ON THE HEIGHT OF THE HIMALAYA MOUNTAINS.

BY H. T. COLEBROOKE, ESQ.

WHEN I presented to the Society the narrative of a journey, performed by Lieutenant Webb and Captain Raper, to explore the sources of the Ganges, I had occasion to notice the observations mentioned to have been made for determining geometrically the altitude of remarkable peaks of the snowy mountains, and the inference which appeared to be fairly deducible, that this chain of mountains is among the most elevated in the known world, neither surpassed nor rivalled by any other but the Cordillera of the Andes*. I should have been justified by the premises in saying more: but I thought it right to speak thus guardedly; not having been then enabled to examine the particulars of the altitudes taken, the distances measured, and the calculations founded on them; nor to procure barometrical measurements tending to confirm or to correct conclusions drawn from those grounds. But having been since furnished with further observations taken by Lieutenant Webb, in prosecution of the same inquiry, and having compared them as well with those before made by him, and by the late Lieutenant-Colonel Colebrooke, as with Lieutenant-Colonel Crawford's labours in the pursuit of the same

* As Res. vol. xi, p. 445.
inquiry, I consider the evidence to be now sufficient to authorize an unreserved declaration of the opinion, that the Himálaya is the loftiest range of Alpine mountains which has been yet noticed, its most elevated peaks greatly exceeding the highest of the Andes.

This had been long suspected, or rather had been very generally believed, in India, upon less conclusive evidence than will now be submitted to the public. It was remarked, that this chain of mountains constantly covered with snow is visible from the plains of Bengal at the distance of 150 miles* (it might have been said at a still greater distance). This fact demonstrates great elevation. For the peak of Teyde, or Teneriffe, measuring nearly 12,000 feet †, is discernible in clear weather at a distance of 120 miles, and appears like blue vapour scarcely darker than the sky; and Chimborazo, the highest peak of the Andes, ascertained to be more than 20,000 feet high ‡, is seen at a distance of little more than 60 leagues, the rest of the Cordillera of the Andes being then concealed from view: but the Himálaya chain of mountains is visible in the horizon, as a continued line extending through more than two points of the compass, at a distance equal to that last mentioned, appearing in clear weather like white cliffs, with a very distinctly defined outline.

To justify the assertion, that the distance, at which the chain of snowy mountains continues to be visible, exceeds 150 miles, it may be sufficient to mention, that it is seen bearing Easterly of North, from Patna and from other stations (as Bhágalpur, &c.), on the Southern bank of the Ganges. Now the latitude of Patna, by astronomical observation, is 25° 36' §; and that of Cat'h—

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* Rennel's Memoir of a Map, p. 302. (2d Edit.)
† 1,904 French toises.
‡ 3,220 French toises.
§ Reuben Burrow.
nearly due North of it, is 27° 42', the difference being 126 geographic, or about 146 English, miles. But the nearest of the Himalaya mountains are yet distant in a horizontal line above 25 miles from the last-mentioned town; more than one valley and intermediate ridge being interposed; some of which, to a distance of ten miles, have been visited by Europeans, without approaching within several days' travelling distance of the foot of the Himalaya.

The continuation of the same chain of mountains divides Bután from Tibet, and is distinctly visible from the plains of Bengal. Captain Turner and Mr. Saunders, on their journey to Tisholumbo, after traversing Bután and crossing the frontier of Tibet, found themselves near a range of mountains covered with everlasting snow, which seemed to be but two miles distant from their route. Captain T. particularly noticed a conspicuous peak held in high veneration by the Hindus, and named Chamalári. Both the travellers were satisfied, the one from the remarkable form of the peak, the other from the height and bearings of the range, that the mountains which they then viewed are the same which are seen from Purnea, Rajmahal, and other places in Bengal. Now, according to the survey of Captain Turner's route, Chamalári is placed in Lat. 28° 5' Long. 89° 18'; a position no less than 165 geographic miles from Purnea, and 200 from Rajmahal, which is situated in Lat. 25° 3' and Long. 87° 44' by observation. From a commanding eminence, on the frontier of Tibet, the travellers had an extensive view of the mountains of Bután, covered with verdure to the very tops; and it appears, from what is said by them, that Bután contains no mountains on which snow con-

* Lt.-Col. Crawford.
† General Kirkpatrick's Account of the Kingdom of Nepal.
‡ Capt. Turner's Narrative, p. 203 (2d Edit.), Phil. Trans. vol. 79.
§ Reuben Burrow.
tinues during all seasons of the year, and few on which it remains until the middle of summer. These circumstances seem to establish, beyond question, the fact, that the snowy range, of which Chamalāri is a part, is that which is seen from stations in Bengal, distant 165 and even 200 geographic miles, answering to 191 and 232 British miles. Now it requires an elevation exceeding 28,000 feet to be barely discernible in the mean state of the atmosphere at so great a distance as that last mentioned; though a much less elevation, it must be acknowledged, may suffice under circumstances of extraordinary refraction.

The presumption, which was however raised on these grounds, was to my apprehension corroborated by observations, which I had myself the opportunity of making twenty years ago; and which gave, according to the note I have preserved of them, 1° 1′ for the usual altitude of a conspicuous peak of the Hīmalaya viewed from a station in Bengal, which, according to the construction of Rennel’s map, was not less distant than 150 English, or about 130 geographic, miles. If this distance might be relied on, the height to be inferred from that observation of altitude, after a due allowance for terrestrial refraction, would considerably exceed that of Chimborazo, being not less than 26,000 feet above the level of the plains of North Bengal. But, as the distance was not ascertained with sufficient accuracy for the purpose of confidently grounding on it a calculation of this nicety, I proposed to determine it by observations of the bearings of the same peak, from two places distant enough to afford an adequate base, the length of which might be found by correct survey. Not having had the means of completing the inquiry upon the principle here explained, I recommended it to the attention of the late Lieutenant-Colonel Colebrooke, by whom it was prosecuted during his survey of Rohilkhand; and it has been further pursued to a satisfactory result by his assistant, Lieutenant
WEBB, during his journey towards the sources of the Ganges, and finally during a survey of the province of Góarakhpúr.

Colonel Colebrooke’s notice was also drawn to the subject by the communications of Dr. Francis Buchanan and Lieutenant-Colonel Crawford, who both visited Nepal in 1802, and who were convinced by the information they received there, from intelligent persons, that the sources of the Ganges are on the southern face of the Himálaya, and that these mountains are of vast height. He had likewise a knowledge of a survey by Lieutenant-Colonel Crawford, executed in 1805, along the northern frontier from Behar to Róhilkhánd, in which bearings were taken of every remarkable peak of the snowy range, which could be seen from more than one station; and consequently the distance of those peaks from the places of observation, and their geographical positions relatively to the plains of Hindustán, were determined by the intersection of the bearings and by calculation. Colonel Crawford had also taken altitudes, from which the height of the mountains might be computed, and which gave, after due allowance for refraction, the elevation of conspicuous peaks, at least equal to that above mentioned. But the drawings and journal of this survey have been unfortunately lost.

The observations instituted and completed by Lieutenant-Colonel Colebrooke, while in Róhilkhánd, were two; one taken at Pilibhít, where the elevation of a peak distant 114 English miles, according to bearings from two stations, the distance between which was measured, was found to be 1° 27′; the other at Jétpúr, where the elevation of the same peak, distant 90 English miles, was observed to be 2° 8′. I find among his papers numerous other observations of the bearings and appearance of the chain of snowy mountains, as seen from
many successive stations. But the only altitudes which have been preserved are those above mentioned.

In calculating from these observations of altitude, allowance was first made for refraction at the same rate as for celestial objects of the same apparent altitude: and, from the observed elevation so corrected, was deduced a height of 20,019 feet for the mountain as viewed from Pilibhit, and 20,598 for the same as seen from Jet'hpur, or 20,308 \( \frac{1}{2} \) feet on a medium of both observations. But the allowance for refraction being much too great, amounting to \( \frac{3}{4} \)ths of the contained arc in one instance and \( \frac{1}{4} \)ths in the other, the computation was again made, allowing \( \frac{3}{8} \)th of the intercepted arc for terrestrial refraction, and the result showed a height approaching to 22,000 feet above the level of the plains of Rohilkhand.

However, this allowance of an eighth part of the contained arc still exceeds the mean of terrestrial refraction, as appears from the trials conducted by General Roy, and Colonels Williams and Mudge*, and especially from those of the last-mentioned observer. They found terrestrial refraction subject to great variation, amounting to no less than \( \frac{1}{3} \)d of the contained arc in some instances, and so small as \( \frac{1}{10} \)th of the intercepted arc, and even less, or absolutely 0, in others. But, in the numerous observations of those gentlemen, the extreme instances are few; and the range of variableness is commonly within narrower limits, from \( \frac{1}{4} \)th to \( \frac{1}{8} \)th, being on a mean either \( \frac{1}{10} \)th or \( \frac{1}{12} \)th part. The trials most to be depended on, being those which were conducted by means of correspondent and contemporary observations, give a mean of \( \frac{1}{10} \)th. It appears, also, that the refraction is least variable where the ray passes through the air at a considerable distance from the surface of the earth, for the greatest part of its course: which is eminently the

* Phil. Trans. vol. 80, 85, and 87.
Reduced Copy of part of New U.S. Webb's Current in OUDE 1812

British Miles
No. 3
Reduced Copy of part of
Mr. W. S. Webb's
Survey in
OUDE
1812
British Miles
case in the instance under consideration; and especially in some which will be subsequently noticed, where the altitude of the mountains was taken from elevated spots: and, in all, the ray must pass for a great part of its course through a stratum of the atmosphere of much less density than in the experiments of General Roy and Colonel Mudge, to which reference has been made.

It follows, from these considerations, that the mean terrestrial refraction should not be taken at more than \(\frac{1}{4}\)th of the arc contained between the object and station. This allowance agrees with that which Delambre directs to be made: it exceeds what was found by Legendre, (viz. \(\frac{1}{4}\)th); and it approaches very near to Maskelyne’s estimate of \(\frac{1}{9}\)th. But from Major Lambton’s observations, in the peninsula of India, terrestrial refraction was found to vary from \(\frac{1}{4}\)th to \(\frac{1}{9}\)th*, or on a medium \(\frac{1}{8}\)th of the contained arc. As this mean refraction may be thought more applicable to the north of India than that deduced from the trials made in the climate of Great Britain, I shall compute from altitudes reduced by this as well as the preceding correction for refraction, and contrast the results with similar calculations, in which the refraction shall be taken at the utmost quantity which any past experience could justify, viz. \(\frac{1}{3}\)d of the arc.

To compute from the data, we have, in an oblique plane triangle, the angle (B) at the base of the mountain, which exceeds a right angle by half the contained arc; or (which is the same thing) by half the angle at the earth’s centre subtended by that arc; the angle (S) at the station of observation, which is the sum of the observed altitude (corrected for refraction) and half the contained arc; and one side (A), which is the chord of the contained arc, or distance between the

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base of the mountain and station of observation, differing but a few feet, in the cases before us, from the circular arc itself. The angles and one side of the triangle being thus known, the other two sides may be found; one of which, subtending the angle $S$, is the height of the mountain, or perpendicular from its summit to the middle of its base. The observations at Pilibhit and Jetéhpur, calculated upon this principle, and with an allowance of $\frac{1}{11}$ for refraction, give 22436 and 22146 for the elevation of the peak observed from those stations; or on a mean 22291 feet above the level of the plains of Rohilkhand; or about 22800 feet above the level of the sea.

In the same manner may be calculated the height of the peak, situated, according to the information of the mountaineers, near the source of the Jamund, and measured from the summit of Nágún-ghátt, near Lákuri, under an angle of $3^\circ 17'$, and, from that of Chandrabadani, under one of $2^\circ 50'$. The position of the mountain, deduced from horizontal angles taken at both stations, is settled by Mr. Webb in lat. $31^\circ 23'$, long. $78^\circ 31'$. The latitude of the stations, determined by astronomical observations made at the next places of encampment $\dagger$, is $30^\circ 39'$ and $30^\circ 90'$; and the distances, taking the longitudes as inferred from survey, are 54.2 and 53.2 geographic miles respectively. Whence, allowing $\frac{1}{11}$ for refraction, we have 20895 and 21855 feet; or, with an allowance of $\frac{1}{11}$, 20503 and 21320 feet; for the elevation of the mountain above those stations. Their respective heights are yet unascertained: but Chandrabadani was, by Mr. Webb, thought the highest, contrary however to what the result of the present calculation indicates. The height of Nágún-ghátt was estimated by him at 5000 feet; and this guess is

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* Asiatick Researches, vol. 11, p. 442.
† MS. Journal.
corroborated by a trigonometrical measurement of a
mountain called the Khanjar near Bhuvan-devi*, seen
the preceding day, and found to be 3297 feet above the
valley. It is distantly supported by barometrical mea-
sures of mountains in a different part of the same chain,
as will be noticed further on.

The elevation of the Jamunavatari appears then to
be not less than 25000 feet above the valley. It is
however right to observe, that this measurement of the
height of that mountain above the summit of the passes
from which the angles were observed is not entirely to
be relied on; as the distances are not determined with
sufficient precision, being dependent on the relative po-
sition of the stations in longitude, concluded from a sur-
vey performed by means of a route measured by time in
a very uneven country.

It might be expected that use should be made of nu-
merous other observations, which were taken from various
elevated situations among the lower mountains, especially
those which exhibited much larger angles; on the pre-
sumable ground, that the height of any selected point
among the numberless snowy peaks of the Himalaya
would be best ascertained by angles taken at the nearest
positions approaching it. No doubt such would be the
case, could a survey be leisurely performed in the moun-
tains, choosing the fittest stations upon a previous view
of the country, and satisfactorily identifying the point to
be observed. But a hasty journey (more was not in this
instance practicable) among mountains nearer to the ob-
ject affords less means of an accurate measurement than
a survey carefully conducted at a remoter distance in the
champaign country. Instead of keeping in view, from
day to day, during the progress of survey, the same se-

* It is to be regretted that more frequent opportunities did not occur
for similar measurements.
lected point, and being fully assured of its identity by the uniformity, or at least the very gradual alteration of its appearance, the traveller through the mountainous skirts of the Indian Alps loses sight of those objects for successive days as he proceeds along the valleys, and finds it impracticable, when he emerges to higher ground, his route leading him over some mountain, to discern from its summit the loftiest peak, now perhaps intercepted from his view by one nearer, though of less elevation; or to discriminate and recognise among innumerable glaciers, which have varied their aspect with his change of place, the particular snowy peak before contemplated by him from another side, in a different point of view, and with another aspect.

On these considerations, and after carefully inspecting Mr. Webb's journal, in which I find observations of unnamed snowy peaks seen from the stations of Ret'hal* and Bahmencôî'hi † under angles of nine and ten degrees; with others, from more distant stations, of mountains supposed to be known, as the peak near Gangávatárit seen from Nágün-ghâtî and Chandra-badani ‡, and Cédár-nát'h from the last mentioned station §; I do not deem any of these points to be so verified as to be made the certain grounds of a correct measurement of altitude. The horizontal distance of the near glaciers appeared to the travellers, in more than one instance, to be only ten miles ||; but this, being a mere guess, cannot serve for the basis of correct calculation. Employed as a conjectural measure, it gives 9000 feet for the height of the objects above the lofty spot whence they were viewed.

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* 10° 18', 9° 55', 9° 42', 9° 19', 8° 19' bearing respectively N. 62° 49' E. N. 59° 04' E. N. 54° 56' E. N. 49° 42' E. N. 45° 28' E.

† 9° 55', 9° 14', 8° 17' bearing N. 43° 35' E. N. 39° 12' E. N. 28° 17' E. respectively.

‡ 30° 1' and 20° 50'.

§ 20° 34'.

|| Asiatick Researches, 11, p. 515 and 552.
The position of Cédâr-nâî'h is not confidently stated*, the materials for determining it being insufficient. Supposing however that of Gangâvatârî to be more nearly correct, the pyramidal peak in the vicinity of that celebrated place, if indeed the same which was seen and measured from Nâgün-gûâtî, is 17784 feet above the summit of that pass, esteemed to be 5000 feet high.

But, leaving these conjectures and doubts, let us pass to more certain observations and more exact measurements. To Colonel Crawf...
measured twice. The positions of the same mountains were also settled by observations of them made from the plains of Behar in the progress of the great survey which has been mentioned.

The angles of elevation of the mountains above the stations of Sambhú and the queen's garden near Caíthmándu were taken with an astronomical sextant and an artificial horizon. Among the most remarkable is an observation of a mountain pointed out as mount Dhaibun. It was seen under an angle of $5^\circ 4' 21''$, and ascertained to be distant $35\frac{1}{2}$ g. m. The elevation calculated from this measure is 20140 feet above the station from which the altitude was taken, and which is itself more than 4500 feet above the level of the sea, as concluded from barometrical observations to be subsequently mentioned. Another seen under a similar angle, $5^\circ 3' 58''$, but less distant by four miles, exceeds the elevation of the station by 17819 feet. Both these mountains are but little to the eastward of north from Caíthmándu. The following are as little north of east; viz. one nearly in the position of the Cála-bhairava*, distant 59 g. m., with an altitude of $2^\circ 48' 6''$, and consequently 20025 feet high; another in its vicinity, with an angle of $3^\circ 23' 6''$, distant 48 g. m. and elevated 18452 feet; and a third, as much more remote, being 68 g. m. with an altitude of $2^\circ 7' 21''$, and a consequent elevation of 18662 feet above Caíthmándu.

All those mountains are perceivable from Patna: the first or the supposed Dhaibun, at a distance of 162 g. m., and Cála-bhairava, or the mountains in its vicinity, at that of 153, 150, and 145 g. m. These are the nearest of the Himalaya which are visible from that city. The most remote are seen in the N. E. quarter, at the prodi-

* General Kirkpatrick's Account of Nepal.
gious distance of 195 g. m., ascertained by their position, which is determined by bearings taken by Colonel Crawford from stations approaching within a hundred miles of their site.

Mount Dhaibún, or at least the peak which was indicated to Colonel Crawford under that name, and which is not surpassed by any of the points measured from Cat'hmându, was viewed by General Kirkpatrick, if indeed it be the same mountain, from a position ten miles nearer to it on mount Bhirbandi *, and his animated description of the sublime prospect contains presumptive evidence that the remoter glaciers of the Himálaya are still more elevated; for he speaks of a neighbouring mountain not less stupendous, yet surpassed by one of the pyramidal peaks of the snowy chain seen peeping over its towering summit. It may readily be credited that the more accessible mountains which approach Cat'hmându, as Jibjibia, Dhaibún, and Dhánchá, may be inferior in height to the abrupter peaks in the chain of the Himálaya.

Among the loftiest in that chain is one distinguished by the name of Dhawala-giri, or the white mountain, situated, as is understood †, near the source of the Gandhac river, called in its early course Sálagrámt, from the schistous stones, containing remains or traces of ammonites, found there in the bed of the river, and thence carried to all parts of India, where they are worshipped under the name of Sálagráma; the spiral retreats of

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* Account of Nepal, p. 138. It is right to observe that the map annexed to that publication places Dhaibún and other mountains, as Dhánchá and Ghirkhú, much nearer to Cat'hmându than they are by Colonel Crawford's survey. The latter is however most to be depended on.

† Kirkpatrick: Nepal. Sálagráma stones are found in great abundance near Muctinát'h, and more sparingly at Dám dher cund still nearer to the source of the Gandhac. Colonel Crawford's MS.
antediluvian molluscas being taken by the superstitious Hindu for visible traces of Vishnu.

A high peak, among the most conspicuous of those which are seen from the plains of Gôrakhpûr, and on that account selected by Mr. Webb for a measurement, conducted by means of observations taken at different stations in that province, was pointed out to him as recognised by the mountaineers to be Dholagir (Dhawalagiri). Mr. Webb took the bearings from four stations, and altitudes from three; and the particulars of his observations are as follow:—

At station A, situated near Khâtûr, bearing of the snowy peak P, corrected for magnetic variation and error of adjustment by an azimuth observed at the time ...... N. 30° 12' E. 2° 48'

Altitude ......................

At station B, Nowá newâdâ on the Rapti. Bearing of P .............. N. 49° 30' E.

At station C, two furlongs W. of Slûgaon. Bearing of P .............. N. 35° 49' E. 2° 19'

Altitude ......................

At station D, two furlongs W. of Bhôpetpûr. Bearing of P, .............. N. 60° 1' E. 1° 22'

Baltitude ......................

B bears from A by the survey, W. 2° 5' N. distant, .............. 43,4 B. M.

D bears from A, W. 7° 5' N..... 73,5 B. M.

The bearing of C from A is not used, the side A C measuring only 16,3 B. M.

C to B W. 13° 54' N. distant 29,4 B. M.

C to D W. 15° N. ......... 60 B. M.

B to D W. 14° 3' N. ...... 30,5 B. M.

From these data Mr. Webb computes the distance of
the peak (P) from the stations A, C and D*, at the numbers under mentioned: viz. From the station A, by the triangle A PB, 89,6, and by the triangle A PD 89,1; mean of both computations 89,35 miles, or 471768 feet. From the station D, by the last triangle, 135,9, and by C PD 136,8; mean of both, 136,35 miles, or 719928 feet. From C, by the last of these triangles, 103,4, and by C PB 102,3; mean of both 102,85 miles, or 543048 feet. He remarks that several other bearings of the same peak were taken from different stations; and that, by laying off the rhumb-lines of bearing on the map, they intersect at very inconsiderable distances from the position of the peak, as deduced from those which were selected for calculation.

Let us proceed to compute the height of Dhawalagiri (vulg. Dhôlágir) with the foregoing measures of distance and the observed altitudes.

At the station A we have the distance 471768 feet, 77,85 geographic miles†, or in parts of a circle 1° 17' 51"; the chord of which in feet is 471758. The altitude observed being 2' 48", and the refraction being taken at 1/4th of the intercepted arc, the angles are S 3° 20' 26" 15"" and P 86° 0' 38" 15"", with the side S B 471758; whence we have the side B P, or height of the mountain, 27558 feet.

* See the annexed map.
† The geographic mile, or sixtieth part of a degree of a great circle, is here taken at 6060 feet. The length of the meridional degree in different latitudes, according to the latest measurements, being 60995 fathoms in latitude 66° 20', 60820 in latitude 59° 2', 60783 in latitude 46° 12', and 60487 in latitude 11° 6'; whence may be concluded 60600 nearly between the latitudes 27° and 31°; and this measure is employed without correction or modification, though the position of the arcs be at acute angles to the line of the meridian; greater precision in reducing the distances to parts of a great circle appearing to be unnecessary, as the utmost accuracy would make little difference in the computed height of a mountain.
By a similar calculation of the altitude of the same mountain observed from the stations C and D; viz. 2° 19' and 1° 22', or corrected for refraction 2° 11' 32" and 1° 12' 6", with the distances above found, which in parts of a circle are 1° 29' 36" 36"" and 1° 58' 48", and, reduced to the chords of the arcs in feet, 543031 and 719893, the height comes out 27900 and 27573; or, on a mean of the three, 27677 feet above the plains of Gorak'hpur; and reckoning these to be 400 feet above the mouth of the Ganges, as inferrible from the descent of the stream of rivers, the whole height is more than twenty-eight thousand feet above the level of the sea.

The following table exhibits a comparison of this result, with other computations made on different rates of refraction:

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<tr>
<th>Dist-</th>
<th>Interc.</th>
<th>Alt.</th>
<th>Height, allowing for refraction.</th>
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<td>Starr. in miles.</td>
<td>in deg.</td>
<td>obs.</td>
<td>1</td>
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<td>A</td>
<td>8° 46'</td>
<td>1° 17' 51&quot;</td>
<td>2° 48'</td>
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<tr>
<td>C</td>
<td>10° 35'</td>
<td>36° 6</td>
<td>9° 19'</td>
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<tr>
<td>D</td>
<td>15° 58'</td>
<td>48&quot;</td>
<td>10° 22'</td>
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<tr>
<td>Mean</td>
<td></td>
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<td>Extreme difference</td>
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It is apparent, from inspection, that the observations at the stations A and D agree best; and if that computation be nearest the truth, wherein the extreme differences are least, the conclusion will be, that the height is about 27550 feet; such being the elevation deduced from the mean of observations calculated according to middle refraction.

The limit of error arising from refraction must be taken at less than 850 feet, as the observations at A and C coincide for the height of 26690 feet, 1/6 of the contained arc being allowed for refraction; and those at C and D for an elevation of 28290 feet, 1/5 being allowed; while those at A and D do so for the mean altitude of 27565
feet, refraction being taken at the middle rate of \( \frac{1}{2} \) th; and a larger allowance than \( \frac{1}{4} \) th of the intercepted arc, which would exceed mean celestial refraction for like altitudes, cannot be requisite, without very wide disagreement in observations made on different days, which would mark extraordinary refraction; but that is not the case with those in question.

The limits of error in respect of the observations themselves, whether for the distance or for the altitude, are more confined, since the uncertainty in the distance, amounting to a quarter of a mile in one instance, and half a mile in the rest, induces uncertainty in the computed elevation to no greater extent than 76 or 99 feet for the nearer stations, and 180 for the most remote. An error of a whole minute in an observation of altitude affects the consequent calculation of height in the proportion of about 200 feet for the more distant station, and 130 to 150 for the nearer. But the instrument which was used should, with due care, give angles true within that quantity; and the observer was enjoined to take the angles to the nearest minute.*

It would be an extreme supposition that the errors have in every instance been the highest possible, and on the side of excess. Assuming, however, that they are so, the elevation, as observed from the two nearest stations, is not reduced below 26457 and 26467, or, on the mean of both, 26462 above the plains of Gbrak'hpur.

We may safely then pronounce that the elevation of Dha\(w\)alagiri, the white mountain of the Indian Alps†,

* Instructions, quoted in Asiatick Researches, vol. 11, p. 448. The writer of these was acquainted with the instrument, and knew the degree of precision which it comports.

† Sans. Dha\(w\)ala, white; Giri, mountain. Vulg. Dh\(w\)alagir, the white mountain. Kirkpatrick's Nepal, p. 287. It is the Mont-blanc of the Himalaya.
exceeds 26862 feet above the level of the sea; and this
determination of its height, taken on the lowest compu-
tation of a geometrical measurement, is powerfully corro-
borated by the measure of an inferior, though yet very
lofty mountain, observed from stations in Rohilkhand.

It may be satisfactory to bring this measurement to the
test of comparison with the calculation of heights from
like observations of small angles at great distances in a
case where the elevation is otherwise known or more pre-
cisely determined. This we are enabled to do in the
very instance most to be desired, that of Mont-blanc,
heretofore considered to be the loftiest mountain of the old
continent. Its altitude, as seen from Pregny, a station
half a league from Geneva, near the lake, exhibits an angle
of 3° 14', according to an observation by De Luc *.
The distance is stated by him in round numbers, 227000
French feet; but appears from Sir G. Shuckburgh's
series of triangles † to be over-rated, the distance of
Geneva, a little more remote, being no more than 225098
English feet. Calculating from this side, and the angle
observed by De Luc, with an allowance of \( \frac{1}{11} \) of the
arc for refraction, the height is found 13713 feet
above Pregny, or 15122 feet above the level of the sea.
De Luc himself computed it from the same observation,
differently employed in a manner which is little affected
by uncertainty in the refraction or the distance, though
subject to other error, at 2391 French toises equal to
15289 English feet: and Sir George Shuckburgh,
by a trigonometrical measurement, in which he uses from
one station a side of a triangle 206879 feet, and from
another one of 142362 feet, and corrects the observed
angles by an allowance for refraction equal to \( \frac{1}{16} \) of the
contained arc, makes the elevation of Mont-blanc 14411

* Modifications de l'Atmosphere, § 763.
† Philosoph. Trans. vol. 67. The distance is not there stated, but
is easily calculated from the angles and distances exhibited.
and 14453, or, on a mean of the two, 14432 feet above the lake of Geneva, and 15662 above the sea.

These instances may authorize an inference, that, in similar measurements of Dhawalagiri, Dhaibun, and other mountains of the Himalaya, from stations some as near, others twice or thrice as distant, the uncertainty respecting the accuracy of the result is not so much greater as to render that result vague and dubious.

Barometrical measurements, though less to be depended upon than a geometric one, would have been desirable, as showing that no very material error has by any oversight crept into it. In the absence of any observations of the barometer on the nearest accessible heights, we are in possession of some made on summits of mountains belonging to the intermediate chain. For instance, at Chisopani fort, on the route from North Bihar towards Cat’hmândú in Népâl, the barometer was noted on two days at an interval of more than a month (23d February and 28th March 1793), and both observations gave the same length of the column of mercury 24.63. On one of those days the barometer was observed at a spot a little more elevated, near the cold spring which gives name to the place*, 24.43; and the temperature shown by the thermometer is also given, 65° Fahrenheit’s scale at 9 o’clock, and 67° at 11 in the forenoon†. A meteorological journal was kept by Dr. F. Buchanan at Cat’hmândú, for nearly ten months (April 1802 to February 1803 †), and the mean height of the barometer in that period is 25.22. The greatest height being (in May) 25.62; and the least (in August) 24.83 §. On a

* Népâl; Chisô cold, Pâni water. Sans. S’isîra-pânîya.
† KîrkpâtrîcK. Népâl, p. 52 and 331.
‡ MS.
§ The barometer, by which the journal was kept, gave less length to the column of mercury, than another, with which it was occasionally
minute inspection of it, the changes, though observations were made at four different hours of each day, are small, seldom amounting to the tenth of an inch within the day, and by no means corresponding to the changes of temperature shown by the thermometer.

To compute the elevation of the stations at Chisapant and Cat’hmund, under the want of corresponding observations of the thermometer and barometer at the foot of the mountains, we must either seek in some journal, which may have been preserved, a contemporary observation at a station (a very distant one) in Bengal, or else be content to take the mean height of the barometer in Bengal, where it is very stationary, and seemingly unaffected by changes of temperature.

For here, as in most countries near the tropics, the barometer has a very confined range, and does not vary with the fluctuations of the temperature, owing to contrary but equal variations of density and elasticity of the air, or other countervailing causes not investigated. The column of mercury stands within a few tenths of an inch of the same height at all seasons of the year*; and exhibits, but within narrower limits, the phenomenon of diurnal tides, which also do not correspond with the rise and fall of the thermometer†. Towards the end of February, the season when the mountains of Népdl were visited by General Kirkpatrick, the barometer does not vary in Bengal so much as the tenth of an inch above and below 30 inches, while the thermomenter in the shade ranges 10°, (from 70° to 80° on a medium,) and much more in an

compared, and which was constantly higher by a quarter of an inch. The latter agrees more nearly with General Kirkpatrick’s barometer, which in March exhibited 25.87 for the length of the column of mercury at Cat’hmund. The measure of it must be therefore taken as doubtful to one quarter of an inch.

open exposure, between morning and noon. In the months of December and January, the season when the column of mercury is at its maximum*, the mean elevation of the barometer is 30.07, while that of the thermometer is 68°. At Cat'hmándú, during the same season of the year, the mean height of the barometer is 25.28, while the thermometer is 52°: seldom altering so much as the tenth of an inch, and never more than 1½ tenths, in the compass of one day, nor during the whole season so much as two tenths for the same hour of the day.

The last of the two methods proposed seems therefore preferable, as the barometer is shown by the journal kept at Cat'hmándú to be as little variable in Nepal as it is in the plains of India; and contemporary observations at places very remote (no other could be found) would produce no greater degree of accuracy, since a like state of the atmosphere in respect of elasticity, or in regard to humidity and other circumstances affecting its density exclusive of temperature, is hardly to be presumed to prevail through an expanse of many hundred miles between places so differently situated; the one on the open plain within the reach of influence of the sea, the other in the midst of mountains at the foot of the loftiest Alps. I shall therefore take the mean height of the barometer in Bengal, towards the end of February, or 30 inches, and the observed height at the spring of Chisápáni at the same season of the year 24.43: and in like manner the mean length of the column of mercury for both Calcutta and Cat'hmándú, in the winter season, when the mean temperature at the one place as much exceeds the zero of the scale adapted to the measurements of heights, as it is short of it at the other. This appears to be 68° at Calcutta and 52° at Cat'hmándú: the mean

of both, or 60°, differing by less than 1½° from the zero of the scale. The corresponding lengths of the column of mercury are 30.07 and 25.28 respectively.

Proceeding on these grounds to calculate the heights of the places, we find from the difference of logarithms*, 753½ French toises or 803 English fathoms in one instance, and 892 French toises or 950½ English fathoms on the other: needing little correction for the difference of temperature, the thermometer being near the zero of the scale†. The elevation thus found, corrected, however‡, for expansion of mercury and variation of the density of the air, as indicated by the thermometer, is 5818 English feet or 9692 fathoms for Chhispáñi, and 4784 feet or 7979 fathoms for Cat'hmándú§, above the plains of Bengal. Hence may be inferred the following approximated measures of other stations where barometrical observations were also made, unaccompanied, however, by observations of the thermometer.

---

* De Luc, Mod. de l'Atmosphere, § 576 and 631.
† Zero of De Luc's scale, 16.75 of Réaumur's, answering on Fahrenheit's scale to... 69.32
General Roy's (Philos. Trans. vol. 67, p. 740), adapted to French toises 61.4
Thermometer at Chhispáñi, 65°, that at Calcutta being 75°; the mean is 70
Thermometer at Cat'hmándú... 52
At Calcutta... 68
Mean of both... 60

‡ According to the mean of the rules proposed by General Roy and Sir George Shuckburgh; and nearly in conformity to De Luc's, excepting the reduction of 8° in his scale: the numbers being 0.454 for the multiplication of the difference of thermometers, and 0.00244 for that of the mean of both thermometers above 32° Fahrenheit.
§ By another barometer which stood a quarter of an inch higher, the elevation of Cat'hmándú above Calcutta is 4510 feet; or 4600, nearly, above the sea.
HIMA'LAYA MOUNTAINS.

Feet.

<table>
<thead>
<tr>
<th>Location</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chandragiri, M</td>
<td>7989†</td>
</tr>
<tr>
<td>Tambékhán, M</td>
<td>6488</td>
</tr>
<tr>
<td>Chisápáni, M</td>
<td>6453</td>
</tr>
<tr>
<td>Cumhara, M</td>
<td>5943†</td>
</tr>
<tr>
<td>Bhirbandí, M</td>
<td>5875</td>
</tr>
<tr>
<td>Sibudhol valley</td>
<td>5711</td>
</tr>
</tbody>
</table>

Also, as before,

Cold spring Chísápáni                   5818
City of Cat'hmándú                   4784

And (by a trigonometrical measurement of mountains encompassing the valley of Népáí**, selecting from it mountains south of Cat’hmándú) Chandragiri M. above Cat’hmándú 3682 feet, and above the sea†† 8466

Palchu M. (above Cat’hmándú 4210 feet) 8994

It does not seem, then, that the elevation of the pass of Nágun-gháti, whence the mountain near Jumundwathri was observed, need be thought overrated at so little as the lowest of these heights, which command a similar extensive view of the Himálaya.

To recapitulate the result of this minute examination of measurements of the Indian Alps, the following are stated as differences of elevation which may be received as near approaches to a correct determination of the

* Estimated, KIRKPATRICK, Népal, p. 331 and 332.
† Doubtful.
‡ KIRKPATRICK, Népal, p. 70.
§ Ibid. p. 57.
‖ Much beneath the summit of the mountain: ibid. p. 139 and 333.
¶ Ibid. p. 334.
** Colonel CRAWFORD, MSS.
†† This mountain, by General KIRKPATRICK's doubtful observation of the barometer (22.5), is 7989 feet above the plains of Bengal.
height, and as fully substantiating the position which was advanced at the beginning of this paper.

*Dhawalagiri* or *Dhólāgīr*; above *Gorakhpur*, which is estimated to be 400 feet above the sea;
On a mean of two nearest observations, and at the lowest computation ................ English feet 26462
On a mean of three observations with middle refraction ................................. 27677
Above the sea, at the lowest computation ..................................................... 26862

*Yamunávatári*, or *Jamautri*; above the summit of *Nágüngháti*, which is estimated to be 5000 feet higher than the sea ......................... 20895
Above the sea ................................................. 25500

A mountain supposed to be *Dhaibun*; above *Cat’hmándú*, which appears by a barometrical measurement to be at least 4600 feet higher than the sea .................... 20140
Above the sea ............................................. 24740

A mountain not named, observed from *Pilibhit* and *Jét’hpúr*; above *Rohilkhand*, which is estimated at 500 feet above the sea:
On a mean of observations at both stations, 22291, or, more exactly ....................... 22268
Above the sea ............................................. 22768

A mountain not named, observed from *Cat’hmándú*, and situated in the direction of *Cálabhairani*; above the valley of *Népál*, 4600 feet higher than the sea ....................... 20025
Above the sea ............................................. 24625
Another near it; above the valley of *Népál*...................... 18662
Above the sea ............................................. 23262
A third in its vicinity; above the valley of *Népál* ......................... 18452
Above the sea ............................................. 23052

I take this opportunity of adding to the former communication of Captain *Raper*’s account of the journey
to Bhadrinath and to Retal, and Beti'hai on the route towards Gangawatari, the narrative of the prosecution of the journey towards the source of the Bhagirathi by the Munsfi, who was sent from the last-mentioned station to explore that source, and who actually penetrated several miles beyond Gangawatari. It is taken from the field-book which was kept by him, and of which the original has been delivered to me by Lieutenant Webb. The route is laid down from this journal in Lieutenant Webb's map of a survey of the Ganges within the mountains, inserted in the last volume of the Asiatick Researches*

It will be observed that the Munsfi crossed the Ganges several times on Sangas, or bridges consisting of one or two fir-trees laid across from bank to bank. The breadth of the river, or, which is the same thing, the length of the bridge, was, in the first such instance which occurred, 56 paces. At the second bridge the breadth of the river crossed was 46 paces; half of which consisted of rocks in the middle of the river, and the other half only appears to have been the breadth of the stream. In the third instance the distance from bank to bank was 51 paces; but one-third of this was rock, leaving two-thirds only, or 35 paces, for the width of the stream. The fourth bridge was 45 paces long; but the fifth 28 only; and the sixth appears to have been no more than 25 paces. This was below the confluence of the Bhagirathi with a rival stream named Kedarganga, and considerably short of the termination of the Munsfi's journey. He has not specified the breadth of the river where last seen by him: but, at Gangawatari, an expansion of the stream is described by him to be 40 cubits wide and two deep, with scarcely any current. The river was traced 3 miles further amidst the snow.

* Vol. 11, p. 447.
Sunday, 1st May, 1808, set off from Bet'hári, Pergh
Taknúr in Garhwal.

Left hand. Bears by
Road level. Ganges
Name
of the place Bet'háriban.

Mauza Kiárkhí in sight; distant ½ coss. 
A small stream from the mountain flows towards the Ganges. The river 100 paces distant. Road over rocks; difficult.

Road level over rocks. Ganges very near.
Ascent. Ganges 400 or 500 paces distant.
Descent. Ganges 250 paces off.
Over rocks near the river; extremely difficult.
A small stream from the mountain flows into the Ganges.
A grotto resembling a veranda, near the road.
Torrents, fifty or sixty paces wide, running with great violence towards the river, 200 paces off.
A grotto capable of containing ten or fifteen persons; river as before.
Ascent.
Level road on the high ground. Ganges 400 paces distant. A village in sight, ¼ coss off.
Ascent. Ganges ½ coss off.
Level. River as before.

Bears by
Compass.
Paces.
Right hand.

Across the Ganges, the river Idrar in sight; distant ¼ coss. Name of the place Sálkábán.
320

800 R. Jamaa; distant ¼ coss.

622
128
192
11
56
857
135
80
540
200
### HIMÁLAYA MOUNTAINS.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Over rocks; very difficult.</td>
<td>320</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A grotto capable of containing 25 persons.</td>
<td>240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road level. River still as before.</td>
<td>408</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descent: to the bank of R. Soar.</td>
<td>309</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross R. Soar, by a Sanga.</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The water touched the bridge and flowed with rapidity. Ganges ¼ coss distant. Ma. Murar in sight on an eminence.

**Ascent.**

Road along the side of the mountain. 1208

A large village, Sálang, and river of the same name; distant ¼ coss.

**Descent*.**

Road along the side of the mountain. 320

Road along the side 174

Descent to the bank of the Cúchián N. 560

Ford of the Cúchián N. 5

N.†.

Ascent of mount N. 3 points E. 848

**K‘omtá†.**

Road descends. 704

Ascends again. 128

Descends. 205

Ford of the Taur N.§. 2

Road along the side of the mountain||. 997

**Level.**

N.2 points E. 59

---

* Ganges 500 paces off.
† Ganges ¼ coss off. The village of Cúchián in sight on the height.
‡ Name of the place Agrákha. Ganges ¼ coss distant.
§ This stream comes from North 7 points West. Ganges still ¼ coss distant. Rained at noon. We ate bread on the bank of the stream.
|| Lower down, a grotto capable of holding 25 persons.
ON THE HEIGHT OF THE

Left hand.  

Ascent of mount Tūwārā *

Descent.  

Ascent, A large grotto seen.

Descent along the side of the mountain to the banks of the Tiar R.

Ford the Tiar †.  

Road level; a little undulating.

Total 16865 paces.

Monday, 2d May, proceeded.

Road leads over rocks N. 3 points E. 283  
River Datai in sight, ¼ coss distant. It comes from mount Kailās. N. 6 points E.

Ascent of Mount Cāpar Khola.  
Ganges ¼ coss distant.

Road level. A small N. 1 point E. 464  
Ganges ¼ coss distant.

Road undulating to the banks of the Khōtmārī.  
Ganges ¼ coss distant.

Ford the stream §.

Ascent.  
N. 2 points E. 112  
Water of the Ganges appeared like mud.

Road level on the high ground.

Along the side of the mountain.  
Ganges ½ to ½ coss distant.

† The stream comes from N. 2 points E.
‡ Ganges 500 or 600 paces distant. Stopped for the night in a large grotto or place sheltered by rocks. Rained the whole night.
§ It comes from N. 1 point W. Falls in a cataract of 20 cubits high.
**HIMALAYA MOUNTAINS.**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Crossed the <strong>Réti</strong>;</td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Descent along the side of the mountain. Ganges 1 coss distant.</td>
<td></td>
<td>1336</td>
<td></td>
</tr>
<tr>
<td>Ascent. Ganges 400 N. 6 points E. paces off.</td>
<td></td>
<td>355</td>
<td></td>
</tr>
<tr>
<td>Along the side of the mountain.</td>
<td></td>
<td>1280</td>
<td></td>
</tr>
<tr>
<td>Road level. Ganges N. 2 points W. 1486 200 paces distant.</td>
<td></td>
<td></td>
<td>R. <strong>Nar</strong> 1 coss distant. Comes from N. 2 points E. A cataract 7 cubits high.</td>
</tr>
<tr>
<td>Road level.</td>
<td>N. 3 points E.</td>
<td>193</td>
<td>888 R. <strong>Rânkâ</strong> 1 coss distant, N. 7 points E. A hot spring from the side of the mountain called <strong>Rârêcund</strong>, on the bank of the Ganges.</td>
</tr>
<tr>
<td>Road level. A grotto seen. Ganges 500 paces off.</td>
<td></td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Road level.</td>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Road level to the banks of the <strong>Calyāmî</strong>.</td>
<td></td>
<td>349</td>
<td></td>
</tr>
<tr>
<td>Cross the rivulet.</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Ganges ½ coss distant.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A Dhermala</strong> at Bang-kêk. Some fields of cultivation. Ganges 600 paces off.</td>
<td></td>
<td></td>
<td>The <strong>Malîchâ</strong> falls into the Ganges. It flows from N. 7 points E.</td>
</tr>
<tr>
<td>Level. Ganges 500 paces distant.</td>
<td></td>
<td>266</td>
<td></td>
</tr>
<tr>
<td>Ascent along the side N. 5 points E. 1110 of the mountain. Ganges ½ coss distant.</td>
<td></td>
<td>1154</td>
<td></td>
</tr>
<tr>
<td>Descent by a similar path. Ganges 200 paces off.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* It comes from S. 7 points E. Ganges less than 1 coss distant. Halted at noon to eat bread. It rained.

† The **Réti** falls into the Ganges. This is 50 paces [wide].

‡ A small stream from the mountain’s side falls into the Ganges.
98% ON THE HEIGHT OF THE

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Ford of the Banghéli N. It flows from N. 2 points W. Road level *</td>
<td></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Road level. Road level to the Ghat. Crossed the Ganges N. 7 points E. by a Sángá, or spar bridge, 1½ space wide †.</td>
<td></td>
<td>280</td>
<td>186</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
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<tr>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>128</td>
<td>Ascent. Ganges 200 paces distant.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>320</td>
<td>Road level.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Along the side of the mountain.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>Same. A torrent crosses the road.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>249</td>
<td>Level along the edge of the Ganges ‡.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>480</td>
<td>Road level §.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>152</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R. Kanéla in sight, a coss distant: comes from N. 3 points W. 800 Road level: a grotto seen. Ganges 200 paces distant. 1280 Road level ‖. 120 Road level ¶. Total 17609 paces.

Tuesday, 3d May.

N. 2 points E. 325 Road level to Déordni, a rivulet from N. 5 points E.

* A deserted hut of herdsmen. Ganges 300 paces off.
† The stream was 30 cubits below the bridge. The Sángá consisted of two or three spars, with a few pieces of wood tied on them. It was not a safe bridge. Having crossed, have now the Ganges on the left hand.
‡ A fir-tree, which had fallen in, rested against the bank.
§ A grotto seen: might hold 50 people.
‖ A torrent from the mountain passes close to the road.
¶ Stopped for the night at a large grotto, capable of containing 40 persons, 200 paces from the Ganges. Slight rain all night.
HIMALAYA MOUNTAINS.

Bearing by

Paces.

Right hand.

Compass. 3

Forded the Déordáni.

N. 5 points E. 378 46

Road to Déordáni ghát

of the Ganges.

Crossed the Ganges

by a Sánghá, or bridge of

spars *.

Ascent. N. 2 points W. 40

Level road. 400

Descent. 40

Level. 688

Over the snow. 182

Road level. N. 2 points E. 48

Ascent. 40

Level. A small grotto 120

Crossed the Ganges at

the Ghát Lókárindá by

a Sánghá, or bridge of

spars †.

Ascent. N. 2 points W. 40

Level road. 400

Descent. 40

Level. 688

Over the snow. 182

Road level. N. 2 points E. 48

Ascent. 40

Level. A small grotto 120

Crossed the Ganges at

the Ghát Lókárindá by

a Sánghá, or bridge of

spars †.

N. 4 points E. 1095

Road level along the

mountain’s side. Ganges

100 paces off.

19 Crossed the Lótgárh

by a Sánghá, consisting

of 4 timbers †.

480 Over rocks on the edge

of the Ganges.

296 Over snow which had

fallen on the bank of the

Ganges.

N. 7 points E. 184 Proceeded over rocks

in the Ganges.

* It consisted of three small spars, and was \( \frac{1}{2} \) a pace wide; very dangerous and terrifying. Went over it in a sitting posture, sliding along. The wooden part 24 paces, of which 11 very dangerous, and 13 more easy. The rest (22 paces) on rocks in the Ganges. The stream 7 cubits below the bridge.


† It was 2 paces wide, and was touched by the water, which flowed with great rapidity. This stream comes from Himáchal N. 7 points E.
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>464</td>
<td>Ascent of the mountain, which was very steep. Climbed, holding by the grass and small shrubs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>Descent towards the Ganges: went in a sitting posture.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Road level.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Ascent; very steep and difficult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Level.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Ascent very difficult; overhangs the Ganges.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Level. Ganges 200 paces off.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>131</td>
<td>Ascent; steep and difficult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>Descent; extremely steep.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>462</td>
<td>Ascent. Ganges 250 paces off.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>272</td>
<td>Level. Ganges 150 paces distant.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Over rocks on the edge of the Ganges.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>168</td>
<td>Descent from rocks; very steep.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>831</td>
<td>Over rocks of the Ganges; but less difficult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1544</td>
<td>Road level; over stones in the bed of the Ganges*.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>Level.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>192</td>
<td>Ascent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232</td>
<td>Descent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>Over the rocks of the Ganges; very rough and difficult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>192</td>
<td>Ascent.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* A cave or grotto seen, and a small one capable of containing 50 persons.
Beuinga hy
320
Level, along the bank
of the Ganges.
96
Ascent.
200
Descent.
653
Overrocks of the Ga-
ges; extremely rough
and difficult.

N. 4 points E. 11
Cross the Bhéld by a
Sángá*.
135
Level.
N. 7 points E. 54
Cross the Ganges at
the Ghát of Sákh, by a
Sángá†.

Ascent, along the side N. 7 points W. 659
of the mountain.

Along the side of the N. 7 points E. 1654
mountain to Sákhí.
Ganges one coss dis-
tant.

Along the side of the
mountain.
Ascent.
Descent. Ford the
Choraki N. 3.
Road level. Ford the
Pakchahár§.

Road level. Ford the
Gangátri N. This flows
from N. 7 points W.
Ascent to Jhédá;
which is 100 paces from
the Ganges ||.

* Five cubits above the water. The stream comes from S. 1 pt. E.
† One pace wide, five cubits above the water. The old one had
been broken down, and a new one had been recently erected. The
greatest part of the distance in crossing was over rocks. viz. Rock 26.
Wood 17. Rock 11.
‡ Comes from N. 7 points W. Ganges 200 paces off.
§ It comes from S. 1 point W. Ganges 100 paces off.
|| Slight rain. Snowy mountains on all sides, and apparently very
near. In the middle of the night much snow fell. In the morning
the whole forest, and the surface of the ground and roofs of houses,
were covered with snow. Halted till noon of next day.

HIMA'LAYA MOUNTAINS. 285
### 4th May.—Proceeded at noon, when the snow was a little cleared away.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Road level.</td>
<td>N. 2 points W.</td>
<td>496</td>
<td>Ford the Nibbānī N.</td>
</tr>
<tr>
<td>It comes from S. 7 points E. Ganges 200 paces off.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Along the side of the N. 7 points W. 640 mountain.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descent. Ganges 2 to 300 paces off.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road level. N. 5 points E. 400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross the Shīndā by a Sangā.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road level. 40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the shallow bed of the Ganges.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over stones in the Ganges.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the shallow water of the river.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over stones. 35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the shallow water. 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over stones along the edge of the river.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the shallow water†. 48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Along the banks of N. 2 points E. 336</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the Ganges‡.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascent. 48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Along the side of the mountain.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over the rocks of the Ganges, very rough and difficult.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross the Gongti by a Sangā.§</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road level. Ganges N. 7 points E. 531</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250 paces off.</td>
<td></td>
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</tr>
</tbody>
</table>

* The stream comes from N. 2 points W.
† Two channels of the river here unite.
‡ The melted snows descending from the mountains.
§ The water touched the bridge. Stream comes from N. 5 points E.
Cross the Harsíd by a Sángá *
Road level. Village of Cachórá.
Ascent of the mountain near Cachórá.
Level road.
Continued ascent of the same mountain.
Descent †.
Road level.
Ascent. Along the side of the mountain.
Descent. Along the side of the mountain.
River very near.
Cross by a Sángá near Dherdó †.
Level road over the rocks of the Ganges.
Cross the Ganges by a Sángá §.
The deserted village of Shkhia in sight across the Ganges.
Khera N. descends from Cailás.

**Total 9002**

* The stream comes from N. 7 points E.
† A stone representing Mahádéva, on a mountain said to be Cailás, was in sight from Cachórá, bearing N. 5 points E.
‡ Five cubits above the water.
§ At the Ghát of Dherdó. The water rises within 5 cubits of the bridge. The Ganges is now on the left hand.
¶ Containing a stone linga to represent the deity. It was buried in the sand. The temple said to have been founded by Sancardchárya. Other houses to the number of five or six.
¶ Containing near 25 huts, of which only 5 inhabited.

5th May.—Proceeded from Dherdó.

S. 5 points E. 160 Ascent.
<table>
<thead>
<tr>
<th>Left hand</th>
<th>Bearing by Compass</th>
<th>Paces</th>
<th>Right hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>Descent. Ganges 200 paces off.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>416</td>
<td>Level road. A stream from the mountain crosses the road.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>792</td>
<td>Over rocks on the edge of the river.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Crossed the Ganges-sáriti by a Sángá.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S. 5 points E. 1000 A stream from the mountain crosses the road. Ganges 250 paces distant.

320 Road level: but over rocks.

96 Level: over snow.

864 Level: over rocks. Ganges 300 paces distant.

160 Level: over snow.

480 Level: over rocks. Ganges 200 paces distant.

80 Level: over snow.

400 Level: Ganges 200 paces distant.

N. 5 points E. 480 Ascent.

320 Level: Ganges 400 paces distant.

496 Descent: Ganges 300 paces distant.

R. Gúmgúm in sight, one coss distant †.

80 Level: A torrent from the mountain S. 1 point E.

160 Level.

249 Over snow. A stream from Changthanga.

240 Level: Ganges 300 paces off.

* The stream is very rapid, and comes from Mount Cañlás, S. 3 points E.
† Comes from N. 2 points. Is crossed by a Sángá on the road to Bhót (Thibet).
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>N. 6 points E.</td>
<td>488 Level.</td>
<td>80 Over snow.</td>
<td>533 Level. A stream from Changla crosses the road.</td>
</tr>
<tr>
<td></td>
<td>445 Level. Ganges 4 or 500 paces distant.</td>
<td>1064 Along the side of the mountain.</td>
<td>14 Cross the Lacenga by a Sādagā.</td>
</tr>
<tr>
<td></td>
<td>240 Level.</td>
<td>240 Ascent of Mt. Ratānā.</td>
<td>64 Level: over rocks.</td>
</tr>
<tr>
<td></td>
<td>312 Level: over rocks.</td>
<td>120 Ascent.</td>
<td>96 Level: over rocks.</td>
</tr>
<tr>
<td></td>
<td>160 Level. Ganges 300 paces off.</td>
<td>64 Ascent.</td>
<td>64 Level: over rocks.</td>
</tr>
<tr>
<td></td>
<td>560 Along the side of the mountain.</td>
<td></td>
<td>16 Cross the Ganges by a Sādag at Bhairāgāti.</td>
</tr>
</tbody>
</table>

R. Jāhā-ḡangā from N. 5 points E. 1588 Level: over rocks. 184 Level: over rocks †. 512 Road undulating. Descent by means of a short ladder. 16 Level. A stream from the mountain crosses the road. 25 Cross the Ganges by a Sādag at Bhairāgāti †.

A figure of Bhairālā.§ 168

Ascent ||. 144

Total 15032

* It comes from Mount Cailā S. 5 points E. Ganges 200 paces off. † Cāl-bhairō: a mere heap of stones, with no idol. Walnut-trees. Ganges 500 paces off. ‡ The stream appeared to be 500 cubits below the bridge. § Carved in the stony scarp of the mountain. Two idols of stone, daubed with minium. Pilgrims make offerings here, and proceed. || Halted in a grotto which might contain 100 persons.
6th May.—Proceeded on the journey.

<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Ascent by means of N. 7 points E.</td>
<td>299 ladders.</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Ascent of the mountain.</td>
<td>Level: over rocks †.</td>
<td>1080</td>
<td>Level: over rocks †.</td>
</tr>
<tr>
<td></td>
<td>Level: a plain.</td>
<td>80</td>
<td>Level §.</td>
</tr>
<tr>
<td></td>
<td>Level: over rocks †.</td>
<td>1085</td>
<td>Level §.</td>
</tr>
<tr>
<td></td>
<td>Level §.</td>
<td>336</td>
<td>Along the side of the N. 6 points E. 840</td>
</tr>
</tbody>
</table>

mountain.

| Level || Level: Over rocks | Ganges 400 paces off. | 400 |
| Level: Over rocks | Level: Over rocks || Level: A stream from Terdli crosses the road. |
| Terdli crosses the road. | Level: Halted in the grotto of Terdli. Fir-trees. Ganges 400 paces distant. | 576 |
| Level. | N. 7 points E. 40 | A stream from the snow on the other side of the river. Distant † \( \) coss: |

| Level. | Road crossed by a stream from the mountain. |
| Level: over rocks **. | 444 |
| Level: over rocks † †. | 1392 |

* A temple of wood, containing an image of Bhairbālī.  
† A stream from Banlago crosses the road in three places, towards the Ganges. Comes from S. 7 points W. Ganges' 500 paces off.  
‡ A stream from Mount Matwārī crosses the road.  
§ Halted in a grotto of Matwārī. Ganges 400 paces distant.  
‖ A stream near the deserted village of Himin, from the mountain, across the road.  
¶ A stream near Bhandrā (formerly a village), comes from the mountain across the road.  
** Grotto of Otsaro, capable of containing 20 persons. Ganges 500 paces off.  
†† Many torrents from the mountain cross the road and fall into the Ganges. River 250 paces distant.
A foaming torrent crosses the road called Meemerd or Shtrcai. Falls into the Ganges.

† A grotto capable of holding 10 persons. Ganges 250 paces off.

‡ A torrent passes near the road. Falls into the Ganges. The river 200 paces distant.

§ Patágm, where the Pandus are said to have performed a sacrifice. Ganges 200 paces off.

‖ A torrent falls into the Ganges. Pakora and Cachori: a spot surrounded with red marks, where the Pandus are said to have prepared their victuals. River 300 paces distant.

¶ A spot named from salt and oil, which might formerly be perceived, but not so now.

** Gauricund, a pool in which the water collects, and whence a stream proceeds. Confluence of Kídrgangá from S. 5 points E. with Bhágirat'hi or Ganges from N. 7 points E. Hindus shave and bathe here preparatory to visiting Gangáwatí.

†† On the banks of the Ganges. A wooden temple, containing the footstep of Gángá on a black stone. Suryacund, Vishneucund, and Brahmcund, within the Ganges, being names assigned to distinct portions of the river, where pilgrims bathe. The last is 40 cubits wide, and 2 deep. It is the pure Gángá, unpolluted by water of any other stream. Bhágirat'hi-síd, a large rock in the river, on which the king Bhágirat'ha worshipped the deity. The river comes from N. 7 points E., and has very little current. Scarcely any trees but the Bhágpat (birch?). On all sides snow. A large temple roofed with wood, containing an image of Gángá in red stone, a small female...
ON THE HEIGHT OF THE

7th May.—Proceeded onwards.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Road level: over N. 7 points E.</td>
<td>1320</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

rocks of the Ganges.

<table>
<thead>
<tr>
<th>Road level: the river might now and then be perceived amidst the snow.</th>
<th>1416</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Road level: on rocks in the Ganges*.</td>
<td>496</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Ganges might now, and then be perceived under the snow†.</td>
<td>968</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Along the bank of the Ganges: over rocks‡.</td>
<td>760</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over snow, filling the bed of the Ganges§.</td>
<td>2640</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over rocks along the banks of the Ganges, which here shewed itself‖.</td>
<td>520</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

figure of silver, images of Mahādeva and Pārbati in red stone represented with the human form, Bhāgirathā, Annapūrṇā dévi, Viśnu, Brahma, and Ganesā, in red stone. A Brāhman, who is an inhabitant of Dherāk, attends here during three months, Vaśakā, Jyotāk, and Asārā. Scarcely any but Bairākīs and Sanshādās come here: the road being in the highest degree difficult, and the place amidst snow most inhospitable.

* The breadth still less than at Gāndhāvatī. On one side the road is practicable. On the other a perpendicular wall of rock. In the bed of the river saw a rock 2 or 3 paces wide and 5 long, bathed by the river on both sides, and overhanging the stream; the depth of water being very small. This rock exhibits a similitude of the body and mouth of a cow. It is called Gāo-mūcāh.

† An image of black stone might be seen in the snow; but could not be approached, for fear of being buried in the snow. The road was over the snow of the Ganges.

‡ A large cavern, quite capable of containing 100 persons: consists of several apartments.

§ The river was not once seen, nor was any sound of its current heard. The snow, being soiled, appeared like the earth of cultivated fields.

‖ In front was a steep mountain like a wall of rock, from an angle.
8th May.

Set off to return by the same road towards Dherdi, there being no other practicable route.

The sequel of the field-book is kept in a similar manner; but it is thought unnecessary to translate it.

of which the Ganges appeared to come. Beyond the present station was nothing but snow, nor any road but that termination of the valley. From dread, none would venture into the water of the Ganges. The snowy tops of the mountains appeared of various height; and not the least sign of vegetation: nothing but snow, masses of which were falling from the mountains. As the people in company were deterred from advancing, and there appeared no road by which to penetrate, and further progress seemed full of peril and of terror, I was under the necessity of returning to Gangāwstrī.