mile and a half, at the short horizontal distance of only $2\frac{3}{4}$ miles.

May 31st. From halting place, forward.

		Feet.	Bg. from N. Degrees.
1	Along, and above the right bank of the river, rocks and snow.....	1445	133
2	Descent to the bed of the river, enclosed by rocks.....	864	198
3	A most wonderful scene.—The *B'hágirat'hí* or *Ganges* issues from under a very low arch at the foot of the grand snow bed—The river is here bounded to the right and left by high snow and rocks; but in front, over the *Debouche*, the mass of snow is perfectly perpendicular, and from the bed of the stream to the summit, we estimate the thickness at little less than 300 feet of solid frozen snow, probably the accumulation of ages;—it is in layers of some feet thick, each seemingly the remains of a fall of a separate year. From the brow of this curious wall of snow, and immediately above the outlet of the stream, large and hoary icicles depend; they are formed by the freezing of the melted snow water of the top of the bed, for in the middle of the day, the sun is powerful, and the water produced by its action falls over this place, in cascade, but is frozen at night.—The *Gangotri Brahmin* who came with us, and who is only an	511	140

Pace. Degrees.

illiterate mountaineer, observed, that he thought these icicles must be MAHÁDÉVA'S hair, from whence, as he understood, it is written in the *Shástra*, the *Ganges* flows.—I mention this, thinking it a good idea, but the man had never heard of such a place, as actually existing, nor had he, or any other person to his knowledge, ever been here.—In modern times they may not, but *Hindus* of Research may formerly have been here, and if so, I cannot think of any place to which they might more aptly give the name of a Cow's Mouth, than to this extraordinary *Debouche*.—The height of the arch of snow is only sufficient to let the stream flow under it. Blocks of snow were falling about us, so there was little time to do more here, than to measure the size of the stream.—Measured by a chain, the mean breadth was 27 feet.—The greatest depth at that place being knee deep, or 18 inches, but more generally a foot deep, and rather less just at the edges, say 9 or 10 inches.—however, call the mean depth 15 inches.—Believing this to be, (as I have every reason to suppose it is), the first appearance of the famous and true *Ganges* in day light, saluted her with a Bugle march, and proceeded, (having to turn a little back to gain an oblique path), to the top of the snow bed; having ascended it, to the left,

		Paces.	Degrees.
4	Pretty strong ascent up to the inclined bed of snow. This vast collection of snow is about 1½ miles in width, filling up the whole space between the feet of the peaks to the right and left; we can see its surface forward to the extent of 4 or 5 miles or more, to where its it bounded, on the left, by the feet of the 4 Saints, and to the right, by snow spurs from other mountains beyond mount Moira: these last spurs rather overtop the feet of the Saints, and to them, and to the place where we judge there is a ridge, is all ascent over snow.—Pyramid peak 236°—Mount Moira 180°—St. George 129°—St. Andrew 136°.....	1400	144
5	Ascent of the same kind—generally acclivity 7°, but we pass over small hollows in the snow, caused by its irregular subsiding.—A very dangerous place; the snow stuck full of rubbish, and rocks imbedded in it.—Many rents in the snow appear to have been recently made, their sides shrinking and falling in. A man sunk into the snow, and was got out not without some delay. The bed of the *Ganges* is to the right, but quite concealed by the snow	509	do.
	In high hope of getting on to what may be at the top of the acclivity, we have come on cheerily over the hollow and treacherous compound of snow and rubbish, but now with bitter regret, we both agree that to go on is impossible! The sun is melting the snow		

	Paces.	Degrees.
on all sides, and its surface will not bear us any longer. I have sunk up to my neck, as well as others. The surface is more and more ragged, and broken into chasms, rifts, and ravines of snow with steep sides.—Ponds of water form in the bottoms of these, and the large and deep pools at the bottoms of the snow hollows, and which were in the earlier part of the day frozen, are now liquid. It is evident, from the falling in of the sides of the rents in the snow, that there are hollows below, and that we stand on a treacherous foundation.—It is one o'clock, and the scene full of anxiety and awe. The avalanches fall from mount Moira with the noise of thunder, and we fear our unsteady support may be shaken by the shocks, and that we may sink with it.		
St. George 130° 45′ altitude 17° 49′		
Pyramid 255 33 do. 26 49		
Inclination of the snow bed about 7°, what appears the highest part of snow bed, ahead 155°—Altitude 7°.		
No time to take more	1427	155
.....		
	6156	

AND here we were obliged to return! Had it been possible to have got across the chasms in the snow, we would have made every exertion,

so anxious were we to get forward; but onward, their sides were so steep, and they appeared of such great depth, that I do not think it would be possible to pass them, (this year at least), even if the snow was not, as at this hour, soft, and the bottoms of the chasms filling with water. Be that as it may, they are now utterly impassable. At this season snow must fall here, whenever it rains below, so that it does not acquire such hardness on the top, as it does on the avalanches we have hitherto passed, where no new snow at present falls.—We now set out on our return, and not too soon, as we found, for the snow was so soft, and the increase of the water so great, that though we went with the most possible expedition, it was only by 2½ hours hard labour of wading, and floundering in the snow, and scrambling among rocks, where they would give a footing, that we reached the turf, tired and bruised with falls, and the skin taken off from our faces and hands by the sun and drying wind of these elevated regions.

It now remains to give some account of this bed or valley of snow, which gives rise to the *Ganges*. It appears that we passed up it, some what more than a mile and a half.—From our last station, we could see onwards, as we estimated, about 5 miles, to where there seemed to be a crest or ridge of considerable elevation, though low when compared with the great peak which flanked it; the general slope of the surface of the snow valley was 7°, which was the angle of elevation of the crest, while that of the peak St. George, one of those which flanked it to the left, was 17° 49'.—In the space we had passed over the snow bed, the *Ganges* was not to be seen; it was concealed, probably, many hundred feet below the sur-

face; we had a fair view onward, and there was no sign of the river, and I am firmly convinced that its *first appearance in day* is at the *debouche* I have described; perhaps indeed, some of those various chasms and rents in the snow bed, which intersect it in all sort of irregular directions, may occasionally let in the light on some part of the bed of the stream, but the general line and direction of it could only be guessed at, as it is altogether here far below the broken snowy surface.—The breadth of the snow valley or bed is about a mile and a half, and its length may be $6\frac{1}{2}$ or 7 miles from the *debouche* of the river, to the summit of the slope, which terminated our view; as to the depth of the snow, it is impossible to form a correct judgement, but it must be very great.—It may easily be imagined, that a large supply of water is furnished at this season, by the melting of this vast mass in the valley, as well as by the melting of that of the great peaks which bound it. From their bases, torrents rush, which cutting their way under snow, tend to the centre of the valley, and form the young *Ganges*, which is further augmented by the waters which filter through the rents of the snow bed itself.—In this manner, all the *Himálaya* rivers, whose heads I have visited, and passed over, are formed; they all issue in a full stream from under thick beds of snow, and differ from the *Ganges*, inasmuch as their streams are less, and so are their parent snows.—On our return down the snow valley, we passed nearer to its North side than in going up, and saw a very considerable torrent cutting under it from the peaks; this was making its way to the centre; at times, we saw it through rents in the snow, and at others, only heard its noise: as there must be several more such feeders, they will be fully sufficient to form such a stream as we observ-

ed the *Ganges* to be at the *debouche*, in the space of 6 or 7 miles.—I am fully satisfied, that if we could have gone further, that we should not have again seen the river, and that its appearance at MAHA'DE'VA'S hair, or whatever we may choose to call it, was the real and first *debouche* of the *B'hágirathí*.—All I regret, is, that we could not go to the ridge, to see what was beyond it. I suspect there must be a descent, but over long and impassable wastes of snow, and not in such a direction as would lead direct to any plains, as the course to bring one to such plains would be to the N. East or North, whereas the line of the rivers course, or rather of the ridge in front, was to the S. East, parallel to the run of the *Himálaya*, which is generally from S. E. to N. W. Immediately in front of the ridge, no peaks were seen, but on its S. E. flank, and at the distance of about 18 miles, a large snowy peak appeared, so that I think there can be no plain within a considerable distance of the S. E. side of the ridge: if there be streams from its other side, they must flow to the S. East.—After all, I do not know how we should have existed, if we had been able to go to the ridge, for we could not have arrived there before night, and to pass the night on these extensive snows, without firewood or shelter, would have cost some of us our lives, but of that we did not then consider much, (if we could have gone, we would). We had only a few trusty men with us, and a short allowance of grain for them, for this and the following day, and had sent orders to the people left at *Gangotri*, to make their way back towards *Reital*, leaving us what grain could be spared, and to forward on what they might meet, as I expected some from *Reital*, from whence we were supplied during our absence from it, of altogether 28 days.—I cannot suppose that by

this way, there can be any practicable or useful pass to the *Tartarian* districts, or doubtless the people would have found it out, and used it, as they do that up the course of the *Jáhnaví*. While I give it as my opinion, that, under any circumstances, the crossing of the ridge must be difficult, I would by no means wish to be understood to assert, that I think it impossible, under more favorable circumstances, and in a year when less snow has fallen than in the present; but I seriously declare, that situated as we were, it was not possible for us to go further than we did, and that it was with great difficulty we got back.

It is now to be considered, if the supplies of water, produced as above described, are sufficient to form a stream of 27 feet wide, and 15 inches (mean depth) at the *debouche*.—It has been stated, that at *Gangotrí*, the breadth of the river on the 20th May, was 43 feet, and its depth 18 inches.—The distance thence to the *debouche* was 22,620 paces, which I reckon about 11 *British* miles. In that space, it received some supplies, as mentioned in the notes, but they were not abundant.—Thus the quantity of water is diminished nearly one half; but it is to be remembered, that on our return to *Gangotrí*, on the 2d June, the bulk of the river was considered as being doubled, it being 2 feet deep, and also much wider, so that on the 31st May, we may suppose it to have been 21 inches deep, and perhaps 48 feet wide at *Gangotrí*. It is with this mean size, that the comparison of the difference of its bulk at *Gangotrí*, and the *debouche*, must be made; the proportion thus is, that the body or quantity of water would be at *Gangotrí* almost treble to that at the *debouche*; but allowing it to be only double, in this 11 miles, it will be evident, that in 5 or 6 miles further, there can be little

or no water in the bed, under the snow, and, consequently, that the most remote rill, which contributes under the snow, to the first formation of the *Ganges*, cannot be more distant than the ridge; so I think it may be allowed, that such first formation is on the hither side of the ridge, and not at any lake, or more distant place beyond it.

INDEED, considering the large supplies which the snow valley furnishes, I rather wonder that the stream was not larger, when I measured it at the *debouche*.—Whether there are any boiling springs under the snow, as at *Jumnotri*, I do not know, but suppose there are not, as I did not see any smoke; a steam, however, there may be, and the steam may be condensed ere it can appear.—I imagine, that the season of the rains would be, in one respect, the most proper to attempt the passage of the great snow bed; it may at that time be reduced in thickness, but I have no idea that it ever melts away; yet, in the rains, it perhaps will not be possible to ford the river above *Gangotrí*, which must frequently be done, if the smaller avalanches, on which we very frequently crossed it, are melted. In the rains also, there must be greater hazard from the falling of the rocks, and slips of the mountain, for the melting snow forms many rills, which undermine the rocks, and set them loose, and it is not possible to avoid a large fall of the mountains side, if one should unfortunately be in the line of its direction, when it comes down.

I HAVE preserved specimens of the rocks of which these peaks are composed, also of the different sorts of pines which grow at their bases. Above *Suc'hí*, and *Jhala*, the country is not inhabited, nor is it habitable

beyond those places, except at the small village of *Durá'i*, which is now deserted.—*Tuwarra*, *Suc'hí*, and *Jkala*, are very small and ruinous villages.—*Reital* is a pretty good village of about 25 houses, as is *Salung*, and there are 2 or 3 more in that neighbourhood.—I found the inhabitants civil and obedient.

THE people of *Rowaen* are, in general, much inferior in appearance to those of *Jubul* and *Sirmour*, and the more western mountains; indeed, with few exceptions, they are an ugly race, both men and women, and extremely dirty in their persons. They complain much of the incursions of the banditti from the western parts of *Rowaen* and *Busahir*, who carry off their sheep in the rains; but, from what I can learn, they in turn plunder their eastern neighbours of the *Cédar-nát'h* districts, and they pride themselves on the long journeys they make in their sheep stealing expeditions.—The proper time for those forays is the latter end of the rains, when the snow in the defiles is much reduced.—The women have not here, as to the westward, a plurality of husbands. I saw no fire arms among the inhabitants, nor swords or war hatchets; their weapons are bows and arrows.—The climate of *Reital*, is, at this season, very pleasant, and the price of grain is not high, but it is not abundant. —The corn is cut in the beginning of June.

No volcanos were seen or heard of in these mountains, whose composition is granite of various kinds and colours.—No shells or animal remains were seen—The magnetic variation was small, and differing little, if at all, from what it is on the plains of the upper provinces; it is

from 40' to 1° and 2° according to different needles, and is easterly, by which I mean, that the variation must be added to the magnetic azimuth. The diurnal small changes in the barometer were perceptible, the mercury always falling a little before noon, as in the plains.

HAVING received new thermometers from *Calcutta*, both long and short, I found that they gave the same boiling point, but the thermometer I had last year, in *Busahir*, &c. shewed the boiling point 2° or $2\frac{1}{4}$° below the new ones.—I always suspected the thermometer, but had not then a better. It boiled in the *Panwei* pass in the *Kunaur* and *Busahir* snowy mountains at 188° at my camp a little above the lower line of snow, on the 24th June last, so that it should have been 190°, or 22° lower than at the sea side. Bears abound in the higher mountains, also the *Goorul* or *Boorul*, an animal between the deer and goat, and the *Pheir*, a larger animal of the same kind; I have preserved the skin, horns and bones of the head of one shot near *Jumnotri*. Near the villages, where snow lays a great part of the year, there are abundance of the *Monaul* Pheasants and *Chakors*. In the lower mountains, there are black partridges, and tigers, leopards, and bears. I never saw any snakes in the cooler regions.

IT was remarked above, that the snow on the great bed was stuck as it were with rock and rubbish in such a manner, as that the stones and large pieces of rock are supported in the snow, and sink as it sinks; as they are at such a distance from the peaks, as to preclude the idea that they could have rolled down to their present places, except their

sharp points had been covered, it appears most likely that the very weighty falls of snow, which there must be here, in the winter, bring down with them pieces of rock, in the same manner as a larger snow ball would collect gravel, and carry it on with it in its course.—Masses of snow, falling from the high peaks which bound the snow bed, if they chanced to collect more, and to take a rounded form, would have a prodigious impulse, and might roll to the centre of the snow valley, loaded with the pieces of rock they had involved.

IT is not very easy to account for the deep rents which intersect this snow bed, without supposing it to be full of hollow places.—It struck us, that the late earthquakes might have occasioned some of the rents.—I never saw them before on other snow beds, except at *Jumnotri*, where they are occasioned by the steam of the extensive range of boiling springs there; perhaps, there may be such springs here also; they are frequent in the *Himálaya*, and one might suppose they were a provision of nature to insure a supply of water to the heads of the great rivers, in the winter, when the sun can have little power of melting the snow above those deep recesses.

I WILL now proceed to give some account of the course of the river *Jumna*, within the mountains, and of its spring at *Jumnotri*, which I also visited this year; the above remarks, respecting the *Ganges*, having already swelled this paper to too great a bulk, I will make those, regarding the *Jumna*, in as few words as possible.—In the maps published ten years ago, the *Jumna* is laid down as having a very long course

from the latitude of 34½; from what authority, it is difficult to guess, for much as has been surmised and written respecting the head of the *Ganges*, I cannot find any accounts of that of the *Jumna*.—It was not known, until the year 1814, that the *Jumna*, properly so called, was a comparatively small river above its junction with the *Tonse* in the *Dún*, and I believe the existence of the latter river, though fully treble the size of the *Jumna*, was unknown to *Europeans*.

THE junction of the *Tonse* and *Jumna* takes place at the N. W. end of the *Dún* valley, in latitude 30° 30′, where the large river loses its name in that of the small one, and the united stream is called the *Jumna*. The course of the *Jumna* from *Jumnotri*, which is in latitude 30° 59′, being generally south 50° west. It is fordable above the confluence, but the *Tonse* is not.—Not having yet visited the sources of the *Tonse*, I am not certain whether it rises within the *Himálaya*, as the *B'hágirathí* does, or at its S. W. or exterior base like the *Jumna*; but the latter I believe to be the case. I apprehend, that three considerable streams, which, like the *Jumna*, originate from the south faces of the *Himálaya*, in the districts of *Baraza*, *Leulowari*, and *Deodara Kowarra*, join to form the *Tonse*; and it receives a considerable accession of water from the *Paber* river, which I imagine to be equal in size to any of the three above-mentioned feeders. Respecting them, I have at present only native information to guide me, but of the *Paber* I can speak with more confidence, for, when in June 1816, I penetrated within the *Himálaya*, by the course of the *Setlej*, I found that the north bases of many of the snowy peaks, seen from the plains of *Hindustan*, were washed by that river.—Its

course, in the province of *Kunaur*, in latitude 31° 31', and longitude 78° 18' being from east 25 S. to 25 to the N. of west. In this position, the *Setlej* is bounded both to the N. and S. by high and rugged snowy mountains, from which many torrents descend, and increase its bulk.—Leaving the left bank, and bed of the river, I ascended the snowy range, of which it washes the north base, and crossed over it on the 21st June 1816, at 40 minutes past 11 o'clock, in the forenoon, during a heavy fall of snow, being the first *European* who effected a passage over the grand *Himálaya* ridge in that direction.

ON surmounting the crest of the pass, I found that the *Indrawatí* river, which is a principal branch of the *Paber*, originated from the snows, on which I descended, on the S. W. or hither side of the ridge; and I followed its channel, to the place where it joins the *Paber*, which river must have its beginning, in like manner, on the same side of the ridge, as I was informed by the people of the country it had, and I am nearly certain it is the case; and it is most probable, that all the streams which form the *Tonse*, do, in like manner, descend from the south west side of the fronting snowy range, the north east base of which is washed by the *Setlej*, as above mentioned.

HOWEVER, I intend to explore the sources of the *Tonse*, as well as of the *Setlej*, and *Jáhnaví* rivers.—But to return to the *Jumna*.

THE route from its confluence with the *Tonse*, in the *Dún*, is thus;—to *Calsí* four miles,—a large village immediately within the mountain of

Jaunsar, of which district it is esteemed the capital.—It is situated between two high and steep mountains, and on the *Omla*, a small river which joins the *Jumna*.—*Calsi* is a place of some little trade, as the people of the neighbouring mountains bring to it their productions, and exchange them for cash to pay their rents, and a very small quantity of the produce of the plains.—On the march, the *Jumna* is forded above its confluence with the *Tonse*. Carriage cattle may go to *Calsi*, but further within the mountains, every article is carried on men's backs.—Latitude of *Calsi* 30° 31' 24".

Calsi, to Bairat Fort.

Total distance 24,511 paces.

6000 paces of exceedingly steep ascent of the mountain, on left bank of the *Omla*;—2600 easier, to the village of *Khuny* on the ridge; remainder, along the mountains side, with occasional ascents and descents, to the foot of the peak of *Birat*, which rises conically above the ridge;—1800 paces of the steep ascent up it to the fort, which is a small double enclosure.—It was abandoned by the *Gorc'ha* garrison, on the approach of a force under Colonel CARPENTER.

THE height of *Birat* above *Seharanpur*, (which is visible from it), is 6508 feet; it commands a noble view of the snowy mountains, and the various intermediate ranges, as well as of the *Dún* valley, and the plains on both sides of the *Jumna*.

INVALIDS from the plains, requiring a change of climate, may find it at

Birat.—In the winter, the fort is almost buried in snow, which remains in shady places, and on the northern side of the peak, till the beginning of April; but snow seldom falls later than the last week of March, at which season, while I was in the fort, there was a shower which covered the ground to the depth of 2 inches:—the peak is a bare slaty rock, with some quartz intermixed.

29th March, 1817.—*Birat to Murlang.*

Total distance 4 m 6 f.—2 m 5 f, narrow path along the mountain's side, then a steep descent of 2 m 1 f to *Murlang*, a small village in a glen, on the *Silgad* rivulet, which falls into the *Jumna* three miles to the east.—No grain here.

Lat. observed 30° 36′ 53″.

Thermometer at noon 78°. It was yesterday, at noon, at *Birat* 50°.

30th March.—Murlang to Cot'ha.

Total distance 9 m 5 f.—Proceed 2½ miles down the bed of the *Silgad* to the *Jumna*,—then leave it, and cross a ridge, and go up the bed of the *Jumna*, to the confluence of the *Cunti* river, which joins it from the *Keinah* peak to the west.—That river is about 60 feet wide, and 1½ and 2 feet deep. The *Jumna* is 90 feet wide, 3 to 5 feet deep, rapid, and not fordable.—The rest of the path is a long ascent of the mountain, above the right bank of the *Jumna*, to *Cot'ha*, a village of 10 houses, about 3000 feet above the level of the river.—A fatiguing march,—heavy rain,—no grain here.

31st March.—Cot'ha to Lakha Mandal.

Total distance 8 m 7 f.—For 6 m 7 f, the path lies generally along the side

of the mountain, with occasional strong ascents and descents; m 1. f 5. of very steep descent into a dell, the rest lighter descent, flat and ascent from a rivulet to *Lak'ha Maṅd'al*, on the right bank of the *Jumna*, and about 300 feet above it.

Lak'ha Maṅd'al is a place of some celebrity, in *Hindu* story, as having been one of the temporary residences of the *Paṅd'us*; and tradition says, that formerly there were a great number of statues and temples here, but I imagine the greater part to have been buried by the slip of the side of the mountain, at the foot of which it is situated.—Several pieces of cornices, entablatures, and other ornamental fragments of buildings, are seen projecting above the soil, which buries the remainder; they are of black stone, and the carving of the ornaments is very well executed. There are also two statues of BHÍM and ARJUN, of the size of life, which are half buried in the soil; and a prodigious number of small idols are deposited in a little temple, which is the only one now remaining, and which does not appear to be of any remote antiquity.—The ignorant *Brahman* could give no account of the builder; he declared, as they all do, when consulted on such subjects, that it is not of human workmanship, but was built by BHÍM, countless ages ago.

IT does not appear that pilgrims now resort here; the place is nearly desolate; it is surrounded by high rocky peaks, and may have been chosen as a fit seat for gloomy and recluse superstition.

WITHIN the temple, there is a large slab of blue stone, inscribed with

Hindu characters; I cleaned it, and took off a reversed impression, as well as circumstances would allow, and sent it to Colonel MACKENZIE.

Latitude of *Lak'ha Mańd'al* 30° 43' 24".

Lak'ha Mańd'al, to Bancauli.

Distance 3m 5f.—Gradual descent 1½ miles to the *Ricnar* river, which is the boundary between *Sirmor*, and the *Rewaen* district of *Gurhwal*.—It has a course of about 10 miles from the N. W. and joins the *Jumna* here.—From the river, a very strong ascent of 1¼ mile up the mountain, to a crest called *Gén'd'a Ghát'*; three obliquing to *Bancauli*, a village of 20 houses, with a temple;—it is on the mountain's side, and about 3000 feet above the *Jumna*.—No grain to be had here, as at other places;—I planted potatoes. Rainy weather;—no latitude.

3d April, 1817.—*Bancauli, to Paunti.*

Total distance 11m 1f by the wheel; in paces 23,108.—To the bed of the *Jumna* 3m 3f mostly oblique descent, though steep in some places above the right bank of the river. Here are very high and steep precipices, from which large blocks of granite have fallen into the bed of the river, which forces its way through and over those obstructions with much violence and noise. After passing over the rocks by the river side for half a mile, we leave it, and climb the right bank, by an exceedingly steep ascent, to the *Tocni Ghát'i*, which overhangs the stream, and is about 1000 feet above it.—Hence, descend a mile to the *Camauda* river; cross it on trunks of trees laid across, a little above it's junction with the *Jumna*.

THE *Camaulda* is the largest river which the *Jumna* receives above the confluence of the *Tonse*; its course is from N. 10° west, down the *Ráma Seráí* district, which is a small valley, and is reported to be in some places a mile wide, but it is now overrun with *jungles*, full of wild beasts.—The *Camaulda*, now swollen by the rain, is about 70 feet wide, and 2½ feet deep, and very rapid. Immediately on crossing it, the country up the *Jumna* assumes a more pleasing appearance; the mountains which bound it, though very lofty, do not rise so abruptly, and several small villages are seen on their lower slopes. On the right bank of the river, there is a slip of level ground 3 to 500 yards wide.—The summits of the mountains are covered by cedars and other pines, and the snow yet lies on them. Proceed by the river side to *Paunti*, a village of 20 houses, pleasantly situated about 400 feet above the *Jumna*.—The march was long and fatiguing, as it rained the whole way; the loaded people did not arrive till after dark.—At this village, I got supplies of grain.—The country I have passed through from *Calsí* is nearly deserted, on account of famine, caused by the crops of last year having been destroyed by the hail, in October.—Aware of this circumstance, I have brought grain with me from *Calsí*, and subsisted my followers with it.

Latitude of *Paunti* 30° 48′ 08″.

5th April, 1817.—*Paunti*, *to Gíra*.

Total distance 7ᵐ 1ᶠ½.—2¼ miles parallel to the *Jumna*, and descend to its bed, where the stream from the *Banaul* glen joins it.—Leave the *Jumna*, and proceed three miles N. W. up the *Banaul* river.—Then ascend the south face of the mountain to *Gíra*, a village of 10 large

houses pleasantly situated, and sheltered from the northern blasts. This district of *Banaul* is about seven miles in length; the N. W. end is closed by a high rocky mountain, where the stream arises, which waters the bottom of the glen.—Several villages are seen placed in advantageous situations on the sides of the mountains, the soil of which is fertile; wood, water, and grain are abundant.

As I learnt that much snow yet remained on my route forward, I halted here some days, to give it time to melt, and to refresh my people, who were harrassed by the journey from *Calsí*, for it had rained every day, and they had been sparingly and ill fed, and also to take the rates of my chronometers.—I took two immersions of Jupiter's satellites, as follows:

	h.	m.	s.	
9th April,—2d Sat. Observed immersion at mean time	14	41	55	5
The same was observed, at the *Madras* observatory, at.....	14	49	35	8
Differences of the meridians		07	40	3
Longitude of *Madras*.....	5	21	14	
Ditto of *Gíra*	5	13	33	7

The observations, at both places, are noted as clear and good.

10th April,—1st Sat. Observed immersion, but not a good observation, mean time		14	09	27
Same at *Madras* observatory		14	17	25	4
		07	58	4
		5	21	14	
Longitude by 1st Sat.		5	13	15	6
Ditto 2d ditto		13	33	7
Mean by immersions		5	13	24	6
Latitude of *Gíra*		30	52	08	

12th April, 1817.—*Gíra, to Thánno.*

Total distance 8 miles.—Down the N. side of the glen, and pass through the villages of *Bisát* and *Dévali*, to *Dakiát*, a large village, 4. 6.—Proceed parallel to the *Jumna*, but above it, 1. 6, and descend to the *Badál* river, which comes from a glen similar to that of *Banál*, but is longer, and contains more and larger villages.

THE river joins the *Jumna* here; it comes from the *Cédára Cánta*, a large mountain covered with snow, and its course is from N. 15° west; breadth about 40 feet, depth 1½ and 2 feet. Proceed 1½ miles further to *Thánno*, a small village, 400 feet above the right bank of the *Jumna*.

THE road to-day, chiefly on a gradual descent; path, good and pleasant.—The *Jumnotri* snowy peaks, seen up the river, have a noble appearance; the eastern peak bears 56° 17' N. E:—its altitude 8° 16'.

Thánno appears to be 4083 feet above the level of *Scharanpur*.

Latitude observed 30° 49' 12".

13*th April*, 1817.—*Thánno, to Catnaur.*

Total distance 4m. 2f.—Steep descent to the *Jumna*, and cross it on a *Sangha*, which consists of three small spars and some twigs bound together, and laid across in the manner of a hurdle.—The *Sangha* is in two portions, being laid from rock to rock; one is nine paces in length, and the other seven, the breadth of the river being about 40 feet; but it is deep, being confined between the rocks, through which it falls like a cataract. The water nearly touches the bridge, which is a bad one.—Some of my goats fell through it, and were drowned.—Above this place, the bed of the *Jumna* is much inclined; the stream bounds from rock to rock, and, for the most part, is a series of small cataracts.

A mile beyond the *Sangha*, cross the *Sílba*, a small river from the glen of that name, and proceed to *Catnaur*, a small village 500 feet above the left bank of the *Jumna;* up the *Sílba* glen is a convenient pass over the ridge, which separates the *Ganges* and *Jumna*.

THE path to-day chiefly ascent and descent, and very rough and steep in most places; and hence, forward, the features of the mountains bear a harsher appearance, there being generally mural precipices rising

from the bed of the *Jumna* to the height of 1500 to 2000 feet, either on one side or the other.—The summits of the mountains all round, are deep in snow.—A stream from a peak called *Dallia Cursu*, joins the *Jumna* here, from the S. E.

Latitude observed 30° 51′ 35″.

As no grain was to be had here, I was obliged to march, in the afternoon, to a very large village called *Pali*, situated up a wild glen; this was a good deal out of my route.—The inhabitants of *Pali*, and the neighbouring villages, have been noted for a rebellious spirit against both the *Gur'hwal*, and *Gorc'ha* governments.—They had cut off several parties of the *Raja's* troops, and surprized and destroyed a complete company of *Gorc'has*, several years ago, for which they were punished by a force sent against them under the brave chief *B'hacti T'hapa*. On my arrival, they refused to sell me any supplies, and I expected to have had trouble.—However, towards evening, we came to a better understanding, and I got abundance of grain.—The village consists of about fifty large houses; the inhabitants are stout and hard featured, and the women generally have light complexions, and agreeable countenances.—In the morning, I went down the glen 1¼ miles, and then along the right bank of the *Jumna*, but high above it, by a difficult and very unpleasant pathway overhanging it; in one place, I was obliged to go with great caution, and bare footed, for a false step would be fatal.—The precipices, on the opposite side of the river, are quite perpendicular, and on this, exceedingly steep. After passing the worst part, descend to *Oj'ha Ghur*, a hamlet of three huts only, in a dismal situation, at the feet of steep and lofty cliffs,—

the rocks hurled from which, by the earthquake of 1803, buried a small fort and village, which once stood here:—dreadful mementos are seen in these mountains, of the effects of that catastrophe. Under *Oj'ha Ghur*, a stream falls into the *Jumna*, and several cataracts are seen falling among the surrounding precipices.—There are some hot springs at the bed of the *Jumna*, which is 400 feet below the hamlet.

Latitude observed 30° 54′ 47″.

15*th April*, 1817.—*Oj'ha Ghur, to Ráná.*

Total distance 4. 5.—In paces 91,815.

2655 paces along the mountain's side, and descent to the *Jumna*.—Cross it on a *Sangha* of 2 small spars; its length 20 feet, breadth about 2½ feet.—The river rushes with great violence under the *Sangha*, and nearly touches it.—The general breadth of the stream is greater, but it is here confined between two rocks.

1200 paces, by the margin of the river; the rest, for the most part, ascent, and in some places very steep and rugged.

Ráná is a small village of 15 houses, about 800 feet above the left bank of the river, on the slope of the mountain;—the general lower line of snow on it, does not appear to be more than 1000 feet above the village. The opposite bank of the river is composed of yellow granite precipices, rising murally from the stream to the height of about 2500 feet, or more.—The courses of the rock are disposed almost horizontally, as high as 1000 feet above the river; but, towards the

summits, they appear to incline in an angle of about 35°, the apex being to the south west.—Heavy storms of hail and thunder.

16th April, 1817.—*Ráná*, *to Bannása.*

Distance 7839 paces.

ASCENTS and descents to the small village of *Bárí*, 2356 paces;—684 paces further descent to the *Burhá Gangá* river, which has a course of about 8 miles from the snows to the right; it is in 2 streams, each 8 paces wide, and 18 inches deep, and joins the *Jumna*;—1480 paces of exceedingly steep ascent; the remainder, ascents and descents, and difficult road.—Cross the *Jumna* on a *Sangha*, and also the *Banntsa* river, which is about two thirds of its size, and joins it here.—Ascent to *Bannása*, a small village, at the foot of a rocky mountain, a fall from which, last year, destroyed half the village. Angle of altitude of the mountain 40° 55'—Among the cliffs, and on the summit, I observed, with a telescope, many of a species of animal, peculiar to these elevated regions; it is called *Pheir*, and as a mountaineer in my service succeeded after many toilsome chaces in shooting one of them, I can give a description of its dimensions.

	feet	inches
Length, from the tip of the nose to end of the tail; the length of the face being 11 inches, and of the tail 3 inches only.....	5	0
Height, from shoulder to toe	3	2½
Girth, at the chest	2	11½
Do. at the loins.	2	4

Length of the hair at the shoulders, 8 inches, but on the other parts of the body, it is short.

I preserved the skin and the bones of the head and horns, and presented them to the MOST NOBLE THE GOVERNOR GENERAL, who, I believe, sent them to Sir JOSEPH BANKS.

THE face of the animal, which was a male, resembles that of the *Níl Gáo*.—The horns are large, the lower part of them stands nearly erect from the forehead, but the upper half bends backward. The hoofs, cloven.—The colour, that of a camel or lion, and the long hair about the shoulders and neck, somewhat resembles a lion's mane.—The flesh appeared coarse, and an unpleasant musky smell exhaled from it. The *Hindustánís* would not touch it, but the *Gorc'ha sipáhís*, and mountaineer *Coolies*, eat it with avidity. It is remarkable, that those people will not eat mutton. The *Pheir* is a gregarious animal, and appears to subsist on the short herbage at the edge of the snow.—The chace of it, in its haunts on the cliffs and precipices, is most difficult and dangerous; but, in the depth of winter, when the snow drives them down to the villages, the people hunt and kill them more easily.

IN this neighbourhood, springs of hot water are very numerous; they are seen bubbling up among the rocks in various places near the rivers.—The heat of the water is too great to bear the hand in it for many moments; but, having broken my long scaled thermometer, I could not ascertain its precise temperature.—The water has little if any taste.—About half a mile above its junction with the *Jumna*, the *Bannása* river falls from a precipice of yellow and rose coloured granite, of 80 or 90 feet high, in a noble cascade.—The breadth of the stream is about 15 feet,

and it falls into a deep basin, which it has worn in the rock, with much noise.

THE stream is caused by the melting of the snows on the heights above.

FROM the village, two of the *Jumnotri* peaks appear towering above the clouds, with sublime effect. Angle of altitude, (taken by reflection in mercury), of the east peak 15° 34′ 45″, of the west 17° 10′ 10″.

16th April, 1817.—*Bannásа.*

	H.	M.	S.	
Observed immersion of the 2d Satellite, M. T.	17	16	05	
The same took place at *Madras* observatory, at	17	23	31	1
Difference		07	26	1
Longitude of *Madras*.....	5	21	14	
Do. of *Bannásа*.....	5	13	47	9

THE beginning of twilight made the observation not so good as it would have otherwise been.

Latitude observed 30° 55′ 50″.

THIS is not a good latitude. The weather was cloudy and stormy, with showers of sleet.

17th April, 1817.—*Bannása, to Curśálí.*

Thermometer at sunrise 33°.

Descend to the *Jumna*, and cross it on a plank 12½ feet long, and again on a plank of 10 feet;—depth of the water 2½ feet;—beds of frozen snow extend to the margin of the stream. A most laborious and steep ascent of 675 paces, whence gradually descend, and cross the *Jumna* on a small *Sangha*, where it receives the *Imri* rivulet from the snow, whence it originates, about 1½ mile to the end. It is less than the *Jumna*, which is now reduced to the rank of a rivulet. Strong ascent to the village of *Curśálí*.

Total distance 4978 paces.

STORMY weather and very cold, driving showers of sleet and rain; path, bad and slippery.

THE village of *Curśálí* contains about 25 substantial houses, and is situated at the immediate feet of the *Jumnotri* snowy peaks; but they are not visible, as the near and steep part of the base obstructs the view.—The situation of *Curśálí* is very peculiar, and one would hardly suppose that people should choose to live in such a remote and cold place. It is the latter end of April, and yet, daily slight showers of snow fall, and the remains of drifts yet lie in shaded places in the village.—By the sides of the *Imri* and *Jumna*, there are several spots of flat ground, on which the inhabitants cultivate grain enough for their subsistence.—To the west, north, and east, this little secluded place is bounded by the lofty cliffs of the *Himálaya*; and to the south, it is sheltered by a mountain, the north

face of which is not so steep, and it is clothed with trees.—All those are at present deep in snow, which reaches down to the level of the two streams;—yet I found the place by no means an uncomfortable abode, for the heights near it, shelter it from the violence of the winds.—The sun is pleasantly warm in the middle of the day, and the progress of vegetation is rapid, in proportion to the length of the winter.—The rocky and snowy defile called *Jumnotri*, where the *Jumna* originates, is seen in the direction of N. 42° east.—Distant 8 miles.

Latitude of *Cursáli* 30° 57′ 19″.

		m	s
17th April,	observed immersion of Jupiter's 1st satellite, mean time	16	03 46

It appears, no observation was obtained at *Madras*, on this day.

During three days, I attempted to get some sets of lunar distances, and also transits of the moon over the meridian, but was constantly prevented, by clouds, from doing any thing satisfactorily.

21st April, 1817.—*Cursáli*, *to Jumnotri*.

		m	f	yards
1	Flat, along the village fields; here climb a steep rocky corner, above the river's bed. *Jumnotri* nearly 41° 30′.—*Chaw* mountain, over which there is a pass to *Succhi* on the *Ganges*, practicable in the rains, (at present it is blocked up by deep snow), 128° 30′	0	3	40
2	Steep descent through snow 1 to 5 feet deep, then flat	0	0	148

		m	f	yards
3	Fields—Slight acclivity, snow patches;—abundance of pheasants here, chiefly of the kind called *Monál*	0	0	64
4	Rough and rocky:—descend to the *Jumna*, which in several places flows under beds of snow 25 or 30 feet thick.—An overhanging precipice to right.—A torrent, called the *Bandiali*, ½ the size of the *Jumna*, joins it from a cleft in the rock, and is the last tribute it receives.—The path to this station, entirely through snow:—cross the river twice, once on the stones, and once on a snow arch.....	0	6	143
5	At *Bhairo Ghátí*—The crest of one of the steepest ascents, (for its length), I ever saw; it is entirely up the snow, in which we cut steps with *P'haoras* (spades) to facilitate our passage.—There is here a place dedicated to *Bhairo Lál*, who is esteemed to be the *Janitor* of *Jumnotri*, and *Gangotri*.—It is nothing more than a low building (if it may be so called) of 3 feet high, containing some small iron tridents.—I hung a new English silver coin by a copper ring on one of them.....	0	1	25
6	Exceedingly steep descent to the *Jumna*, by steps cut in the snow.—A cascade of the stream outs through the snow, and falls from a rock of the height of about 50 feet.....	0	0	130
7	Stiff ascent up the snow bed, which conceals the river. Except here, where the stream is visible for			

		m	f	yards
	a few yards through a hole in the snow, the snow bed is about 100 yards wide, and bounded by high precipices, from which masses of rock of 40 feet in length have recently fallen.....	0	3	214
8	River as before, under the snow; here it appears through a deep hole, falling in a cascade from the rock below the snow.—Rocks on both sides, those to the right cased with ice.....	0	1	152
9	*Jumnotri*.—The place so called	0	0	64
	Total miles....	2	7	100

AT *Jumnotri*, the snow which covers and conceals the stream is about 60 yards wide, and is bounded to the right and left by mural precipices of granite; it is 40 feet $5\frac{1}{2}$ inches thick, and has fallen from the precipices above.—In front, at the distance of about 500 yards, part of the base of the great *Jumnotri* mountain rises abruptly, cased in snow and ice, and shutting up and totally terminating the head of this defile, in which the *Jumna* originates.—I was able to measure the thickness of the bed of snow over the stream very exactly, by means of a plumb line let down through one of the holes in it, which are caused by the steam of a great number of boiling springs which are at the border of the *Jumna*.—The snow is very solid, and hard frozen; but we found means to descend through it to the *Jumna*, by an exceedingly steep and narrow dark hole made by the steam, and witnessed a very

extraordinary scene, for which I was indebted to the earliness of the season, and unusual quantity of snow which has fallen this year.—When I got footing at the stream, (here only a large pace wide), it was some time before I could discern any thing, on account of the darkness of the place, made more so by the thick steam; but having some white lights with me, I fired them, and by their glare was able to see and admire the curious domes of snow over head; these are caused by the hot steam melting the snow over it. Some of these excavations are very spacious, resembling vaulted roofs of marble; and the snow, as it melts, falls in showers, like heavy rain, to the stream which appears to owe its origin in a great measure to these supplies. Having only a short scaled thermometer with me, I could not ascertain the precise heat of the spring, but it was too hot to bear the finger in for more than two seconds, and must be near the boiling point.—Rice boiled in it, but imperfectly.—The range of springs is very extensive, but I could not visit them all, as the rest are in dark recesses and snow caverns.—The water of them rises up with great ebullition through crevices of the granite rock, and deposits a feruginous sediment, of which I collected some;—it is tasteless, and I did not perceive any peculiar smell. Hot springs are frequent in the *Himálaya*, perhaps they may be a provision of nature, to ensure a supply of water to the heads of the rivers in the winter season, when the sun can have little or no power of melting the snows in those deep defiles.

From near this place, the line of the course of the *Jumna* is perceptible downward to near *Lak'ha Maudal*, and is 55° 40' S. west. It will be

seen by the notes, that from the place called *Bhairo Ghátí*, the bed of the river is overlaid with snow to the depth of from 15 to 40 feet, except at one or two places, where it shews itself through deep holes in the snow.

THE snow bed is bounded to the right and left by mural precipices of light coloured granite;—on some ledges there is a sprinkling of soil, where the *B'hojpatra* bushes grow. The end of this dell or defile is closed, as before observed, by part of the base of the great snowy mountain of *Jumnotri*, and which is visible from the plains. The altitude of the part of the mountain, visible, is 29° 48'; but higher parts are concealed by the lower and nearer. The face of the mountain, which is visible to the height of about 4000 feet, is entirely cased in snow and ice, and very steep.—The foot of the base is distant from the hot springs about 500 yards, and immediately where the ascent becomes abrupt, a small rill is seen falling from a rock, which projects from the snow; it is about 3 feet wide, and shallow, being only a shower of spray produced by the snow now thawing in the sun's rays at noon. Above that, no water whatever is seen; if there were any, it would be visible, as the whole steep base of the mountain is exposed to view, directly in front; consequently, the above rill is the most remote source of the *Jumna*.—At the present season, it was not possible to go to it, as the snow bed was further on impassable, being intersected by rents and chasms, caused by the falling in of the snow, as it melts by the steam of the boiling springs below it.

HERE then is the head of the *Jumna*, on the S. west side of the grand *Himálaya* ridge, differing from the *Ganges*, inasmuch as that river has

the upper part of its course within the *Himálaya*, flowing from the south of east to the north of west; and it is only from *Suc'hí*, where it pierces through the *Himálaya*, that it assumes a course of about south 20° west.

THE fall of the *Jumna*, from *Jumnotri* to the *Dún*, is very considerable.—I regret I had not a good barometer, to ascertain the height of *Jumnotri*; I had with me an empty country made barometer tube, with which I endeavoured to gain an approximate idea on the subject.—Having warmed and well dried the tube, I filled it gradually with mercury, driving out such air bubbles as were visible, and inverted it in a deep cup of quicksilver, taking care not to remove my finger from the orifice, till the lower end of the tube was fairly below the surface of the quicksilver;—the tube was kept in an erect position by means of a plumb line.

THE length of the column was 20 Inch 40, which, corrected for temperature, gives 10,483 feet for the height of *Jumnotri* above the sea, taking 30·04 inches for the level of the sea.

THE above is only a rude experiment, but I had not the means of making a better; the length of the column may be depended on to the 20th part of an inch, I think, but the probable impurity of the mercury may cause an error of 2 or perhaps 300 feet.

Near noon, I took a short set of circum-meridional altitudes of the sun for the latitude, as follows:

Horary angle....A.—M.	7	19	30°	58′	59″	9
	5	19	0	0	55	2
	1	58	0	0	52	2
P.—M.	0	31	0	0	47	5
	2	51	0	0	55	2
	6	28	0	0	42	6
Mean latitude of the hot springs of *Jumnotri*			30	58	52	1

THE latitude of the small fall or rill, which may more properly be called the head of the *Jumna*, will be 30° 59′ 06″.

HAVING finished my observations by two o'clock, I set out to return; the heat of the sun had then began to melt the snow on the cliffs on both sides, and many rocks and lumps of snow were falling down; this obliged us to run with all speed down the snow bed, to get out of the way of these missiles:—several of the people had narrow escapes from the falling fragments, but no one was struck.

THE inhabitants of *Cursáli* say, that it is 17 years since they had so severe a winter as the last.—At *Jumnotri*, the inclination of the granite rock is from 43° to 45°—from the horizon.—The apex being to the S. W. or towards the plains.

As the season was not sufficiently advanced to allow of my passing to the *Ganges* by the *Chiá* or *Cilsaum* mountains, both of which are

at present impassable from the depth of snow on them, I returned to *Catnaur*, and going up the *Shiálba* glen, crossed the ridge, which divides the two rivers at the *Jackeni Ghát*, and descended by *Bauna*, to *Barahat*, from whence I proceeded up the *Ganges* to *Reital*, and continued my route beyond *Gangotri*, as before mentioned.

I shortly hope to be able to present to the Society, the result of my trigonometrical operations to determine the heights and positions of all the peaks of the *Himálaya*, visible from *Seharanpur*, and also an account of the sources of the *Tonse* and *Jáhnavi* rivers, and of the upper part of the course of the *Setlej*.

ADDENDA.

	feet
Height of the *Sangha* at *Lohari Naig*, above the Sea	7389
Below *Suchi*	7608
Suchi village	8869
Ridge of the mountain on which *Suchi* stands	12,000
Jumnautri	10,849
