MEMOIR

RELATIVE TO A SURVEY OF KEMAON,

With some Account of the Principles, upon which it has been conducted.

By Captain WEBB,

Communicated by the Most Noble the President.

THE progress made in the survey of Kemaon induces me to submit an abstract of the results before His Excellency the Commander in Chief, prefaced by a short memoir, not merely to exhibit, what has been done, but with a view to obtain instructions, as to the degree of minuteness, with which it may be deemed expedient, that the survey in question should be made up.

The number of places, whose latitudes, longitudes, and elevations, are included in the annexed catalogue, is considerably greater, than that "of places on, and near the *Ganges* river, by Mr. R. Burrow," which latter forms the basis, on which the whole map of this side of *India* has been made to rest.

If it is not required, that the map of Kemaon should be more detailed, than those of other districts under this Presidency, it may be sufficient to fill up the work by routes and information: the present list of elevations may alone, be sufficient to convey a general idea of the physical aspect of the country.

But as great attention has been attracted to ſurveys of this nature, ſince M. Humboldt's account of *New Spain* has been publiſhed, and from other conſiderations, it is probable, that the work will be thought incomplete, if not accompanied by vertical ſections. Hitherto the want of barometers, none having yet reached me in ſerviceable condition, has prevented my attempting a continued ſection, which could ſcarcely be effected by geometrical methods only, as no continued lines of ſtations could be ſelected, the diſtances of which can be determined with ſufficient accuracy for this purpoſe.

It might alſo be deſirable, that ſome approach to a phyſical map ſhould be had, with a view to facilitate geological and mineralogical reſearches, which may by poſſibility, lead to important conſequences. It cannot be doubted, that the mountain diſtricts contain the precious metals, from the well known fact, that the lands of almoſt every mountain ſtream are aſſiduouſly waſhed for gold at the points, where their rapidity diminiſhes The tribe of people, who follow this avocation, are denominated *Boksa*, and their employment is by general report attended with ample profit. The gold duſt ſupplied by the rivers of *Africa*, has long made an opinion current in *Europe*, that ſome lofty central land exiſts, which may rival *South America* in its mines of the precious metals—and the ſame ſpeculation ſeems no leſs applicable to the mountains of central *Aſia*.

I have it alſo in view to point out a ſervice of great practical utility, which may be derived to geography from a knowledge of the true poſition and elevation, of ſeveral ſnowy peaks in the *Himálaya* chain, of which my ſurvey already includes upwards of *thirty*, and moſt of them are viſible from the plains.

With ſcarcely an exception, ſurveys in *Bengal* have been made by the compaſs and perambulator only, and thoſe who have had much

experience in measurements of this description, are well aware, that five miles in an hundred is not an impossible error.

The known positions of snowy peaks afford a ready mode for determining the true geographical place of any station, from whence they are visible, and may therefore be applied to the correction of maps compiled from route-surveys of the description just named. It may be well to detail the several cases, in which they may be so applied, and I have appended to this memoir examples of most of them, from which a tolerably correct idea may be formed of the degree of accuracy, which may be expected to attend the results.

CASE 1st.

Three snowy peaks, the geographical positions of which are known, being visible from any place or station—and the horizontal angles they subtend at that station being observed—the distance of the station from each peak, together with its latitude and longitude, become known also.

CASE 2d.

The latitude of a station being observed, and also the true azimuth of a single known peak—the distance between the peak and the station, and the longitude of the latter, become known also.

CASE 3d.

The angle of elevation of any peak, the heighth and position of which are known, being observed, and the heighth of the station being also known—these data are competent to give the distance between the peak and the station; and if the azimuth of the peak be observed, the latitude and longitude of the place of observation become known also. This case comprises the method adverted to by M. Humboldt in his "Geographical Essay," under the denomination of "Vertical Bases," and which he appears to have adopted very extensively. The survey of a mountain province may thus be accomplished by aid of ba-

rometrical obſervations only, and with extreme accuracy, if the ſtations be not very remote from each other, and are ſo choſen, that their relative difference of elevation ſhall be conſiderable.

CASE 4TH.

THE diſtance and heighth of a known peak, together with its obſerved angle of elevation, give the abſolute heighth of the ſtation of obſervation—or, if this be known, the prevailing degree of refraction may be obtained: which latter it may ſometimes be important to know; far to the weſtward for inſtance, where the ſurface of the country undulates conſiderably, or within the mountains.

CASE 5TH.

As, by ſome of the foregoing, the true diſtance, and relative poſition of two or more ſtations on the plains of *India*, may be correctly found, it follows, that the true poſitions of ſnowy peaks, not at preſent known, as well as their altitude, may be found, and that ſuch peaks will again enable an obſerver to determine the poſition of any number of ſtations on the plain, or within the mountains, from whence they may be viſible.

IT appears, therefore, that the poſitions of ſnowy peaks, already obtained by my ſurvey, are amply ſufficient to correct the geography of a vaſt belt of country: the breadth of which, in a ſoutherly direction from the *Himálaya* range, averages from one hundred to one hundred and thirty miles, and in length ſomewhat exceeds that of the range itſelf.

THE general direction of the ſnowy chain is from W. N. W. to E. S. E. nearly, to which of courſe the belt is parallel, and if from ſuch a line even perambulator routes were ſurveyed in a ſoutherly direction, ſo as to make but ſmall angles with the meridian, the error in mea-

ſurement would not ſenſibly vitiate the longitude of the place come to, which is the element moſt difficult to obtain. That error would affect the latitude almoſt excluſively, and every tyro in practical aſtronomy can correct the latitude by celeſtial obſervation to within a few fathoms of the truth; and thus it appears, that the limits of geographical correction, for which a means is offered by a knowledge of the poſitions of peaks in the *Himálaya* chain, may be made to extend far beyond the points, at which the peaks themſelves ceaſe to be viſible.

Principles upon which the Survey of Kemaon has been conducted.

The baſe is a line, nearly in the direction of the meridian. The latitude of the ſtation, at either extremity, having been carefully obſerved with a circular inſtrument, and the angle of an azimuth made by one of them with a meridian paſſing through the other, aſtronomically determined, the length of the baſe was calculated with thoſe data. The value of the meridional degree is aſſumed to be 60,600 fathoms.

From the baſe ſo obtained, triangles were extended in the uſual manner, the three angles being obſerved in all practicable caſes. The ſides of theſe were next computed in order, by plane trigonometry, the inſtrument made uſe of being divided only to 20 of a degree.

The latitudes of the ſeveral ſtations were now calculated, the angle of azimuth being in all caſes either referred to the orginal baſe, or aſtronomically computed. In every inſtance of trial, the latitude computed from the ſurvey agreed with celeſtial obſervation, ſo nearly, as to leave it doubtful, which might be in error.

But it was desirable to have a station of verification, if I may so term it, as far south as possible, and I selected *Pilibhit* for this purpose. The geographical position of the great mosque at that place had been given by Mr. Burrow in this catalogue, and I purposed adopting it, as the first meridian of my survey; by which means, my map would be immediately connected with that of *Rohilkhand*, and I reserved the verifying of the absolute longitude of *Pilibhit*, till leisure and opportunity should permit me to make a series of observations, correspondent with others at the *Madras* Observatory for that purpose.

The snowy peaks, Nos. XIII, XIX, and XXV, are distinctly visible from a grove, near the town, which became my station, and I was enabled to connect it with a minaret of the great mosque by a single triangle, one side of which was measured. The true azimuth of the minaret, and the distance so obtained, gave its difference of latitude from my station 0′ 51″.4 southerly. Also the latitudes of the snowy peaks, as fixed by my survey, were respectively,

	°	′	″	
XIII =	30	15	36,1	N.
XIX =	30	12	15,1	N.
XXV =	29	52	45,7	N.

The horizontal angles, subtended by the abovementioned peaks, were observed, and their several azimuths astronomically computed.

Assuming the position of the snowy peaks to have been truly given by my survey, I computed, (as in Case 1st,) their respective distances from my station, which came out by the calculation as under;

XIII = 97291 fathoms. XIX = 98340 fathoms. XXV = 96030 fathoms.

These distances, computed with the true angles of azimuth, gave their differences of latitude, and consequently the latitude of my station, and that of the mosque as follows:

Latitude of snowy peaks	XIII =	30	15	36,1	XIX =	30 12 15,1	XXV =	29 52 45,7
Differences of latitude	....	1	36	19,8		1 32 58,2		1 13 28,2
Latitude of station	....	28	39	16,3		28 39 16,9		28 39 17,5
Mosque south	....	0	0	51,4		0 0 51,4		0 0 51,4
Latitude of mosque	....	28	38	24,9		28 38 25,5		28 38 26,1

The latitude of the mosque, by Mr. BURROW's observation, is 28° 38' 29" N.

THIS very exact result may be admitted, as a proof of the correctness of the base, the smallest error in which would have been sensibly felt, when its operation was extended to distances approaching to ten times its own length, or nearly one hundred thousand fathoms.

I NEXT computed the differences of longitude of all the stations from *Pilibhit*, using, what is generally termed, a table of meridional parts for that purpose. It was not till a month ago, that I was much gratified by finding, that M. HUMBOLDT had adopted the same method in his survey of *Mexico*, and that he had even used the same table, that given by MENDOZA DE RIOS.

BEING now assured, that the distances given by my survey were trustworthy, it became necessary to determine the heighth of the several stations above *Rohilkhand*, and approximately above the sea; but the weather became hazy at *Pilibhit*, and it was not till my arrival at *Cásípur*, that a favorable opportunity for this purpose presented itself.

THE snowy peaks, Nos. XI, XII, XIII, XIV, are distinctly visible from *Cásípur*; and their respective heighths above that place, and also above *Cáli Mat'h*, a high mountain near *Almora*, were calculated from their observed angles of elevation at each. The refraction being allowed at $\frac{1}{11}$ of the intercepted arch, though it is not probable, that exactly the same degree prevailed at the mountain station, and that on the plain, gave results as under:

		XI.	XII.	XIII.	XIV.
Above Cás'ípur	Feet	20019.6	22724,4	21684,0	24904.2
Above Cálí Mat'h	Ditto	14269,2	16845.6	15895,8	19252,2
Cálí Mat'h above Cás'ípur	Ditto	5750,4	5878,8	5788,2	5652,0

The mean of the four, give the heighth of Cálí Mat'h above Cás'ípur .... 5767 Feet
Assumed heighth of Cás'ípur above the sea .... 650 Ditto

Approximate heighth of Cálí Mat'h above the sea 6417

THE preceding differences, ſhould, of courſe, be exactly equal to each other, but the uncertainty with reſpect to the refraction due, together with the poſſible errors of obſervation, at both ſtations, are more than ſufficient to account for the exiſting diſcrepancy. The mean of the whole is taken as the heighth of *Cálí Mat'h* above the plains of *Rohilkhand*, and *Cáśípur* is eſtimated to be 650 feet above the ſea, which cannot be very wide of the truth.

ALL the heighths of places within the hills, have been referred to this altitude of *Cálí Mat'h*, either directly, or with intermediate ſtations; alſo $\frac{1}{13}$ of the intercepted arch, has been uniformly allowed for the effect of refraction, in computing the altitude of ſnowy peaks, and $\frac{1}{14}$ of the ſame arch, for all points below the inferior limit of congelation.

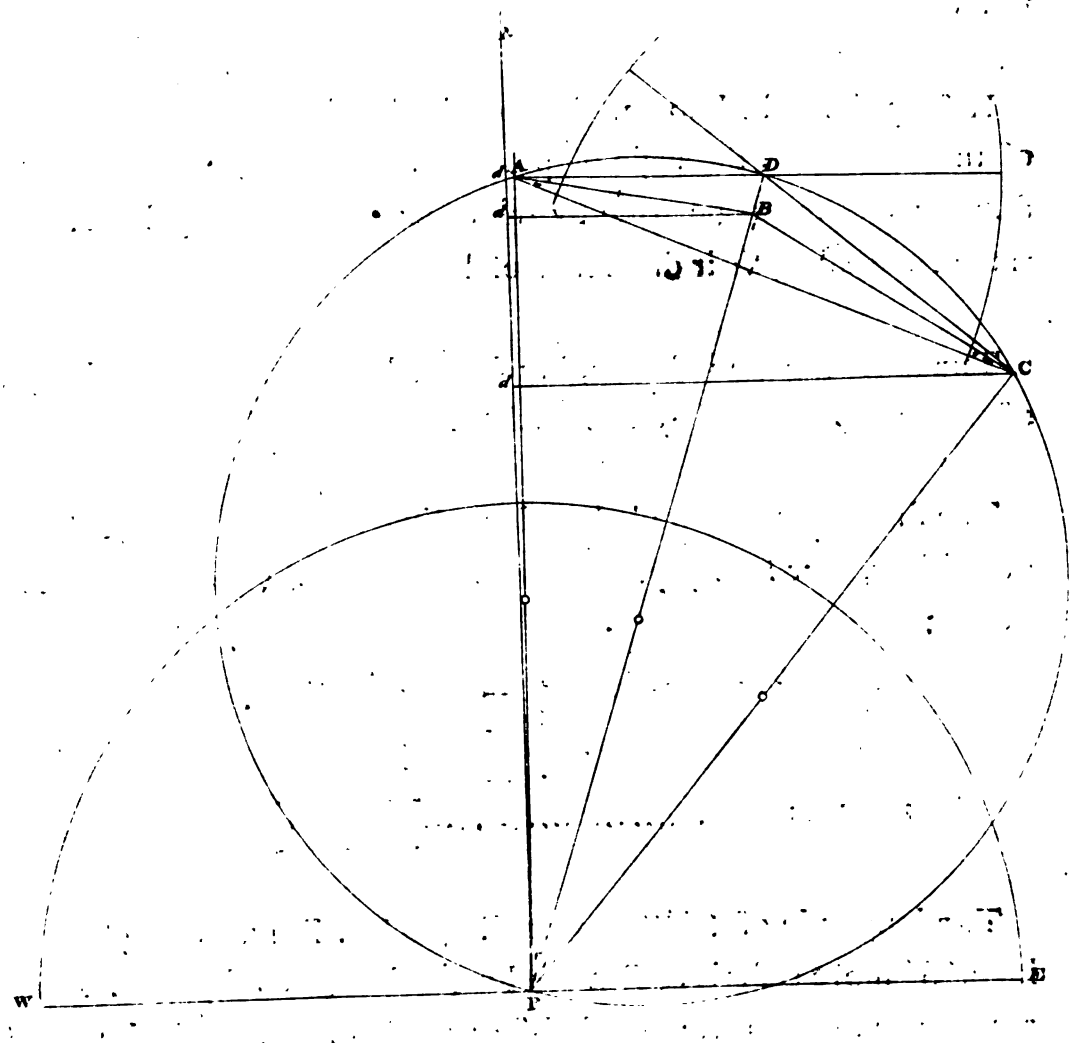
IT is at preſent my opinion, that both theſe quantities exceed the medium effect of refraction; under the circumſtances, in which the obſervations are made, and though it is not neceſſary to exaggerate heighths, already enormous, I am inclined to believe, that all the elevations err a little in defect, in conſequence of having uſed them.

IT remains to ſhew examples of the caſes I have ſuggeſted, in which the known poſitions of ſnowy peaks may be uſefully applied to the connection of geographical maps, conſtructed from perambulator meaſurements.

CASE 1st.

The computations at *Pilibhit*, an abstract of which I have already given, furnish an example of this kind; and it has been shown, that the latitudes of the place of observation as obtained severally, from three very distant snowy peaks, do not differ from each other more than a single second. It may therefore be presumed, that the distances are equally correct, or that the error upon any one of them does not exceed twenty fathoms.

On account of its great simplicity, I subjoin a graphical solution of the problem in that particular instance.



In the preceding diagram the ſtation near *Pilibhit* is repreſented by P. *A*, *B*, *C*, are the ſnowy peaks, Nos. XIII, XIX, XXV, reſpectively; *PA*, *PB*, *PC*, their diſtances from the ſtation; *Pd*, *Pd'*, *Pd''* their differences of latitude. *PN* is a meridian paſſing through the ſtation. The things known are marked with a line (') the things required with a cypher (o).

CASE 2d.

Is that moſt likely to occur in practice, as it affords a means of computing the longitude of the ſtation from obſervations of a ſingle known peak.

It ſuppoſes to be known, the co-latitude of the peak, the co-latitude of the ſtation, and the angle of poſition at the latter; to find the arch of diſtance, and the angle made by their meridians at the pole, or which is the ſame thing, their difference of longitude.

The following are inſtances, in which I have computed the longitude of places in *Rohilcund* by this method.

The firſt ſtation is a walled garden a little to the eaſtward of the town of *Cásipur*, four ſnowy peaks were viſible and gave the longitude as below:

Longitude of Cásipur by No.	XII	=	78 48 54,8 E.
	XIII	=	78 48 52,3
	XIV	=	78 48 55,5
	XI	=	78 48 53 8
Mean Longitude			78 48 54,1

The longitude of *Cásipur* according to Mr. Burrow is 78° 51′ being 2′ 6″ more eaſterly. But the longitudes given by Mr. Burrow are deduced from aſtronimical obſervation entirely, and he himſelf ſuggeſts that ſome of them may be as much as five minutes in error.

THE next ſtation is the village *Chemrowa*, in the *Rampur* jaghir.

Longitude of Chemrowa, deduced from	No. XII,	=	78° 58′ 13″,4
	No. XV,	=	78 58 8,3
Mean Longitude,			78 58 10,8

THE third and laſt example was obtained at the fort of *Afzelgerh*.

Longitude of Afzelgerh by	No. VI,	=	78° 31′ 55″,8
	VIII,	=	78 32 17,7
	XII,	=	78 32 2,7
	XIII,	=	78 32 5,7
	XV,	=	78 32 25,8
Mean Longitude,			78 32 9,5

THE ſnowy peaks, Nos. VI and VIII, are compriſed in the cluſter ſuppoſed to be *Badarinath*, and by a reference to the conditions of the triangle, which aſſigns their poſition, they will be found ſo unfavorable as not to promiſe a reſult of *great exactness*.

IT will alſo be obſerved, that the angles made by the azimuths of the eaſtern peaks with the meridian are very conſiderable, and that the ſmalleſt error in the aſſumed latitude or azimuth, will produce a very ſenſible effect, under theſe circumſtances.

THE longitude of *Afzelgerh* by Mr. BURROW is 78° 33′ 40″, or eaſterly of mine 1′ 33″.

THE difference of longitude between *Pilibhit* and *Cásipur*, is by Mr. BURROW 2′ 6″ *leſs* than by my ſurvey. And the difference of longitude between *Cásipur* and *Afzelgerh* is 0′ 35″ *greater*, than by me, although his ſtation at the former place, was to the *weſtward* of mine.

AND it is evident, that though the errors of aſtronomical obſervations may be plus or minus, *indiſcriminately*, ſuch cannot be the caſe with

trigonometrical deductions from fixed points. I have uſed the ſame peak No. XII and XIII both at *Cásipur* and *Afzelgerh*.

CASES 3 and 4.

I HAVE already noticed that to attain *great* accuracy by theſe methods, the difference of heighth of the ſtations ſhould be conſiderable, and the diſtance not very great; eſpecially when the angle of elevation or depreſſion, can be obſerved at one ſtation only. Not being provided with barometers, I have no ſuch example to offer, as I could wiſh, or as the methods themſelves are fully ſufficient to afford.

WHEN the arch of diſtance is very great, and the angle of elevation extremely ſmall, the varieties to which the refractive ſtate of the atmoſphere is ſubject, will alone occaſion diſcrepancies of vaſt amount. That this is the caſe, will be clearly ſeen by the following approximations, in which I have ſuppoſed the ſtations to be preciſely on the ſame level with *Cásipur*, which is not of courſe, ſtrictly true.

STATION AFZELGERH, EXAMPLE I.

Refraction.	0	$\frac{1}{12}$	$\frac{1}{18}$	$\frac{1}{24}$
Diſtance No. XII. by caſe 3d, ...	77820	80266	79424	79018
True Diſtance of No. XII.....	78843	78843	78843	78843
Errors.....	−1023	+1423	+581	+175

Refraction	0	$\frac{1}{12}$	$\frac{1}{18}$	$\frac{1}{24}$
Diſtance No. XIII. by caſe 3d.....	79779	82316	81403	80926
True Diſtance No. XIII.....	80895	80895	80895	80895
Errors.....	−1116	+1423	+508	+31

Refraction.	0	$\frac{1}{12}$	$\frac{1}{18}$	$\frac{1}{24}$
Diſtance No. XV. by caſe 3d.....	87107	90558	89371	88812
True Diſtance No. XV.....	89018	89018	89018	89018
Errors.....	−1911	+1540	+353	−206

STATION CHAMROWA, EXAMPLE II.

Refraction	°	$\frac{1}{11}$	$\frac{1}{13}$	$\frac{1}{14}$	$\frac{1}{13}$	$\frac{1}{12}$
Distance No. XII. by Case 3d.....	94679	97397	97979	98252	98485	98831
True Distance of No. XII.....	98578	98578	98578	98578	98578	98578
Errors.....	−3899	−1181	−599	−326	−93	+253

THE true diſtances of the ſnowy peaks, which have been uſed as a ſtandard of compariſon in the preceding examples, were derived by Caſe 2d.

IT ſeems reaſonable to infer, that the refractive ſtate of the atmoſphere demanded an allowance, in the firſt example, equal to about $\frac{1}{14}$ of the intercepted arch, and in the ſecond to $\frac{1}{13}$ nearly.

HAD the mean ſtate of refraction, which I aſſume to be $\frac{1}{10}$ for ſnowy peaks, been uſed in theſe inſtances by a traveller, deſirous to know his place in the map, his concluſion would have been erroneous by about $\frac{1}{2}$ a mile, at *Afzelgerh*, and by ſomething leſs than $1\frac{1}{2}$ mile at *Chamrowa*. He might ſtill, however, conſole himſelf with reflecting, that, even were it poſſible to find a level road to the *Himálaya*, a derambulator ſurveyor could not meaſure the diſtance, after many day's labor, with any chance of obtaining it ſo correctly, as it had been thus acquired by an obſervation, which was made and computed in twenty minutes.

I CANNOT at preſent offer an example of the 5th Caſe, as no ſnowy peak is viſible from any part of *Rohilcund*, where I have been, the poſition of which is not already eſtabliſhed by my ſurvey of *Kamaon*.

Catalogue of Places, with their respective Latitudes, Longitudes, and Elevation above the Sea, as derived from a survey of Kemaon.

By Captain W. S. Webb, Surveyor.

No.	Names of Places.	Latitudes.	Longitudes.	Elevations.
				Feet.
1	Pilibhít, (the Great Mosque.).....	28 38 20 N.	79 41 45 E	———
	Station (A) (in Grove near ditto.)..	28 39 16.9	79 42 19.8	———
	Cá'í Math, (Gorkha Stockade.) ...	29 38 11 5	79 30 19 6	6417
	Snowy Peak I. (Great Himálaya.)..	30 49 47.2	78 51 19.6	22345
5	.... II.	30 49 4.8	78 52 11.3	22058
	.... III.	30 46 22 3	78 55 16.9	22840
	.... IV.	30 45 46.9	78 58 46.1	21611
	.... V.	30 38 28.9	79 4 49.5	19106
	.... VI.	30 42 22 9	79 6 10.9	22498
10	.... VII.	30 41 57.7	79 7 28.9	22578
	.... VIII.	30 43 40.9	79 8 17	23164
	.... IX.	30 42 4.3	79 15 16.2	21311
	.... X.	30 20 16.9	79 28 0.7	15733
	.... XI.	30 20 6.1	79 33 40 8	20686
15	.... XII.	30 17 59.5	79 37 7 6	23263
	.... XIII.	30 15 36.1	79 42 49.8	22313
	.... XIV.	30 21 51.7	79 48 39 6	25669
	.... XV.	30 16 13.3	79 54 25 7	22419
	.... XVI.	30 12 3.7	80 5 26.6	17994
20	.... XVII.	30 11 14 6	80 7 9.7	19153
	.... XVIII.	30 14 33.1	80 12 40 5	21439
	.... XIX.	30 12 15.1	80 15 42.6	22635
	.... XX.	30 9 28 3	80 16 44 3	20407
	.... XXI.	30 6 41.5	80 28 51.1	19099
25	.... XXII.	30 6 18.7	80 30 22.8	19497
	.... XXIII.	29 59 33.7	80 44 3 6	22727
	.... XXIV.	29 57 13.3	80 50 23.8	22238
	.... XXV.	29 52 45.7	80 51 36.5	22277
	Snowy Peak XXVI. (Himalaya.)..	29 50 44.5	80 51 31.1	21045
30	.... XXVII.	29 49 42.8	80 54 19.3	20923
	Reoni Temple.	29 39 33.7	79 22 4.2	6526.7
	Nyathana Fort.....	29 47 56.5	79 9 32.8	5785
	Siahi Oak Tree.	29 34 14.5	79 24 4.7	7193.2
	Badhun Dhun Peak.	29 28 33 7	79 13 1.1	8433
35	Duna Giri Temple.	29 47 21.7	79 17 50.1	7272.2
	Bhatcot Peak.	29 49 34.9	79 20 50.4	9060.6
	Ahri Deo Peak.	29 44 42.7	79 25 8.2	7030.9
	Gana Nath Stockade.	29 45 56.5	79 30 29.6	6828.5
	Binser Peak.....	29 42 1.9	79 35 42.4	7896.6
40	Shem Deo Temple.	29 36 34.9	79 40 33.9	6964.9
	Fort Moira.....	29 35 7.9	79 29 49.4	5520.8
	Mote'hser Peak.....	29 28 12.1	79 29 20.7	7710.9
	Bandani Peak	29 33 16.3	79 32 24	6725 9
	Shem Deo. (Station.).....	29 36 13.1	79 41 15.9	6923.3
45	Pin Nath Temple.....	29 49 57 1	79 23 19 2	7627 6
	Bagha Ling Temple.....	29 47 30 1	80 2 27.5	7646 5
	Rai Peak..	29 42 21.1	79 51 49.7	7796.7
	Rai (Station.)..	29 43 14.5	79 51 29 3	6594.3
	Dhaj Peak.....	29 38 34 9	80 7 45.1	8168 3
50	Thasil Peak.....	29 30 17.9	80 2 27 2	8148.6

No.	Names of Places.	Latitudes.	Longitudes.	Elevations.
		° ′ ″ N.	° ′ ″ E.	Feet.
	Heights above Ascot. (Station.)	29 45 46 3	80 8 56.8	5502.9
	Sí acot Temple.	29 48 28.9	80 5 3	6862.1
	Bárah Bisht Peak.	29 42 49 9	80 4 40 I	7805 4
	Rún Peak.	29 58 35.5	80 6 28.9	9847.4
55	Cut lgérh Fort,	29 24 13 9	79 53 38 4	6321.7
	Bamou Peak.	29 20 36.1	80 3 7.3	6061.2
	Bynt'hari Fo t. (Dotee.)	29 33 9.7	80 15 58 3	5543.2
	Calí Nágh Peak.	29 51 36.1	79 57 13.4	7898.
	Charák'h P. (in Dotee.)	29 34 55.9	80 19 6.4	6544.4
60	Roulacot. (Ditto.)	29 33 15.7	80 24 6.8	8291.2
	Go'al Lékh P. (Ditto.)	29 29 1.9	80 14 57	8194.8
	Chaumunh Temple.	29 35 41.8	79 11 35.9	6355.7
	Gupat Gangá Peak.	29 37 31.9	79 52 57.6	7192.2
	Asú Chúla Temple.	29 37 31.9	80 1 11.4	7034.9
65	Cumbhpúr Temple.	29 38 17.5	79 15 34 4	6306.9
	Cát'h rí Na'o Fort.	29 35 45 7	79 0 32.4	4978.1
	Lobahger'h Fort.	29 58 4.3	79 10 53.3	6357.7
	Ascot Village.	29 45 17,5	80 10 35.9	5916.7
	Chipala Peak. (Bŭtan.)	29 54 42.1	80 16 52.5	13455.1
70	Rání Shica P. (Dotí)	29 46 41 5	80 24 1.2	10132.3
	Shica P. (Ditto.)	29 44 34 9	80 21 10.5	9.76.3
	Chand Págh P.	29 37 37.3	80 3 56.9	7078 7
	Mount Lébug (Summit of the Pass. (a)	30 19 43.3	80 27 24.9	18870.6
	Goh Village. (Bútan.)	30 14 40.5	80 22 45.5	11488.3
75	Edge of the Calí R. below Ascot			3273.2
	Deo Dhúa Temple.	29 24 33	79 43 17	6669.6
	Khilpatí Stockade.	29 21 30	80 0 44	6324.8
	Chamáwat Cantonment.	29 19 45	79 56 17	5467.5
	Súi Peak.	29 25 27	79 55 10	5837.8
80	Hawal Bág'h.	29 38 20	79 28 3	3889.
	Sitolí Stockade.	29 36 13	79 29 8	5187.
	Mount Browne.	29 36 44	79 30 46	5705
	St. Mark's Tower.	29 35 40	79 30 28	5104
	Fort Almora.	29 35 30	79 30 0	5337
85	Cutár Mall.	29 37 22	79 27 9	5144
	Simtouca Peak. (Bútan)	30 18 46	80 28 49.9	10662.2
	Jeútí Village. (Ditto,)	29 57 40.1	80 26 24.7	6310
	Snowy Peak ab. Golaghí (Himalaya.)	29 8 19	80 32 38	21150.
	Taugling Ghatí. (Bútan.)	30 1 12	80 27 15	11651.6
90	Runju Village. (Ditto.)	30 57 48	80 25 25	6779
	Saíusura Village. (Ditto,)	29 55 32	80 28 45	6211.8
	Cíla, or Seealpunt. (Ditto.)	29 56 30	80 25 36.3	5218.6
	Cíla Bridge over the Dhulí R. (Do.)			3811.2
	Confluence of Réla Gher & Calí R. (Ditto.)	29 53 56	80 24 0	3721.8
95	Camp below Lúma. (Ditto)	29 54 18	80 23 45.8	3924.8
	Júma Village. (Bootan.)	29 52 57	80 23 27	6564.2
	Rat'hí (Ditto,)	29 55 27	80 24 15	5686.5
	Shacúrí (Ditto,)	29 48 31	80 0 16	5931.2
	Dingat'har, Village	29 47 23	79 56 55	4443 2
00	Thal Debís Temple.	29 48 11	79 52 52	4224 8
	Khané Village.	29 50 43	79 51 52	5128.1
	Hanú.cí Thán. (Temple.)	29 48 10	79 31 45	5717.4
	Odíarí Village.	29 46 12	79 53 53	5703.5
	Dhandulú. Ditto,	29 46 43	79 54 32	5375.3
05	Bádéra. Ditto,	29 30 31	79 51 52	4341.3
	Loha Thal Ditto,	29 50 31	79 53 33	5730.6
	Desaulí Ditto,	29 51 30	79 52 0	5734.3
	Saulí Ditto,	29 50 50		5618.4

No	Names of Places.	Latitudes.	Longitudes.	Elevations.
				Feet.
	Garbia village. (Bútan.)	30 6 55 N.	80 41 32.6 E	10200.2
110	Mt. Namjang. (Himalaya.)	30 2 18.4	80 39 44.6	18398
	Trig. Station near Garbía.	30 6 1	80 39 46	10983..2
	Spar Bridge over Calapaní R. (Bútan.)	30 9 7	80 42 23	12670 4
	Byás Rik'hi P. (Himalaya.)	30 9 28	80 46 2	19857 2
	Mandarin's Camp. (Bútan.)	30 11 19	80 44 18	14433·8
115	Ghatí, or Pass to Factory.	30 11 45	80 48 10	17597.8
	No. 1 of Cúntas. (Himalaya.)	30 13 17	80 45 0	22441.4
	No. 2, (Ditto.)	30 12 47	80 46 8	20991.8
	Kuwa Lekh P. (Bútan.)	30 8 0	80 42 52	15245.4
	Station near confluence of the Calí and Cálapaní Rs. (Bootan.)	30 8 16	80 41 31	11341.4
120	Sithi Lekh P. (Himalaya.)	30 7 28	80 40 16	15811.4
	Bouling village. (Bútan.)	30 5 12	80 26 49	——
	Phakul ditto. (Ditto.)	30 3 21	80 27 17	——
	Cálapaní Fountain.	30 10 30	80 43.28	——
	Deodar Ghat. (b)	29 28 2	79 26.40	6273.7
125	Ghagar Ghat, (c)	29 24 25	79 23 3	7696.1
	Loharcat Stockade.	29 27 45	79 26 7	6732.4
	Surface of the Lake, Bheem Tal. (d)	29 19 18	79 23 53	4271.5
	Kissenpúr (Rohilcund.)	29 12 18	78 48 54.1	——
	Chamrowa. (Ditto.)	28 46 26.9	78 58 10.8	——
130	Afzel Khan's Palace. (Ditto.)	29 23 52	78 32 9.5	——
	APPROXIMATIONS. (e)			
	Taclasot. (Chinese Factory.)	30 12 43	81 2 10	14500
	Lake Mansarovar. (Ditto ditto.)	30 23 7	81 9 10	

(d) *A ch'habútra*, or Sat'hí at the southern extremity of the lake.

REFERENCES.

No. 73, (a.) With extreme difficulty, and I may add, with extreme peril, I was fortunate enough to accompliſh the paſſage of *Lébúg Ghátí*, without accident on the 6th of June 1816.

Nos. 124, 125, (b,) (c.) The new road from *Bamauri* to *Almora*, recently conſtructed at the expence of the Britiſh Government, croſſes both theſe points.

No. 126, (d.) The ſhape of the lake *Bhím Tál* approaches more nearly to a triangle, than to any other regular figure, the length of the longeſt ſide is about a mile, and that of the ſhorteſt five furlongs. Its extent appears to have been much greater at ſome former period; and the diminution it has experienced, is evidently to be attributed to depoſition by the ſtreams flowing into it. There is ſtill depth of water

ſufficient for a firſt rate line of battle ſhip to ride at anchor. Lieut. STEPHEN, who had a ſmall canoe on the lake, ſtruck ſoundings in 64 feet or nearly 11 fathoms, about the central parts, and the banks ſhelve very rapidly.

APPROXIMATION E; the poſition of the paſs leading to *Taclacot* is already given by my ſurvey; the direction of *Taclacot* was pointed to the north 82° eaſt from thence, and its diſtance from the eaſtern deſcent is one day's journey for laden goats; the above bearing, with a horizontal diſtance of eight miles from the ſummit of the paſs, cannot give a very erroneous poſition to *Taclacot*.

THE direction of *Manſarovar* was alſo deſcribed to me by many perſons, who had viſited it to be about north 30° eaſt from *Taclacot* and the diſtance two day's journey, for laden goats, which as the road is level may perhaps be 14 miles.

BY this information I have aſſigned, what I imagine to be the geographical poſition nearly of the monaſtery, mentioned by Mr. MOORCROFT, and which I conclude to be ſituated on the weſtern bank of the lake, but as *Manſarovar* is ſtated to be of an elliptical ſhape, and to have its diameters equal to eleven and ſeven miles reſpectively, it ſeems at leaſt probable that the latitude and longitude, I have given will fall ſomewhere within the limits of the lake itſelf eſpecially if it be remembered, that the place at which my information was obtained, is not ſo much as twenty miles diſtant from *Manſarovar*.

ALL the *Tartars* and *Bhútias* who were with me were of opinion, that the eaſtern deſcent of *Taclacot Ghátí* was not greater than the weſtern, and hence we may conclude that the elevation of the lofty table

land of central *Aſia* is nearly the ſame, as that of the *Deba's* camp. (No. 114,) or 14,500 feet above the level of the ſea.

ALTHOUGH ſeveral of the preceeding latitudes, and longitudes, are inſerted to the tenth part of a ſecond, as given by the calculations, it is by no means intended to convey an idea, that the principles, on which this ſurvey is conducted, can attain to that great degree of exactneſs.

EVERY figure of even the most trivial computation will be found in the field books, which I have tranſmitted to the Surveyor General's Office: in ſo much work, when the ſurvey in the field and all its dependant computations reſt with an individual, a few errors may be excuſed; ſome I have diſcovered and corrected, though none have been pointed out to me, ſome may ſtill remain.

UPON the whole, I flatter myſelf, that in the more eſſential parts, this ſurvey will bear compariſon with any, that have been performed in Bengal; and I can only lament that I have not been able to collect the materials into a map of ſuitable external appearance.