

connected with them; Chinese charities and educational methods; the system of government and the failings and virtues of the mandarins; and many other questions of importance for the future of the empire. For the Chinese mobs—at whose hands her life was on two occasions in actual danger—Mrs. Bishop has naturally no good word to say; but she found much to like in the dwellers in the country districts, who are generally quiet and harmless. She is far from sharing the views of those who regard the empire in a hopeless state of decay, and, while acknowledging the evils of the system of government, points out various counterbalancing features which tend to the stability of the country. The “open door” policy, as opposed to the political encroachments of European nations, finds in her a vigorous champion. We have said nothing of the many hardships encountered during the journey, but though the writer does not dwell on these, she says enough to make us wonder at the spirit and hardihood which enabled her to persevere in spite of all obstacles, and carry through her undertaking to so successful a termination.

NARRATIVE OF A JOURNEY TO THE LAKES RAKAS-TAL AND MANASAROWAR, IN WESTERN TIBET, UNDERTAKEN IN SEPTEMBER, 1848.*

By Lieut-General Sir RICHARD STRACHEY, R.E., G.C.S.I., F.R.S.

August 8-16.—Accompanied by my friend Mr. J. E. Winterbottom, I left Almora on August 8, 1848, with the intention of going *viâ* Milam, as far as the Satlaj river in Tibet, and if possible on to the lakes. The first part of the journey presented little that was remarkable, and it was hot and rainy. Our route lay, for about 50 miles, over the outer Himalayan ranges, at elevations between 3000 and 7000 feet, to the valley of the Gori river, at the head of which Milam is situated. Into this valley we descended from the Kalamundi pass, over a ridge rising to over 9000 feet, at the foot of which lies the cluster of villages of which Jalat is the centre and most important. These form the winter residences of the inhabitants of Juhar, the name given to the highest portion of the valley of the Gori, that of the lower part, in which Jalat is situated, being Munshari.

The direct road to Milam lies up the bed of the Gori, but it passes through a gorge between lofty and precipitous mountains, and at this season was impracticable, as bridges, which are each winter destroyed by avalanches, had not yet been repaired. Earlier in the year, when the migration of the people of the highest valleys commences from their winter quarters on the outer ranges, the snow which is accumulated by these avalanches itself affords the means of crossing the river. At the time of our visit the snow had melted, and the Gori was unfordable; we therefore had to take a more circuitous route by the Ralam valley, which joins that of the Gori a little above Jalat.

August 21.—Crossing the Gori, we soon got into dense forest, which became continuous until we left it in ascending the Ralam valley, at an elevation of about 11,000 feet, beyond which arboreous vegetation ceases, and the alpine herbaceous

* As this narrative has not before been published, the information it contains has been considered by the Council of sufficient value to be placed on permanent record.—*En. G. J. Map.* p. 204.

MAP OF THE MOUNTAINS ON THE NORTHERN BORDER OF KUMAON AND OF THE ADJACENT PARTS OF TIBET.

Scale of Statute Miles.

THE GEOGRAPHICAL JOURNAL. 1900



zone is entered, which by its wonderful luxuriance characterizes the southern flanks of the snowy ranges at these elevations. In the six days occupied by our journey from Jalat to Milam, upwards of 250 species of flowering plants were added to our collections.

August 23.—Ralam, 12,000 feet, is a wretched-looking village with flat-roofed mud and stone houses, which cut no figure when compared with the far smarter slated abodes of the more civilized inhabitants of Juhar. The people are poor and uncouth, approximating in their habits to the semi-Tibetan population of the contiguous valley of Darma, which is so difficult of access that I was told that no European had entered it since the surveyors in 1817. Ralam is said to be famous for its turnips, but I had no means of testing this.

August 24.—From Ralam our route lay over the Barji-kang pass, 15,400 feet.

Hansa ling, 18,200 feet.

Dhānsi, 19,200 feet.



Bed of the Gori, 4000 feet.

VILLAGE OF JALAT, 6400 FEET.

The ascent was easy, and the vegetation abundant and varied, and no fewer than thirteen species of saxifrage were collected between Ralam and the top of the pass. From the summit we looked down into the head of the Gori valley, seeing right up it to the extremity of the great glacier from which that river rises. For a few minutes the peaks of Nanda-devi, 25,700 feet, and Nanda-kot, 22,600 feet, distant about 15 miles to the west, were visible, but they were soon covered by the clouds that constantly hung about the higher points of the snowy mountains during the rainy months. The contrast between the view on the two sides of the pass was most striking. To the north the Milam valley looked bright, cheerful, and dry, chiefly in sunshine, though a few detached clouds threw patches of shadow here and there on the bare brown hillsides; while to the south the Ralam valley was densely filled with mist, which rolled up just over the crest of the pass, but soon dissolved on the dry north face.

August 25.—In the morning, which was wet and cloudy, the temperature of the air was not below 38°·5, but next day, after a clear night, it fell to 32°, and a thermometer exposed to the sky on loose cotton fell to 23°·2. The maximum afternoon temperature was 51°, with the sun shining and the sky tolerably clear.

August 26.—The descent from the pass lay over the faces of the beds of the schists, which dipped steeply to the north-north-east, the uptilted southern ends of which we had crossed during our ascent. The surface was well clothed with the plants common to alpine pastures, such as *Potentilla*, *Ranunculus*, *Primula*, *Polygonum*, etc., but afforded few new species. With the exception of a dwarf willow (*Salix Lindleyana*), which was found at 14,000 feet, the first woody plant met with was the birch, *Betula utilis* (*Bhojpatra*), which appeared at about 13,500 feet.

The change from the forest-clad mountains and luxuriant vegetation, with the soaking wet and clouds of the outer ranges through which we had come, to the dry and relatively sunny climate of the bare valley of Juhar was very striking, and most acceptable to all of us, and not less so to our herbarium, which, in the constant rain of the last few days, was not improving.

August 27.—We reached Milam, 11,400 feet, on August 27, and it at once became apparent that we had been long enough exposed to the vicissitudes of wet and heat, for almost every one of our servants had been attacked by intermittent fever, some of them rather severely. We fortunately did not suffer.

The highest inhabited part of the valley of the Gori, lying between 10,000 and 12,000 feet above the sea-level, is called Juhar. It is about 10 miles in length, with a bottom breadth of 1 or 2 miles, beyond which the mountains rise steeply, but not very abruptly in their lower portions. The summits of these mountains, for the most part, enter the region of perpetual snow, and most of the larger side ravines are occupied by glaciers. The vegetation is generally scanty, and, with the exception of a few stunted birch, a juniper or two, *Juniperus communis* and *macropoda*, near Milam, and a small cluster of *Pinus excelsa* near Tola, there are, I think, no trees whatever in this part of the valley. The shrubs also are diminutive and confined to a few species, the herbage, where not under the influence of a stream of water, being equally scanty. The flora, however, though poor, is interesting, as containing a very distinct proportion of Tibetan elements, no representatives of which spread into the Gori valley below Juhar. Of these may be mentioned *Caragana pygmaea* (*versicolor*), the commonest of the bushes of the Tibetan uplands, called in Tibetan "trama," but corrupted by the Bhotiyas into "dama." It is a thorny and usually a stunted shrub, which may be compared to our English furze. Other Tibetan forms are *Clematis orientalis*, *Hippophaë rhamnoides*, and species of *Potentilla*, *Lonicera*, and *Pedicularis*.

In the upper part of this valley we come upon the base of the great fossiliferous series of rocks that constitute the mountains forming the ranges on which are situated the principal passes into Tibet. To this line of elevation I have applied the general designation of the *Indian watershed* of the great Tibeto-Himalayan tableland. The occurrence of well-defined series of fossiliferous strata, first established by my observations during this journey, and those made in the following year in the neighbouring valley of Niti, is of special importance, as it supplies an unquestionable basis on which speculation as to the geological history of this vast mountain region may now be founded.

The most important village in Juhar is *Milam*; the next is *Martoli*, and, as a natural consequence, there is a feud between them. The men of Milam are, however, generally recognized to be the most enlightened and most enterprising of the Juharis, i.e. people of Juhar, and much superior to any other branch of the half-bred races, commonly spoken of as *Bhotiyas*, found along this part of the frontier between India and Tibet.

Milam, though large for Juhar, is in reality but a small village. The houses are usually built of stone, often whitewashed, two-storied, and roofed with slates. The inhabitants are almost wholly traders, agriculture being of quite secondary

importance with them. The crops, such as they are able to raise, are wheat, the beardless barley of Tibet, and two species of buckwheat, *Fagopyrum esculentum*, *Oyal*, and *F. tataricum*, *Phaphar*; besides mustard and turnips. The year of our visit the wheat and barley were very poor, hardly more than 15 inches in height, owing to an unfavourable season, with less rain than usual.

The trade with Tibet is carried on almost exclusively by the Bhotiyas distributed along the higher valleys of the Himalaya, the Tibetans taking little part in the carrying business on the south side of the passes. The chief articles dealt with are salt and borax from the Tibetan side, which are exchanged for grain from the Indian side, miscellaneous merchandise being taken to Gartok, a mart beyond the Satlaj. The inhabitants of the parts of Tibet contiguous to Kumaon and Garhwal—and the same may be said of those bordering on Nepal—are almost wholly dependent on foreign supplies of grain for their sustenance, their



PEAK OF NANDA DEVI.
As seen from the south, through a telescope, at a distance of 50 miles.
Elevation 25,693 feet.

own country being almost incapable of producing it. The population, however, is so scanty that the quantity they require is small, and their poverty is such as to afford them little means of supporting an import trade in miscellaneous goods of any considerable value. The material difficulties of transit over the snowy mountains might seem likely to be nearly fatal to the development of the traffic carried on, as it is mainly on the backs of goats and sheep, which can only carry loads of 20 or 30 lbs. weight each. It has been estimated that the trade of Milam amounts in value to upwards of 60,000 or 70,000 rupees, each way, during the season. Fortunately, there is perfect free trade on our side, though the Tibetan authorities exact a duty on all imports.

A cross-breed of horned cattle, called *jhobu*, peculiar to the borders of Tibet, is also employed in this carrying trade, though less extensively than goats and sheep, the multiplication of which animals is favoured by the small number of beasts of prey, such as abound on the outer ranges of the Himalayas. The *jhobu* is used for the heavier and more bulky merchandise, as well as for riding by the more wealthy Bhotiyas. This breed, which is called *jhobu* by the Bhotiyas, and *dzo* by the Tibetans, is a cross between the Indian bull and the Tibetan or yak cow. The best are said to be raised in the neighbouring valley of

Niti. It is more tractable and less uncouth in its appearance than the shaggy yak, which has much of the fierce look of the bison. The yak is incapable of supporting a hot climate, to which the jhobu is better suited, being from its Indian blood less impatient of heat, and hence more fitted for the Bhotiya trade, which at times involves journeys into the warmer valleys of the Himalaya.

A good *jhobu* is valued at from twenty to thirty rupees, while a yak, called by the Tibetans *chanwr*, costs only seven to twelve rupees. The other cross-breed, between the *chanwr* bull and the Indian cow, is said to be far less valuable than the jhobu. These mule races are said to be sterile *inter se*, but to breed with the pure stock of either species.

The load of a jhobu is about 120 lbs., or equal to that of three men, and the ordinary distance they can travel in a day is about 10 or 12 miles. The cost of a goat or sheep varies from one to two rupees, and they are seldom driven more than 5 or 6 miles a day.

The Bhotiyas of Juhar are smart and intelligent men, decently educated, all things considered, and even have some knowledge of Hindi literature, such as it is. They are commonly short and stout, and some of them decidedly obese. Their dress consists of a long coat, called *baku*, the skirts reaching below the knee, of white or grey woollen cloth, with loose trousers to match. They are cheerful and well-mannered. Theft is unknown among them, and their chief vice is drunkenness, to which they are somewhat addicted.

We employed the interval required after our arrival at Milam for the necessary preparations for our journey into Tibet, in making an excursion up the great glacier which fills the head of the Gori valley, and from which that river issues, with the object, amongst others, of measuring its motion. The glacier terminates about a mile and a half above the village of Milam, at a height of about 11,590 feet above the sea. Its main trunk extends nearly 10 miles up the valley, which there ends abruptly in a ridge, on which is a cluster of snowy peaks, the altitudes of which are from 22,500 to 23,800 feet. Six tributary glaciers of smaller dimensions occupy as many ravines or valleys on the west, on which side the mountains are extremely lofty, culminating in the great peak of Nanda-devi, before referred to. Three smaller glaciers descend from the somewhat lower ridge to the east of the central valley. The ice from two or three of these tributaries does not, however, now join the main glacier, though it appears to have done so formerly from all of them.

The line that I selected on which to fix marks for the measurement of the motion of ice was 7 miles from the lower extremity of the glacier, which was here about 4000 feet across. The elevation of the surface of the ice was about 14,600 feet, and the highest part of the main stream of the glacier rose in a great dome of clear ice immediately above, reaching probably to a height of 15,000 or 16,000 feet. Beyond this the glacier bifurcated to the right and left, and the branches were lost sight of behind projecting angles of rock.

The most remarkable feature of this glacier was the immense quantity of *débris* with which its lower part was covered, so that for the last 5 miles no clear ice at all could be seen, the entire surface being concealed by a confused mass of rocks and *débris*, with many large pools of water scattered over it. The indications thus afforded of a great shrinkage of a glacier of former far greater proportions are everywhere confirmed. The lateral moraines show this in a striking manner. In many places several parallel lines are to be seen one within the other, left stranded on the valley floor, as the main body of the glacier has shrunk and subsided. The enormous accumulation of *débris* that has taken place at the extremity of the glacier entirely covers and conceals the ice, so that the terminal face, instead of

being convex, as is usual, is concave, the ice on the flanks being protected by the *débris* piled over them, while the centre is being constantly eroded by the river which rushes, a giant at its birth, from the terminal cave that appears in the concavity formed by the projecting flanks.

These signs of the gradual diminution of this glacier are confirmed by the testimony of the people of Milam, who point out a rock up to which the ice formerly extended, but is now several hundred yards below its termination. But a still greater and more ancient extension is shown by an old moraine that is to be seen to the east of the village, which reaches for about a mile below it, or altogether not less than $2\frac{1}{2}$ miles from the present end. The evidence of any extension of this glacier farther down the valley is wanting, though there is probably another ancient moraine filling up the mouth of the ravine at which the village of Martoli is situated. This mound rises to about 500 or 600 feet above the present level of the river, but whether it has been caused by a former extension of the



THE GLACIER OF THE GORI.

great Gori glacier, or by the glacier which exists higher up the ravine, or is an accumulation formed by running water, is somewhat uncertain. Such accumulations at the ends of lateral ravines are to be seen in all mountain valleys under similar circumstances, and villages are commonly placed upon them, as, from their constituents, they afford a surface more capable of tillage than is usually to be found elsewhere.

Our route up the great glacier followed a track along its east flank leading to grazing-grounds used by the people of Milam. The vegetation was scanty, but interesting. Among the shrubs last seen were two roses, *R. sericea* and *R. Webbiana*, white and red. One of the most conspicuous of the flowers was an *Allardia*, a genus of Himalayan and Central Asian Compositæ, with a beautiful rosy ray. On some of the moraines we crossed I found Lower Silurian fossil remains, among which was a trilobite, the first, as I believe, ever met with and recognized as such by any traveller in these mountains. The rocks further down the valley were solely metamorphic schists, the fossiliferous beds all lying to the north-eastward, higher up the mountain face, from which the fossils, among which were remains

of brachiopods as well as trilobites, had been brought down by glaciers and avalanches.

In several places small streams of water running down the mountain-sides cut quite through the lateral moraines, occasionally keeping open deep-recessed spaces in the ice several hundred feet in breadth. At the meeting of one of the side glaciers with the main ice-stream, the veined structure was very distinctly seen in both, the bands curving upwards towards the line of junction where they were nearly vertical, the beds of apparent stratification being in planes perpendicular to the lines of pressure, quite in accordance with the accepted views of the method of the formation of glacier ice-structure by the combined result of the pressure and motion of the ice-particles.

While on the glacier, we witnessed the fall of a magnificent avalanche from among the great snowy peaks at its head. Its approach was notified by a loud roar, like that of distant heavy artillery; then what appeared to be a pure milk-white torrent poured down a ravine, followed by a vast white cloud of snow, having the appearance of a great column of steam, or of smoke after an explosion of gunpowder, thrown up 100 or 200 feet or more into the air when the avalanche reached the surface of the glacier.

In order to ascertain the rate of movement of the glacier, I revisited the marks that had been set up on August 29, on my return from Tibet on September 30. The results were as follows:—

Station 1.	At 900 feet from cliff on east ...	Movement in 32 days.		Movement in 24 hours.
		ft.	in.	in.
" 2.	1052 " " "	33	0	12·4
" 3.	1289 " " "	34	9	13·0
" 4.	1763 " " "	38	0	14·7
		44	9	16·8

These rates do not differ in an important degree from those commonly observed in the summer months on glaciers in the Alps, which lie between 9 and 27 inches in 24 hours.

The motion of a smaller glacier, that of the Pindar, on the outer face of the Himalaya, observed by me in the month of May, was found to be $9\frac{1}{2}$ inches for the 24 hours at the centre of the clear ice; and for the whole period between May 21 and October 15, when it was revisited, the motion was $98\frac{1}{2}$ feet, giving an average rate of just 8 inches in the 24 hours. The surface of the ice where the measurements were made in this case was at an elevation of 13,000 feet, and the extremity of the glacier was at 11,900 feet.

On the Milam glacier we found, lying in considerable numbers, the remains of locusts, which had been preserved from decomposition by the cold for a period of two or three years, so far as I could learn, the last flight of locusts having occurred at about that time. Such flights penetrating into the very heart of the snowy mountains are not uncommon, the insects being, no doubt, facilitated in their journey by the periodical winds which so regularly blow from the plains of India up the valleys during the day hours, from about 10 a.m. to sunset.

On August 29, at our encampment 6 or 7 miles above Milam, we caught a bat flying about at dusk. It seemed rather a curious locality in which to find such a creature. Here, at an elevation of 13,700 feet, the thermometer rose to 57° at about the hottest time of the day, and the temperature of the earth about 3 feet below the surface was 48° . There was no trace of snow on the ground or neighbouring rocks, and the vegetation was abundant. At Milam at 6 p.m. on

October 2, at 11,500 feet, the temperature of the earth 1 foot below was 59° 6, and at 3 feet below the surface, 55°. The maximum temperature during the day was a little below 60°.

The terminal moraines of the glacier extend to the junction of a side stream, the Gonka, with the Gori, and have forced the Gonka up against the face of the mountain, into which that stream has now cut itself a bed in the solid rock. The gradual depression and erosion of the Gori river has cut away a series of terraces out of the unconsolidated mass of the moraine, on the highest of which the village of Milam is situated. The lower terraces are cultivated, and the soil is in all respects identical with that laid out by the river that now flows below them.

PLANTS FOUND AT AND NEAR MILAM, 11,000 TO 13,000 FEET.

<i>Clematis orientalis.</i>	<i>Pyrus aucuparia.</i>
<i>Thalictrum platycarpum.</i>	<i>Cotoneaster microphylla.</i>
<i>Ranunculus</i> —sp.	<i>Saxifraga flagellaris.</i>
* <i>Aconitum Napellus.</i>	" <i>Stracheyi.</i>
" <i>heterophyllum.</i>	* <i>Ribes grossularia.</i>
<i>Berberis vulgaris.</i>	" <i>glaciale.</i>
<i>Draba lasiophylla.</i>	<i>Sedum asiaticum.</i>
<i>Sisymbrium himalaicum.</i>	" <i>trullipetalum.</i>
* <i>Brassica campestris.</i>	" <i>Ewerii.</i>
<i>Lepidium capitatum.</i>	<i>Epilobium latifolium.</i>
* <i>Silene inflata.</i>	* " <i>roseum.</i>
<i>Stellaria decumbens.</i>	" <i>organifolium.</i>
<i>Arenaria serpyllifolia.</i>	<i>Pituranthos nuda.</i>
" <i>holosteoides.</i>	<i>Sesili trilobum.</i>
<i>Impatiens Thomsoni.</i>	<i>Pleurospermum Candollei.</i>
<i>Thermopsis barbata.</i>	" <i>stellatum.</i>
<i>Caragana crassicaulis.</i>	<i>Heracleum Brunonis.</i>
<i>Guldenstædtia himalaica.</i>	<i>Lonicera glauca.</i>
<i>Astragalus himalayensis.</i>	" <i>obovata.</i>
" <i>multiceps.</i>	" <i>alpigena.</i>
<i>Cicer songaricum.</i>	<i>Galium triflorum.</i>
* <i>Potentilla fruticosa.</i>	<i>Nardostachys Jatamansi.</i>
" <i>ambigua.</i>	* <i>Erigeron alpinus.</i>
" <i>bifurca.</i>	<i>Anaphalis Royleana.</i>
<i>Rosa Webbiana.</i>	<i>Allardia tomentosa.</i>
" <i>sericea.</i>	<i>Tanacetum tibeticum.</i>
<i>Artemisia scoparia.</i>	<i>Axyris amaranthoides.</i>
" <i>biennis.</i>	<i>Polygonum islandicum.</i>
" <i>sacrorum.</i>	* " <i>aviculare.</i>
<i>Cousinea Thomson.</i>	" <i>tubulosum.</i>
<i>Crepis glauca.</i>	" <i>glaciale.</i>
<i>Lactuca rapunculoides.</i>	" <i>polystachyum.</i>
<i>Campanula cashmiriana.</i>	<i>Rheum Webbianum.</i>
" <i>aristata.</i>	<i>Hippophaë rhamnoides.</i>
<i>Androsace Chamæjasme.</i>	<i>Parietaria debilis.</i>
<i>Gentiana cachemirica.</i>	<i>Ephedra vulgaris.</i>
<i>Pleurogyne carinthiaca.</i>	* <i>Juniperus communis.</i>
<i>Polemonium cœruleum.</i>	" <i>pseudo-sabina.</i>
<i>Eritrichium strictum.</i>	" <i>macropoda.</i>
* <i>Verbascum Thapsus.</i>	<i>Allium victorialis.</i>

<i>Scrophularia lucida.</i>	<i>Potamogeton pectinatus.</i>
<i>Veronica ciliata.</i>	* <i>Scirpus setaceus.</i>
" <i>biloba.</i>	" <i>caricis.</i>
<i>Pedicularis megalantha.</i>	<i>Hierochloa laxa.</i>
" <i>tubiflora.</i>	<i>Deyeuxia scabrescens.</i>
<i>Orobanche epithimum.</i>	<i>Avena ænea.</i>
<i>Elsholtzia eriostachya.</i>	<i>Danthonia cachemyriana.</i>
* <i>Origanum vulgare.</i>	<i>Bromus tectorum.</i>
<i>Nepeta spicata.</i>	<i>Agropyron longe-aristatum.</i>
" <i>discolor.</i>	" <i>semicostatum.</i>
<i>Scutellaria prostrata.</i>	<i>Elymus sibiricus.</i>

N.B.—An asterisk prefixed in this list, and in subsequent parts of this journal, implies that the species is also British.

September 2, 1848. *Milam to Shelong, 6 miles.*—All preparations being completed, we left Milam this day. Our retinue consisted of sixteen Bhotiyas, taken two or three from each village in the valley, so that the pains or profits of the expedition might be fairly distributed. The nominal head of the party was one *Bachu*, a relation of the principal native official in Juhar, stout and short, but young and active, not very wise, yet intelligent enough, reputed to be a good sportsman, and having no objection to a glass of grog. He was provided with a jhobu of his own, but was the only one excepting ourselves who habitually rode. Next to him in importance was *Boru*, the *Padhan* or headman of *Tola*, a village near Milam; he was oldish, thin, and taller than the ordinary run of his countrymen. He was a shrewd fellow, and had been over a good deal of *Hundes* (i.e. country of the Huns), as the part of Tibet bordering on the Indian watershed is commonly called by the Hindu inhabitants of this part of the Himalaya. *Boru* naturally became our guide, and on him would devolve the duty of answering any questions put by over-inquisitive Tibetans who came in our way. In doing this, as he could not have given a satisfactory account of us if the truth had been strictly attended to, he never failed to draw freely on his imagination, and with most successful results. To the rest of our people were allotted the miscellaneous functions of loading and driving the cattle, pitching the tents, getting firewood and water, cooking our dinners, and performing other domestic services.

We were victualled for a month, as no provisions were to be got after we had once entered Tibet. We carried two small tents, 8 or 10 feet in length, one for our own use, the other for the Bhotiyas; and if it be asked how our sixteen men could get into one such tent, it must be explained that there is an aristocracy even in the heart of these snowy mountains, who appropriate such comforts of life as are to be had to themselves, and that the underlings were expected to live wholly in the open air, day and night, which they did without any apparent inconvenience, being as rough and hardy as any of the twenty jhobus that carried our baggage.

The jealous policy of the Chino-Tibetan Government rigorously excludes all strangers from its territories, and it is only by adopting some disguise and avoiding any contact with the people, or, in some rare cases, by boldly advancing in spite of the prohibitions of the authorities, that it is possible to penetrate to any distance into the inhabited parts of Tibet. On the present occasion we adopted the quieter plan, and made such modifications of our costume as would enable us, without attracting special notice, to hurry past any Tibetans we met unexpectedly, and with whom we might be forced into proximity; for we altogether gave up the idea of being able to pass ourselves off as authorized travellers if we were distinctly seen. Hats

were abandoned, their places being supplied by felt skull-caps, such as are worn by people of the country, while over our ordinary clothes we put on the Bhotiya *baku*, a garment of the cut of a dressing-gown, which answered sufficiently well the purpose of a great-coat.

Our scientific equipment consisted of a few bundles of paper for drying plants; a small theodolite, azimuth compass, and reflecting circle; a short barometer, which I had myself prepared for the purpose, suited for the great elevations at which we were about to travel, with a spare tube in case of accidents; and thermometers, with apparatus for observing the boiling-point of water. The barometer was carried by one of the men; all the other things were packed on the jhubus' backs, and travelled with perfect safety.

We left Milam about noon. A token of the Tibetan affinities and sympathies of the inhabitants stands a few hundred yards from the village, by the side of the path we followed, in the shape of one of the Budhistical buildings commonly called *Mane-pane*. The structure in this instance is a rudely built dry stone wall, 20 or 30 feet long, 4 or 5 feet thick, and as many high, with a recess in one of the longer sides in which are inserted three wooden cylinders revolving on vertical iron axes, while a fourth is similarly fixed in one of the ends. These praying-cylinders, as they have been called, are without ornament or external inscription. It was not possible to examine their interior, but such articles are commonly filled with rolls of paper covered with sacred texts, or inscribed many hundred times over with the sacred legend, "*Om mane padme hum*," which signifies, "O Lotus-bearer, Hun!" the mythical personage thus addressed being an important character in Budhistic ritual.

On the top of the wall are placed slabs of stone, on which the same words are roughly carved. The devout passer-by, touching the cylinders, causes them to revolve, and each mystic sentence within them, as it is carried round, becomes endowed with the same efficacy to the passer as though it had been spoken by him in adoration. Hand-machines of a similar description, often richly carved in brass or silver, are used by pious individuals; but some of the monastic societies of Tibet employ for their more serious devotions a more ponderous liturgy, and call to their aid water-power and a praying-cylinder 6 feet high.

Crossing the old moraine before noticed, which is covered with barberry, goose-berry, and rose bushes, we descended and passed the stream, called on the old maps *Gonka*, by a wooden bridge. *Gonka* is really the name of the ground near the bridge, though it is applied to the bridge also. It means "below," and has been given to this locality because it is below an old fort on the moraine. The river itself, as is often the case in Kumaon and Gurhwal, has no special name. In a state of society such as here exists, geographical names, as Humboldt has well observed ("Aspects of Nature"), are only necessary to distinguish places which are likely to be confounded one with another. Thus we find that in these mountains—and this holds good in many other parts of India—the great rivers are called by the inhabitants simply *Ganga*, *i.e.* "the river," while distinctive names are hardly used or known except by strangers. So with respect to the mountain peaks and ranges, many have no other names than those of the *Deotas*, or local deities, who are supposed to reside on them. The passes, pasture-grounds, and regular halting-places have definite names, and it will often be found that one of these supplies the deficiency, when a European traveller insists upon having a name given to him, for peak, ridge, or other locality, which in reality has no recognized name at all.

The old fort is a small enclosure surrounded by a ruinous wall a foot or two high, regarding which stories are told of heroic defences by the ancient people of *Milam* against lowland invasion. Regarding the origin of this ancient people of

Milam, tradition says that an adventurer from *Daba*, the chief place in Guge, the neighbouring province of Tibet, was led over the mountains by a mysterious stag to the place which he called *Mi-dum*, or *lame man*, inasmuch as he was lamed by his walk over the passes. There were stories also of a dragon, a standard dish in the myths of Tibetans, and of an old woman—a witch, I suppose—but it was not clear what these had to do with the foundation of *Milam*. It is curious that the *Shea*, a stag with great antlers, which enters into these histories, though now quite unknown in this part of the mountains, has a real existence. It is the *Cervus Wallichii*, of which specimens have been lately got from Tibet by Mr. Hodgson, as well as from the north of Kashmir by Captain Cunningham. Some of the names of the places on the road we were following are connected with these traditions: *She-long* is the place where “the stag got up;” and *Sam-gong*, “happy heart,” the spot the beauty of which captivated the trans-nivean immigrant. [I have since been informed by Dr. W. E. Blanford that the greatest doubt attaches to the existence of Hodgson’s *Cervus Wallichii*, though it is possible that the stag of Kashmir may have been found in the Bhotiya valleys of Kumaon.]

My own taste, I confess, differed from that of the Tibetan explorer. The valley of the *Dung* river, as the stream along which our route led us may more properly be called, is nothing more than a mere ravine, down which rushes a roaring torrent jammed in between mountains, that rise from the very edge of the water either in shattered cliffs, or more frequently in great slopes of loose *débris* that extend upwards without a break for thousands of feet. The vegetation was miserable, the heat of the sun and the glare from the bare surfaces were most disagreeable, and the whole aspect of nature was wretched in the extreme.

The road, which, however, hardly deserves the name, in spite of an affectation of repairing it that had been gone through in our honour, is a track, and that a bad one, keeping generally near the stream, sometimes pretty level over a talus of *débris*, now descending to cross a side ravine, now ascending abruptly over some prominent point of solid rock that juts out into the centre of the valley. The accumulations of mud and stones heaped together by torrents, avalanches, and glaciers, over which the road goes, though compact and firm enough when dry, are quite otherwise when the snow is melting or after any considerable fall of rain, and this road then becomes difficult and even dangerous. In these heterogeneous accumulations of loose material, curious pinnacles or rough cones of various sizes often detach themselves from the general mass as it decays, capped with stones which have afforded protection to the summit of the pile, while the materials around it have melted away under the action of rain or weather. Great fragments of rock of considerable dimensions are thus left perched high in the air on very slender columns of mud and stones, in positions which at first sight seem strange enough. These pinnacles are frequently met with in other places on the borders of Tibet, where the conditions of soil and climate are similar. I remember, also, to have seen precisely the same thing in some of the unconsolidated boulder strata of the Siwalik hills, and the analogy with the ice-tables on glaciers is complete.

As we increased our distance from *Milam*, the vegetation became more and more scanty, and we passed the last bushes worthy of the name (**Juniperus communis*) a mile or so before we reached *Shelong*, where we halted. As far as the pass of *Unta-dhura* there is only one route from the valley of Juhar into Tibet, though beyond that pass a choice is possible between two or three lines. Consequently, on this portion of the route the frequent demands for firewood for travellers, and the attacks of sheep and goats for fodder, have nearly annihilated the vegetation, which, had it been left undisturbed, would have been miserably poor.

Shelong is a mere ledge a few hundred feet square on the valley-side, at an

elevation of 12,860 feet. It supports a show of vegetation and tries to be green, but the multitudes of sheep that pass over it, succeed in depriving it of any claim to such an epithet. The plants observed were *Astragalus strictus*, an *Artemisia*, *Sedum trullipetalum*, and *Cotyledon oreoides*. Immediately above us rose a great talus of *débris* issuing from a narrow rent in the cliffs behind, and spreading out into a broad-based cone below. These cones of *débris* are among the characteristics of these regions; their formation seems partly due to avalanches, and partly to torrents caused by melting snow, which take their place later in the season, and they often terminate as this one did, in a snow-bed. Such accumulations, when their ends are cut away by the eroding action of streams at their bases, often exhibit an appearance of stratification, which may cause them to be mistaken for river-deposits at great elevations above the existing waters, where, in fact, no such deposits have ever been formed. The origin of this false stratification is readily understood: the fresh material which is brought down from above, as it rolls onward, spreads out and covers up, with some regularity, the older and inferior parts of the slope.

A first trial of a ride upon a jhobu, though highly satisfactory as to the sure-footedness of the animal, gave but a sorry augury of the pleasures of a long day's journey. We thought it prudent on this journey to use the ordinary saddle of the country, as it was important to avoid anything that would attract attention, and to those not accustomed to them these saddles are excessively uncomfortable. I have, however, subsequently used an ordinary English saddle on a jhobu's back with perfect success. The pace of the jhobu is very slow, hardly more than 2 miles an hour at best, and often much nearer a mile. They are usually quiet beasts, though sometimes impatient when being mounted or loaded. They are driven or led by a nose-rope fixed in the cartilage between the nostrils in the ordinary Indian fashion of dealing with horned cattle, but it is hardly worth while to attempt to guide them, as they resolutely take their own way, and it is soon found that they may be trusted implicitly. Like other animals, they are treated by their human masters with a peculiar language. *Chu* and *Ryu* are the words of exhortation most common, the latter being the more emphatic. Whistling is in these regions an invariable accessory to all driving, either of horned cattle or sheep, but with the latter animals the noise is incessant and accompanied by the most outlandish guttural sounds, which it would be difficult to imitate with a civilized throat, and quite impossible to represent upon paper.

At 9 p.m., therm.—air, 45°; earth, 9 inches below the surface, 52°.

September 3, *Shelong to Topidhunga*, 13 miles.—At a.m., therm. 44°. To-day we were to cross the first great pass, and here, therefore, we left behind our ordinary servants, and assumed our complete Bhotiya costume.

The road still follows up the same valley, with the same characteristics as yesterday, as far as *Dung*, shortly before reaching which place we passed over the terminal moraines of a small glacier, the ice of which was visible a few hundred feet above us on the right.

Dung, 13,570 feet above the sea, is the name of the halting-places on both sides of the river, near the junction of the stream from the *Lasar* glacier, and that from the *Shikal-gal*, another glacier, up which our road lay. Attempts have been made to establish a route over the *La-sar* (*La*, "pass," *sar*, "new"), which will be seen from the map to lead direct to *Chirchun* and Tibet generally; but the difficulties—glacier crevasses, I think—are said to have been found insurmountable, and the only road now used is that over *Unta-dhura*, which leads up the *Shikal-gal*. The river at *Dung* is crossed by a solid causeway, built on some large masses of rock which have fallen from the cliffs above or have been brought down by the glacier, and which

now form a sort of natural bridge. There are a great number of these fragments of rock near this spot; the majority lie on the right bank of the river, from which they have fallen, but many are found also on the left bank. Good shelter is to be had on the left bank under some of these rocks, which form spacious caves, or, as they are here called, *udyar*. These masses of rock are composed of an impure concretionary limestone, which here forms the upper member of the Lower Silurian series, and I have seen rocks which no doubt form a continuation of the same beds as far nearly as the *Niti* pass.

The present extremity of the *Shikal-gal* is about a quarter of a mile from *Dung*, but there are evident marks of the glacier having formerly extended to that place. The face of the ice at its lower end forms a great precipice, the lateral portions projecting beyond the centre, so as to give it a general concave outline, like the *Gori* glacier. The conchoidal structure is finely exhibited. Keeping to the southern side of the lateral valley we had entered on passing *Dung*, we at once ascended and crossed the glacier. This was done with remarkable ease, the ice being very little crevassed, and its whole surface being entirely covered with broken and disintegrated stones. A tedious and disagreeable ascent along the north moraine, over sharp angular fragments of Silurian limestones and the quartzites that cap them, brought us to a flat-topped knoll of firm ground called *Bompras*, at an elevation of about 14,500 feet, on which we found a few new plants, *Arenaria glandulifera*, *Erigeron alpinum*, and *Lloydia serotina*. Here we left the *Shikal-gal*, and, crossing over a low ridge, came upon another smaller glacier called the *Shetu-gal*, which ends before it can effect a junction with the *Shikal-gal*, into which, therefore, it pours, not ice, but only a small stream of muddy water. *Bompras*, having a little vegetation, is sometimes made a halting-place for parties travelling with sheep. Among the last plants which straggled up to this spot, we found *Carex Lehmanni*, *Saussurea sorocephala*, *Arenaria glandulifera*, and a larkspur, *Delphinium Brunonianum*. The latter, which has a strong smell of musk, is one of the flowers to the poisonous effects of which the hill people attribute the distress caused by the rarefaction of the air at great altitudes.

I may here remark that my own experience leads me to the conclusion that the pains and aches of which travellers complain at great heights, are almost entirely to be placed to the account of the bodily exertions they usually make in their ascent in the rarefied atmosphere. I have always found that so long as I remained at rest, I felt no real inconvenience whatever at any height that I ever reached, up to about 18,400 feet. A very moderate amount of exertion, however, at the greater elevations, is sufficient to bring on violent headache and painful shortness of breath. Above 13,000 or 14,000 feet even, when remaining quite still, I have frequently found myself drawing a long breath, hardly different from sighing, the lungs, I suppose, demanding more air than they could get with their ordinary degree of action. Below 11,000 or 12,000 feet, I am not conscious of ever having noticed anything abnormal in my respiration. During this ascent, by sitting quietly on our jhobus we escaped all inconvenience, though the difficulty of breathing was felt the moment we attempted to exert ourselves by walking up any part of the mountain. The beasts got on wonderfully well, though evidently not by any means insensible to the rarefaction of the air. It is, I presume, from the groans which the yak utters in working its way uphill under such circumstances, that it has received its specific name of *grunntens*; and the jhobu, a hybrid between the yak and Indian cow, inherits this peculiarity.

The morning had been cloudy from the beginning, but before we had got half up the ascent we were in a dense mist, which almost wholly prevented our seeing where we were going, excepting that we had an occasional glimpse of the glaciers

with which we were at times surrounded. We were, however, more fortunate on our return journey, when we saw everything most satisfactorily, otherwise it would have been difficult for me to have said much of this day's journey.

The *Sheta-gal*, or White glacier, is no doubt so called from its general clean appearance. It forms a wide basin-shaped expanse fed by several small tributaries. The mountains rise from it in precipices, the strata being violently shattered and contorted. Along its south-east face the dip is nearly vertical, but otherwise on the whole northerly. The south-east moraine of this glacier is of black slates, I think probably Jurassic, and the strata from which it is derived are perhaps connected with the Jurassic beds that crown the *La-kehr*, a pass a few miles to the east of *Unta-dhura*. The north-west moraine, however, and the ridge beyond it on which is the pass of *Unta-dhura*, are probably Palæozoic, the moraine being chiefly composed of a pale quartzite which caps the Palæozoic beds of this part of the Himalaya. The ridge of *Unta-dhura* is, I think, of the impure limestones already noticed at *Dung*, which occur under these quartzites. On these points, however, there may be some doubt.

Having crossed this glacier, we reached the foot of the final ascent of about 1000 feet which ends in *Unta-dhura*. This is very steep at bottom, and is covered with loose fragments of black slaty limestone, without the least appearance of vegetation on any part of it. There was no snow whatever on the ground on this ascent, nor on the summit of the pass, the immediate approach to which is tolerably easy for some distance.

We reached the top at about 4 p.m., the weather having got gradually worse as the day advanced and as we ascended, till the afternoon closed with a decided fall of sleet and rain, which, though not in any great quantity, was painful in the extreme, owing to the violence of the southerly wind. This was so high that it was impossible to put up the barometers on the crest of the pass, and the attempts I made to get water to boil were for a long time ineffectual, so that we were delayed here till past five o'clock. The cold we experienced on the pass was much more dependent on the wind than on the low temperature of the air, for the whole ground was worked up into soft deep black mud by the feet of the cattle that had lately crossed, and the snow melted as it fell, the thermometer standing at 33°·5. But the quantity of heat lost by the human body in a strong wind, even with external temperatures as high as 45°, is distressingly great, more especially if the air is much rarefied or very dry.

The height of the pass is 17,530 feet. It is at a break in the precipitous face of the mountain that rises from the *Sheta-gal* glacier. The ridge on either side of the pass had patches of snow on it at no great height, and on the northern slope a considerable accumulation of snow remained that extended 200 or 300 feet down, apparently the effect of the drift caused by the southerly diurnal winds that so constantly sweep through the gap in which the pass lies. The snow-line may be estimated to lie a few hundred feet above the pass. From the accounts of former travellers, it would appear that the ridge is hardly free from snow on the south side at the end of May, and that the descent to *Topidhunga* on the north is then chiefly over snow quite to the bottom.

As is so often the case among high mountains, the view from this pass is not very striking, the immediately surrounding heights preventing any distant prospect. The whole scene is one of utter desolation among huge precipitous barren mountains, the strata violently contorted and shattered, with snow and glaciers lying on all sides. Under favourable circumstances there is still, no doubt, much that is grand to be found in such situations, but the mists which hang over the passes of the Himalayan watershed during the summer months, when alone

they can be crossed with safety, give a traveller few opportunities of really seeing where he is going; and the long-continued exposure to the extreme violence of the winds, to which he is almost always subjected on these passes, too often effectually quenches any sparks of enthusiasm which might otherwise have survived an ascent to an elevation of 17,000 or 18,000 feet. This certainly was the case with us now; nor was our descent from *Unta-dhura* made under a happier star. It commenced over filthy mud in a miserably cold wind, with drifting rain and sleet, and ended in darkness, in which we reached our tent at *Topidhunga*, worn out by fatigue and cold, and in a state of extreme wretchedness. Nor were our troubles concluded even then. In such cold and rain, a fire of some sort was an essential to anything like comfort. But the green bushwood soaked with wet, which had been brought for fuel, and nothing else was to be had, filled the tent with such horribly pungent smoke that it was quite intolerable. No approach to a blaze could be made, even with the help of a magnificent pair of bellows, which seemed to form part of the regular equipment of our Bhotiyas, and to have been specially intended to meet such an emergency as the present. We therefore had to put up with a cold and scanty supper, and to prepare our beds on the ground, which was thoroughly saturated with water, and which was not the more sweet or pleasant for having been used, as it seemed to us, as a halting-place for sheep in all past ages. Thus ended our first day painfully enough.

The vegetation recommenced on the north face of the pass, after a descent of about 500 feet, with a cruciferous plant, *Cheiranthus Himalayensis*, *Elsholtzia eriostachys*, var. *pusilla*, and the curious tufted *Thylacospermum rupifragum*, the dense hemispherical cushion-like masses of which, a foot or more in diameter, might easily be mistaken for moss by a casual observer. A few other species were observed as we came down, but in such miserable weather botanizing was not an exciting task, and night soon made it altogether impossible.

On arriving at our halting-ground at *Topidhunga*, we found that a Tibetan of *Kyunglung* on the Satlaj was already there, on his way home from Milam with sheep loaded with grain. Now, as *Kyunglung* was near the place to which we had intended to go in the first instance, and as it was therefore desirable that we should keep out of this man's sight, we decided to halt a day, to let him get on and out of our way.

September 4. Halt at Topidhunga.—After a wretched night, we woke to find our hopes of finer weather doomed to be disappointed, and we passed the day, during the greater part of which it was raining and snowing, in our tents at this place, which has been most deservedly called by other travellers a dismal pit. *Topidhunga* is a small piece of open and level ground about 300 or 400 feet above the *Girithi* river, a stream which, flowing westward, falls into the *Dhaoli* near *Malari*, in Garhwal. It lies at the bottom of a deep gorge between *Unta-dhura* and the *Kyunggar* pass. The elevation, 14,950 feet, is such that the vegetation is only herbaceous. The chief novelties were three gentians, *G. nubigena*, *tenella*, and *squamosa*, all common in this region; *Veronica ciliata*, *Lychnis macrorrhiza*, *Androsace villosa*, *Isopyrum grandiflorum*, *Artemisia biennis*, *Anaphalis nubigena*, *Microgynæcium tibeticum*, **Poa bulbosa*, **pratensis*, and **alpina*. In this neighbourhood, also, was found the only fern seen in these lofty ranges, **Cystopteris fragilis*. Our firewood, obtained from species of juniper and *Lonicera*, was brought from a mile or so down the river. As to outlook, we had almost none, and clouds choked up the gorge nearly all the time we were here. The thermometer varied from 34° to 41° during the day, the snow melting almost immediately it fell.

September 5. Topidhunga to Laptel, 8 miles.—At 8 a.m. at *Topidhunga*, thermometer 37°. To-day we resumed our journey, leaving *Topidhunga* at

9 a.m., and crossing the *Kyungar* pass, the height of which is probably about the same as that of *Unta-dhura*. I unfortunately broke my barometer on the top of the pass, and was therefore unable to make any certain measurement of its height.

The *Girthi* river, which flows in a most savage gorge along the south face of the *Kyungar* ridge, follows a line of dislocation of the strata, which seems to be continuous with that found further to the west along the *Hoti* river. The rocks immediately to the south of this line are Palæozoic, those to the north being Triassic and Rhætic. To the south-east of *Topidhunga*, the line of separation of the formations probably nearly follows the road we had taken, as far as *Dung*, beyond which I have no information. *Girthi* is a deserted village on the stream which is named from it, about halfway between *Topidhunga* and *Malari*, on the *Dhaoli* in Garhwal; near it are said to be lead and copper mines, but they are only occasionally worked, and then on the most insignificant scale. The Government, which possesses the proprietary right in all the mines of these mountains, has, I understand, not often made a larger sum than five rupees per annum from the *Girthi* workings. The ascent to the pass is up a small tributary of the *Girthi* river, and is excessively steep and rugged, lying over or among fragments of the surrounding cliffs of all sizes. The rocks are limestones mixed with black slates, containing fossils, probably Liassic. The strata are wonderfully shattered and disturbed, and some immense sheets of bare rock, dipping at an angle of 45° to the south, were conspicuous objects on our left. The summit of this pass is a long rounded depression between high bare crags. It rises to about 17,500 feet. The ground is covered with small angular fragments of stone without any appearance of soil, and this is commonly the case at these great elevations. There seems to be a transverse rupture of the strata along the ravine up which we came, which is continued through the opposite face of the ridge down to the *Laptel* river, the dip having been in opposite directions on our right and left hand the whole way.

The vegetation on the ascent was very scanty; a few plants were, however, noticed almost to the very top, namely, two Boraginæ, *Eritrichium spathulatum* and *Microula Benthami*; a nettle, *Urtica hyperborea*; and **Taraxacum officinale*, the common dandelion of England. Besides the foregoing, may also be mentioned a *Ranunculus*, common and very varying in size and form, *R. hyperboreus*, *Arabis alpina*, and **Thalictrum minus*. We crossed no snow whatever, except a small bed in a sheltered place at the bottom of the very narrow ravine up which we came, and the mountains with a south exposure were still clear of snow for several hundred feet above the pass. On the north face a large bed, evidently perennial, lay a little below the summit. This is very usually the case on these passes, and a similar patch is often to be seen under the lee of a peak, from the south face of which the violent southerly winds, which, as before observed, almost constantly blow during the afternoon over these passes, sweep all the snow, which consequently drifts into some sheltered place just under the ridge.

The view from the pass, though striking, was not very picturesque. The weather was still cloudy and unpleasant, and *Unta-dhura* looked dismal enough behind us. To the north the prospect was rather more cheerful; patches of sunlight and clouds less dense gave hope that we should enter a more agreeable climate as we advanced. The range of *Balch*, that still lay between us and Tibet, was 10 or 12 miles distant, and seemed almost snowless, though certainly rising above 18,000 feet in altitude. The pass over which we were to go was clearly seen, and in the valley below us lay the halting-ground of *Laptel*, looking brilliantly green, with deep red cliffs (Lower Carboniferous) rising close behind it.

The descent from the pass, the summit of which we reached at half-past eleven,

lay for a mile or two over a long tiresome slope covered with angular loose fragments of rock. After crossing the bed just under the pass, we saw no more snow; nor is there any sign of a glacier to be met with beyond this ridge. Vegetation commenced in rather a languid way about 1000 feet below the pass, the nettle before named and a yellow saxifrage, **Saxifraga Hirculus*, var. *Hirculoides*, being the first plants met with. The grazing-ground of *Kyungar*, which gives its name to the pass, is a little green spot well down the hill at 15,000 feet, on the edge of a stream coming from the eastward, and near it we found three of the characteristic labiate plants of Tibet, *Nepeta tibetica*, *Lamium rhomboideum*, *Dracocephalum heterophyllum*; also *Draba alpina*, growing on the slopes of loose stones, their roots, in the absence of any soil, penetrating deep among the interstices between the fragments.

Beyond *Kyungar* we came upon a small ridge, which, starting up almost in the centre of the great valley that we had followed from the top of the pass, ran on our left straight down to the *Laptel* river, to which we were descending. We here, for the first time, entered the rotten black shales that represent the Jurassic strata in the Himalayau Mesozoic rocks. The hills formed by these crumbling shales are rounded, and covered with small loose fragments, among which exceedingly hard spherical argillaceous nodules are very frequently found, sometimes containing an embedded ammonite or shell, but oftener a nucleus of iron pyrites without any trace of organization. As we continued to descend, our path lay along a small stream which falls into the *Laptel* river, and the vegetation began to improve greatly. Small shrubs again appeared—*Caragana pygmaea*, *Lonicera glauca*, and *Salix sclerophylla*. A geranium, **G. pratense*, a British species, was common, as well as a polygonum, *P. tortuosum*. The leaves of the last-named plant, and of a euphorbia, *E. Stracheyi*, but especially of the latter, had changed their colour into brilliant reds, and formed most conspicuous contrasting objects on the long, steep, and crumbling slopes of the black shale. A blue violet, *Viola kunawarensis*, and *Corydalis Gortschakovii*, were also found on the descent.

Here, too, we first made acquaintance with the Tibetan marmots, *Arctomys bobac*, called *Phiya* by the Bhotiyas, and our sporting friend Bachu managed to shoot two of them. They live in villages, so to speak, twenty or thirty of their burrows being usually found together, at the mouths of which, if come upon very suddenly, they may be seen squatting (precisely as I have since seen the prairie dog doing in the United States), for they disappear underground in a moment when disturbed. Our specimens were in capital condition, and their fat is considered a specific for rheumatism. The Bhotiyas, I was told, sometimes manage to get the marmots out of their holes by turning a stream of water down them.

The *Laptel* river is a good-sized stream flowing over a broad shingle bed, and is seen to issue from a fine gorge half a mile above the point where we crossed it, again disappearing in a similar cleft as far below. Forging the river at an elevation of about 13,700 feet, a short easy ascent brought us to *Laptel* at 13,860 feet, an encamping-ground of the brightest emerald green, the charms of which were heightened by the utterly bare hills all round. The rills of water that flow down these hills seem somewhat capricious in their effects, at one time running over a bare shingly bed, at others giving rise to a most luxuriant growth of small herbage, which, as at *Laptel*, was in places almost a bog. Besides forms before observed, we here found two shrubby plants, *Myricaria germanica* and *Clematis graveolens*, and **Aconitum Napellus*, *Silene Morocroftiana*, *Lychnis brachypetala*, *Cicer soon-garicum*, **Epilobium alpinum*, *Aster tibeticus*, *Lindelofia Benthami*, *Polygonum viviparum*, *Eurotia ceratoides*, *Juncus sphacelatus*, *Carex rigida*, *Allium Jacquemontii*, *Elymus dasystachys*, and *Deschampsia cæspitosa*; also *Gentiana aquatica*.

one of the least showy of the tribe, and everywhere found on the banks of streams at these elevations. *G. tenella* and *Pleurogyne carinthiaca* are also common in similar situations.

We reached *Laptel* about half-past three, and I immediately set to work to restore the barometer, the tube of which had its top knocked off on the pass by a jerk in taking it out of its leather case. I had taken a spare tube already filled in case of accidents, so I soon got this into its place, and I had no more disasters afterwards. The indications of this barometer were corrected by comparisons subsequently made with barometers that had been left at Milam.

September 6. Laptel to Shangcha, 4 miles.—As we wished to let our Huniya friend get a little ahead of us, we made a short march to-day. This was also otherwise desirable to enable us to get over the *Balch* pass, which was now before us, early on the following day before the wind got up. The route the whole way lay over undulating easy ground, often on the black shale, and it was throughout fairly covered with vegetation. Almost the only shrubby plants were **Potentilla fruticosa*, of which there are several well-marked varieties, a *Lonicera*, and the *Caragana*, all of which were common enough, growing perhaps to 2½ feet high, but not more; and the bright blue *Delphinium cœruleum*, another characteristic Tibetan form, began to be conspicuous.

In many places, strewed on the surface of the ground, are seen fragments of ammonites and belemnites, more particularly the latter, which are at times seen in great masses composing almost the whole substance of the rock. Portions of these same Jurassic beds we afterwards found on the very summit of the Lakhur pass, at a height of 18,400 feet.

Shangcha, 14,800 feet, where we halted, is on a stream that flows from the *Balch* pass, past *Laptel*. It is a flat-bottomed narrow ravine, with nothing remarkable in it. The rocks here again become much harder and more craggy, and gave indications of having suffered alteration by the intrusion of the greenstones and porphyries seen in the vicinity. I found no fossils in these strata, and they have perhaps been obliterated. In this sheltered ravine the vegetation was still cheerful, and, in addition to the plants before noticed, we observed *Campanula aristata*, and several European or Siberian forms of *Ranunculus* and *Potentilla* that are very common in Tibet; e.g. *R. pulchellus* and *hyperboreus*, as well as *P. multifida*, *sericea*, and **anserina*. The fern **Cystopteris fragilis*, the only one of these regions, was also seen in cracks in the rocks.

On one of the hills above, as we went along, we saw for the first time three or four of the wild asses, *Asinus* or *Equus Kiang*, Tib. "Kyang." These animals are so common in the open plain of Guge, that the landscape is hardly complete without one. An attempt of our friend Bachu to get near enough to them for a shot proved futile on this occasion, as on every other during our expedition. He was, however, more fortunate in his attentions to two wild sheep, *Ovis Burrhel*, or *Nahura*, Hind. *Barhal*, Tib. *Sna*, which he managed to bring down; though a third, which was discovered later in the evening on the cliffs over our heads, managed to escape in spite of the scientific stalking of our Bhotiya sportsman, whose operations we watched in inglorious ease, sitting in front of our tent.

Having secured the skins of the barhal, our retainers made a more serious attack on the remains of the slaughtered sheep, concluding their operations with a manufacture of sausages, the details of which may be left to the imagination of the reader. A fine warm evening ushered in a feast which made grand havoc with the game, though our *chef de cuisine* providently reserved certain legs and loins for our special consumption, and we found the barhal, though cooked à la Bhotiya, very good.

My friend Mr. W., who had been somewhat upset by the effects of the cold on *Unta-dhura*, was still suffering a little; but matters were clearly mending, and our anticipations of better luck were not doomed to be disappointed. The thermometer at 9 p.m. was 36°·7.

September 7. Shangcha to Tisum, 13 miles.—As it was always necessary for us to eat our morning meal before we started, we never got off much before eight o'clock. To-day we began to ascend almost immediately over a steep mountain face, if possible more than usually barren, and we reached the summit of *Balch* pass a little before ten o'clock. In the stream of *Shangcha* I had seen a good many pebbles of greenstones, and I was therefore not surprised to find this rock soon appear *in situ*. It forms, indeed, the summit of the *Balch* ridge, the peaks of which rise, as I have said, to upwards of 18,000 feet. The rocks through which these eruptive rocks are intruded are of Cretaceous age. There were a few patches of snow lying about, but this range hardly comes within the limits of perpetual snow. Phænogamous vegetation exists to the very summit, within a few feet of which we found a pretty little composite plant (*Allardia tomentosa*), growing freely on the rock on which I hung up the barometer. Here also we found two species of *Saussures*, so numerous at these elevations, *S. Hookeri* and *bracteata*, *Nepeta longibracteata*, and *Arenaria musciformis*. The wind was already blowing too hard to permit of a halt on the actual crest of the pass. On the rocks exposed to the south were very curious incrustations of ice, icicles indeed, but standing out horizontally like fingers towards the wind. I was not able to understand how they were caused, nor can I tell why they were confined to particular spots. The thermometer stood at 41°, and though the dew-point at the time would probably have been below 32°, and the cold produced by evaporation sufficient therefore to freeze water, yet it is evident that no condensation could ever take place simultaneously with the evaporation. I am afraid that I did not pay sufficient attention to the facts of the case at the time to be able to say more about this apparent puzzle, but I think that I afterwards saw something of the same sort on beds of snow under *Unta-dhura* pass and on the *Milam* glacier. The circumstances of these icicles being noticed by Captain Weller on the *Balch* pass several years before my visit, shows that they are not the result of mere accident. [It has since occurred to me that these icicles were caused by radiation. I found subsequently, in a somewhat similar position, that a thermometer suspended vertically, and simply exposed to the sky in front of it, was depressed as much as 20° Fahr. below the true temperature of the surrounding air. This result was, of course, due to the radiation through the extremely dry and rarefied atmosphere at the great elevation at which the thermometer was exposed. As radiation takes place freely from a surface of ice, the growth of such icicles as those described might be due to the condensation of vapour brought up by the southerly day winds that so constantly blow over these passes, and its accumulation in the form of ice on the exposed extremity of the icicle, the temperature of which might thus have been greatly reduced.]

From the *Balch* pass, 17,490 feet, we looked down over the part of Tibet we were about to enter. The view was somewhat restricted by the projecting points of the mountains on which we stood, and the distance was obscured by clouds, but we naturally looked with great interest at what lay before us. The plain of *Guge*, which we afterwards found to be, as indeed we had expected, much more extensive than it appeared from this point of view, was so much broken up by small ranges of hill and ravines as not to be very striking as a plain, and though its general barren, brown, and red tints certainly looked warm and comfortable from the pass, where we were shivering with cold, they did not otherwise give promise of much either in a botanical or picturesque point of view. A distant line of blue

mountains having an ordinary serrated outline, and a confusion of clouds over them, with very few snowy peaks visible, looked on the whole rather commonplace. It will be seen, however, from the map, that our position was particularly unfavourable for a general view of the country—such, for instance, as I afterwards had from the top of *Lanjar* peak, near the Niti pass.

On the descent, within 500 feet of the summit, or at an elevation of about 17,000 feet, the vegetation had reappeared pretty freely, and by the side of a small stream, which to the north of the Indian watershed is an essential for any approach to vigorous vegetation, we found several new plants. A large flowered gentian, *G. nubigena*; *Draba lasiophylla*, a form closely allied to *D. stellata* of the Alps; three or four species of *Pedicularis*, *P. versicolor*, *rhinanthoides*, and *cheilanthifolia*; some grasses, including *Avena subspicata* and *Deschampsia cespitosa*, and *Carex ustulata*.

Having reached the *Jankum* river, which lies at the foot of the descent, we crossed it, and, ascending its steep bank, at length emerged upon the plain of *Guge*.



PLAIN OF GUGE, IN WESTERN TIBET, 15,000 TO 16,000 FEET.

The margin of the plain immediately in contact with the outer ranges which constitute the Indian watershed is about 16,500 feet above the sea, and was hence sufficiently elevated above the central parts, which perhaps average 15,000 feet, to enable us to see well over the whole surface. We now, too, caught a partial glimpse of the great snowy peak of *Kailas*, which rises to a height of very nearly 22,000 feet. Heavy clouds were hanging over the distant ranges, and here and there rain was seen to be falling. The sunshine and dark shadows intermixed made it difficult to seize upon the arrangements of the ridges, or to judge of their distances. The plain appeared to be perfectly flat and open for nearly 10 miles to the north, with small ranges of hill here and there rising sharply from it, while it ended abruptly on the south on the flanks of the mountains under which we stood. The *Jankum* river ran straight before us, cutting out a huge furrow from the plain, nearly in a direct line, its sides sloping at an angle of about 45°, and almost as even as a railway cutting. Other smaller ravines were seen to originate near us, and deepening as they went at length to unite with the larger one just mentioned.

Down one of these our road led us, and, following its course, we at length reached a halting-ground called *Tisum*, near the junction of the *Chaldu* ravine with that of *Jankum*. It had been intended that we should halt on the *Mamin* ravine before reaching that of *Chaldu*, but there was no water in it, so we had to go on.

The sections of the plain here made by these ravines, to a depth of 200 or 300 feet, showed that it was a great deposit of gravel or boulders, the magnitude of the stones varying from a moderate-sized boulder, a foot or two in diameter, to fine sand. The beds were laid out horizontally, or rather parallel to the surface of the ground, for the plain has a strong fall towards the *Sattaj*. The surface was generally very even, the stones being, with few exceptions, embedded in the soil, which was everywhere scored over with depressions, something similar to those seen on mud when drying, but less definite, probably arising from the draining off of the water as the snow, with which the surface must be covered in the winter, melts away. Stunted bushes of *Caragana*, the *Dama* of the Bhotiyas, or *Trama* of Tibet, and tufts of the half-shrubby *Eurotia ceratoides* hardly exceeding a foot in height, were sparingly scattered over the ground, mixed with a few grasses, *Artemisia*, *Allium*, *Larkspur*, and *Potentilla*; but I estimated that not one-tenth of the surface was covered by these plants near the Himalaya, where the vegetation was most vigorous, while further on the proportion did not probably exceed one-twentieth. The alluvial plain, indeed, is nearly an absolute desert, and it is only near the streams at the bottom of the ravines that habitations are to be met with. The footprints and other signs of the *Kyang* are to be seen in greater or less abundance on all parts of this plain, and it is possible that these animals are more numerous here in spring, for at the time of our visit there was hardly anything for them either to eat or drink. In one or two places we saw their bones lying in the ravines, to the seclusion of which, I suppose, they had retired to perish.

Tisum is the name applied to three halting-places, within a mile or so of one another, near the junctions of the *Jankum*, *Mamin*, and *Chaldu* ravines, and we were told by our Bhotiyas that it was derived from the two words of the Hindu and Tibetan languages, both of which mean "three," viz. *ti* and *sum*. A more probable etymology, however, is that the name is a compound of *ti*, which in the Kunaori-Tibetan dialect means "river," and *sum*, meaning "three." But all such etymologies may be looked on with suspicion. It should, however, be said that *sum-do* is the regular Tibetan term for a junction of two ravines where a flat space suitable for villages or encamping is usually met with, and it will be seen that this word also has *sum* or "three" in it, no doubt from the three portions of alluvial ground at the junction of two streams.

At 9 p.m. the thermometer was no lower than 45°, though *Tisum* is 14,690 feet above the sea; but the night was cloudy.

(To be continued.)

THE LIVINGSTONE EXHIBITION.

UNDER this name, Dr. Harford Battersby, of the Livingstone Missionary College, organized an exhibition of travellers' equipments and health requisites in the St. Martin's Town Hall, which was open to the public from January 1 to January 5. The exhibition was divided into two parts, the first consisting of relics of Dr. Livingstone and of other travellers, and the second of trade exhibits shown by some of the leading equipment and food-preserving firms.

in the early years of the eighth century; occupied the Indus valley; stamped out the remnants of Greek influence, and imposed a dynasty (or succession of dynasties) on Multan which lasted for three centuries. They entered by a route which is not at all coincident with that followed by Alexander in his disastrous retreat to Persia. The latter is not well shown in the illustrative map at p. 288, for it fails to give point to one of Alexander's great strategical blunders, viz. that of attempting to make his army a base of supply for his fleet. Another blunder was his selection of a route the geography of which was unknown to him. As far as Makran he had had Greek pioneers to guide him, but here he made geographical assumptions, which, like all such assumptions, led to certain grief.

Mr. Maguire's book is a most useful work of reference both to the military student and the public at large. It is packed full of "wise saws and modern" (as well as ancient) "instances" from end to end of its 350 pages, and it possesses an excellent index. If we echo Sherman's cry for an atlas in further and fuller illustration of the geographical references, it is with the admission that it would be quite impossible to introduce anything like complete map illustration of so comprehensive a strategical survey within reasonable limits of space.

NARRATIVE OF A JOURNEY TO THE LAKES RAKAS-TAL AND MANASAROWAR, IN WESTERN TIBET, UNDERTAKEN IN SEPTEMBER, 1848.*

By Lieut.-General Sir RICHARD STRACHEY, R.E., G.C.S.I., F.R.S.

September 8. Halt at Tisum.—The thermometer, which at 6 a.m. stood at 30°·8, rose by nine o'clock to 54°, and at ten o'clock to 67°, after which the wind got up, and it became rather cloudy. It may be conceived that a change in the temperature of the air such as this, of 36° in four hours, was rather unpleasant. Inside the small black yak-hair tents used by the Tibetans, however, the change is still greater than this, and I have seen a difference of 42 degrees between 5 a.m. and 1.30, and that at an elevation of 18,400 feet.

As W. was still unwell, we halted to-day to give him a rest, and I went out in the afternoon to do something in the way of survey. I started off nearly south from Tisum, on the plain between the *Chaldu* and *Chirchun* rivers, and at a distance of about 4 miles came to a slight rising ground, from which I got a sight of the great snowy mass south of the *Manasarowar* lake, marked in our map as *Gurla*, the summits of which range from 21,800 to 25,000 feet. It was a good deal covered up in clouds, but still enough could be made out to see that it was a grand mountain. The Juharis called it *Mandhata*, after the name of a personage in the *Mahabarat*, but I don't think they could produce any authority for doing so. From

* Continued from p. 170. Map, p. 204.

the place where I stood, looking to the north, snowy peaks were seen in only two or three directions, and those were very distant, possibly none of them being within 150 miles. To the south-west was the *Balch* range, with very little snow upon it; everything beyond it was quite concealed by clouds. The plain, over which I looked for some 10 miles, appeared of a uniform pale brownish-yellow tint; the hills that rose from it inclined to shales of red, and the effect was anything but cheerful. The only sign of animal-life that I observed in this desert was a large cricket, *Gryllus*, with blue wings, that took short flights, making a peculiar quick, sharp chirrup as he went. Early in the morning, however, wolves had been heard, apparently hunting somewhere near our tents, and a young hare was run down in the course of the day by two of our men. During my absence, Winterbottom, in examining closely the herbage near our tent, found one or two novelties, and among them a curious little leguminous plant, with a remarkable four-cornered and winged prickly pod, which proves to be a new genus near *Eversmannia*. Mr. Bentham named it after me—*Strachaya Tibetica*, the real discoverer, W., having positively declined to allow his name to be perpetuated in such a way. Among the other new plants here met with may be mentioned the following: *Alyssum canescens*, * *Stellaria graminea*, * *Potentilla anserina*, *Saussurea glanduligera*, *Crepis glomerata*, *Parnassia ovata*, *Scopolia procerata*, * *Salsola kali*; and a few grasses—*Stipa purpurea*, *orientalis*, and *sibirica*, *Festuca valesiaca*, *nitidula*, and *sibirica*, *Elymus sibiricus*.

A little excitement was produced at our camp early in the day by the report of the approach of a party of travellers. They turned out to be only some Juhari Bhotiyas returning home from *Kyunglung*, at which place our friend of *Topidhunga* had arrived, and had reported our intended visit to *Hundes*. But there had been no definite knowledge of our actual presence in Tibet. The chief civil authority of the place, the *Kharpun*, they told us, viewed the report with much philosophy; the entrance of foreigners into Tibet was notoriously prohibited, and what more was wanted to satisfy the Justice Shallow of *Kyunglung* that our threatened invasion was impossible? We took the opportunity of sending back letters to Kumaon by these Bhotiyas.

At night, 9 p.m., the thermometer was at 36°·5.

September 9. *Tisum to the Satlaj*, 15 miles.—The morning was cloudy; at 6 a.m. the thermometer was at 40°·5, and it rose nearly to 50° at 8 a.m. Our route lay down the *Jankum* river to the grazing or encamping ground called *Shib-chilam*, the ravine gradually getting deeper as we went on, till at that place, where the *Chirchun* river joins it, the bank is some 300 feet high, forming a steep cliff cut up into singular shapes, looking like ruins of towers and Gothic buildings. The deposits of gravel and sand, of which the plain was composed, might here be seen resting nearly horizontally on schist or shale, black and very rotten, that dipped at a highish angle to the north-west. These rocks are cretaceous, or possibly nummulitic. Between the two rivers, *Jankum* and *Chirchun*, on a tongue of land which hardly rose 100 feet above the water, were the remains of a village which had once existed here. Close by, also, the high-road from *Daba* to *Kyunglung* crosses the united streams by a bridge, said to have been built by a Juhari. On the opposite bank a cave was pointed out to us, where a man exercising the functions of a rural policeman was said to be posted by the *Kyunglung* authorities. These caves—for there are many of them in the alluvial banks—are commonly used as winter residences and storehouses by the nomadic Huniyas. A robbery was said to have taken place the year before of goods and chattels deposited in one of these caves, and to prevent the repetition of such outrages, the policeman had been posted here. During the whole of our journey we were continually hearing of

certain gangs of robbers, said to prowl over these parts of Tibet, and known by the Bhotiyas under the name of *Khampa*. This name, which appears at first to mean simply a man of the province of *Kham*, is, my brother, Captain Henry Strachey, informs us, an ignorant corruption of the word *Kyampo*, which signifies "nomad," and is applied by civilized Tibetans to the wilder races that exist along the northern part of the tableland abreast of the provinces of *Nari* and *Utsang*. Our Juharis were in constant terror of these marauders, who plunder tents and carry off cattle, when they dare, and we were told that some of them had just robbed a Bhotiya or Kumaon at *Darchin*. I received also long details of a raid made by the *Kyampo* two years back, on cattle belonging to the people of *Dungpu*, a village about 20 miles west from *Shib-chilam*. To avenge this, a considerable party of Juharis, who happened to be near at hand, combined with the villagers to hunt down the robbers, whom they appear to have treated as so many wolves, firing upon them without the least compunction. Five or six *Kyampo* were killed, some being shot in the capture by the Juharis, and the rest being summarily disposed of by the Huniyas, to whom such prisoners as were taken were made over by their allies. One or two of our party were present on this occasion, and evidently considered it rather good sport. The Juharis several times repeated to me that in *Hundes* the life of a man is looked upon as about of as much importance as that of a goat; their own civilization is sufficiently advanced to make the difference perceptible.

The constituted Tibetan authorities do not seem much superior to their subjects in matters of this sort, and I was told that one of their regular modes of execution was to smash with a sledge-hammer the thigh-bones of their prisoners, who were so left to die. In this manner, it is said, they murdered an officer of Golas Sing's *Dogra* army that invaded this part of *Nari*. When beleaguered in the Sikh fort at *Kardam*, he foolishly went out to treat with the besieging Tibetan force, when he was instantly seized and treated as I have said, though, with exceptional politeness, they ended by cutting off his head, a distinction not bestowed on ordinary culprits, who are left to perish as they may. No one will be surprised to hear that this brutal treachery and cruelty is accompanied by the basest cowardice.

In the valley down which we had come the vegetation was meagre, but I mention as deserving of notice, **Salsola Kali* and **Triglochin palustre*. This *Triglochin* I afterwards found again at *Hoti*, growing with **Triglochin maritimum* also at an elevation of about 15,000 feet. In addition to these plants, I should mention as being found in other parts of Tibet, and often associated with salt plants, *Salsola*, *Eurotia*, and the *Triglochins* already mentioned, a *Crambe*, *C. Cordifolia*, not greatly differing from *Crambe maritimum*, and *Glauz muritima*. With these are commonly seen many common northern forms of *Potentilla*, *Ranunculus*, etc., so that, strange as it may appear, we here often have at these great elevations, and in the middle of the continent of Asia, an assemblage of plants which may any day be found growing together on the sea-coasts of Northern Europe. It has been suggested with some reason that this curious feature of the Tibetan flora may be attributed to the immigration of the saline types of the Caspian. But considering that a coast-line certainly existed along the northern base of the Himalaya as late as the Cretaceous period, and the probability of the alluvial deposits of Tibet having been originally laid out beneath the ocean, it is not a very wild speculation to suppose that this marine flora may have been diffused along a former coast-line in the past ages of the Earth, and subsequently raised, by the general elevation of the surface, to its present position.

Early in the morning we had sent on two men as videttes to see that the high-road, which we here had to cross, was clear; on arrival at *Shib-chilam*, they reported that a beggar with a few goats constituted the only danger visible, so, he having been

voted contemptible, we proceeded to cross the *Chirchun* river. The water is muddy and dark-coloured, partly perhaps from its rising in glaciers, but partly also from the rotten black shale which here forms its bed. Having forded the stream, we ascended the high bank and again stood on the surface of the great plateau, which was here somewhat narrowly circumscribed by hills of bold outline. The road, or rather track, to *Kyunglung*, which place was now about 12 miles distant, could be seen for a mile or two in a north-easterly direction over the plain, and then, entering the hills, was lost to us. On the west we saw the track to *Dungpu* to a somewhat greater distance, winding between two low rounded lines of hills, the northern of which abuts on the *Chirchun* river near *Shib-chitam*.



TIBETAN BEGGARS.

Judging from their deep red colour, these ridges may probably be composed of igneous rocks, which are abundant in many parts of *Guge*. The bed of the *Satlaj* was not yet visible, but some low ranges due north of us were pointed out, some of which, we were told, lay on this side, and some on the other side of that river. The coast seeming to be clear, we kept on down the *Kyunglung* road, but before we had got far the alarm was given of a party of strangers coming towards us. An attempt to make out more exactly what they were with a telescope proved fruitless, in consequence of the mirage or haze, which utterly distorted all distant objects seen over the surface of the ground, for the sun was already beginning to show himself in earnest. After some consultation, during which we were quickly

approaching the strangers, our people, influenced no doubt by their wishes, declared that they must be Bhotiyas, and not Tibetans, since some of them had on white clothes, which shone out brilliantly in the sun, whereas the habitual dress of the Tibetans is of a dark colour, either naturally or with intense dirt. So we went without hesitation, but to the horror of every one, when it was too late to get out of their way, they turned out to be a party of Huniyas. W. and I instantly tried to sneak off unobserved down a ravine near which we were moving, but the effort was evidently futile. The enemy, however, was plainly not dangerous in point of numbers, the party consisting only of two; so our people, having nearly ten to one in their favour, went on to meet them with great heroism. We soon saw that an amicable arrangement had been come to, and the combined forces, after a short conversation, came to the spot where we had posted ourselves. The Tibetans were two inhabitants of *Dungpu*, one dressed in white, one in black, with square-cut caps, Tartar physiognomy, very dark complexions, and long pigtailed, and were well known to our people. They approached us making many polite bows, and, taking off their caps, presented the cloth of ceremony, as was becoming from inferiors to superiors. This is a form which is universal in Tibet, and extends into China, though I do not remember ever to have heard an explanation of the custom. The cloth we received was of cotton, badly woven, but of a fine texture, about the size of a small handkerchief, but so dirty as to show that it had frequently performed similar offices of civility before. The more wealthy classes employ silk instead of cotton cloths, the legend, "*Om mane padme hum*," being commonly woven in damask at each end. The sale of these cloths of ceremony, I was given to understand, constituted a Government monopoly in this part of Tibet. I made out that the strangers felt, or affected to feel, great alarm at having seen us, fearing the vengeance of their rulers, should it be discovered that they had become accessories to our felonious inroad into Tibet. They seemed, however, to have a preponderating respect for our friends the Juharis, with whom they had commercial dealings, and in whose favour the balances of trade were said now to be rather heavy. They were, in short, poor creatures who evidently were neither capable nor desirous of doing us any harm, or of opposing our advance; and after some talk they showed us how we might go straight down to the *Satlaj*, by a ravine near the head of which we then were, and so get out of the public road and at once avoid all risk of further notice. Assurances that they had only to keep their own secret, and a few rupees which we gave them, soothed them considerably, and we parted excellent friends. Before they left, however, we heard from them that nothing was known of us at *Kyunlung*, beyond the old reports that we were coming.

At 2.30 p.m. we stopped at the head of the ravine down which we were to go to the *Satlaj*, to put up the barometer, and the surface of the plain here proved to be 14,820 feet above the sea. The thermometer was 53°, but slight rain was falling, a storm accompanied by a strong wind having just swept longitudinally over the plain from west to east. The sun had been very hot in the morning, and the usual wind from the south hardly blew, which the Bhotiyas told us was a sign of rain. We here found growing on the dry surface of the plain, which was as barren as ever, *Chamaerhodos sabulosa*, a Siberian plant; and an aster, *A. molliusculus*, with a rather handsome purple flower, was also common. A few more grasses were also seen, *Deyeuxia compacta*, *Stipa Eversii*, and *mongholica*, *Oryzopsis æquiglumis*, *Lasiogrostis mongholica*.

The ravine we followed took us gradually down among more vigorous vegetation, and some hares and partridges that we saw showed that the locality was better suited to support animal-life also. The partridge is, I believe, the same species (*Perdix Chukar*) common in the lower parts of the outer Himalaya, and in Kumaon

called *Chloro*, but why he should wander here in a climate so very different is more than I can say. Our people immediately set to work, and without difficulty ran down three of these lakes, which I understand are common throughout Tibet. The lake, *Lepus Z. medius*, is less frequently seen all over the plain of Gase, being probably the most common of the creatures we observed. It is remarkable for its white tail, and its small habit of swimming close to the bottom channel.

In passing along the ravine, I noticed that in the proximity of calcareous rocks that were seen to underlie the alluvial deposits of which the plain is composed, the boulders, gravels, and sands are frequently cemented together by carbonate of lime,



EVER SATAN AT CAMP OF SEPTEMBER 9 (LOOKING EAST). ELEVATION, 13,350.

forming a thoroughly solid rock. This appeared to be precisely the same as the matrix which may often be noticed adhering to the mammalian fossil remains that are brought from these regions, and there can be little doubt that it is from some parts of the finer of these conglomerates that the fossils have been obtained. In the conglomerates, caves such as I have already mentioned are likewise common.

As we continued to descend, the horizontal alluvial beds were at length again seen to rest on shales and shaly limestones, which dipped at a high angle most commonly to the north-west, but much shattered and varying considerably in their precise dip and strike. The ravine, which had at first been straight, open, and with smooth sloping banks, now that it entered the solid rock, became much

narrower and more tortuous, and ended in an extremely narrow gorge with highish cliffs on either side, from which we had the satisfaction to emerge at about half-past four, on the edge of the *Satlaj*, close to which we encamped.

The spot on which we had thus almost stumbled was rather singular. The river flowed in a beautiful clear blue stream, in a deep and narrow bed, from the banks of which nothing was to be seen but the black shaly cliffs immediately overhead. The upper end of the gorge from which the river issued, seemed at first quite blocked up, but a closer examination showed a rent hardly exceeding 15 feet in breadth, through which the water came with a current that was hardly perceptible, proving the great depth of the channel, for the stream within 20 or 30 yards of its point of issue was already a sparkling rapid, some hundred yards wide, and by no means easy to ford. I thought I saw something like a trap dyke among



SATLAJ RIVER GORGE, ELEVATION 13,350 FEET (CAMP OF SEPTEMBER 9, LOOKING WEST).

the rocks in this chasm, but they were so steep that it was impossible to get at them. On examining the boulders and pebbles in the river, I found that the great majority were of the slates and calcareous rocks of the vicinity, but that a notable proportion were composed of porphyries, only one or two specimens of granite being seen. Similar porphyries have been brought to me from *Sansurga*, on the affluent of the Indus that passes *Gar*, and it is therefore probable that some at least of the intermediate mountains are composed of these rocks, a supposition which is rendered more probable by the fiery red colour of the surface which was remarked by Moorcroft, and which is confirmed by the accounts of the Bhotiyas, who are in the habit of going to the fair at *Gar*.

In the shales near the *Satlaj* I also found an *Ammonite* and *Inoceramus*, showing that these strata are either Jurassic or Cretaceous. We had here descended to 13,350 feet, the lowest point we reached during our expedition, and the vegetation was more cheerful, though still not much to boast of. The largest shrub was *Myricaria elegans*, a plant closely allied to the tamarisk, here growing to a height

of 5 or 6 feet, with stems often 3 or 4 inches in diameter. The *dama* (*Oaragana pygmaea*) was more luxuriant than usual, rising to 3 feet or more. We here also found *Clematis graveolens*, greatly resembling *C. Flammula*; *Crepis glauca*, very like a form of the Altai mountains; two species of *Tanacetum*, *T. gracile* and *alternisoides*; and several species of *Artemisia*, or worm wood, a genus largely developed in Tibet, of which may be mentioned *A. sacrorum*, *salsoloides*, and *Roxburghiana*; also *Christolea crassifolia*, a cruciferous plant which might have been added to the list of saline types before given.

We found our encampment on the Satlaj, after the discomforts of the preceding days, quite luxurious. The *Myricaria*, which they told us was abundant at *Gar*, also gave us admirable firewood, an article in which we were speedily becoming connoisseurs, while we were greatly sheltered from the wind, and quite concealed from inquisitive Tibetans.

September 10. From the *Satlaj* to *Ligchephu*, or *Likstephu*, 16 miles.—Thermometer at 5.30 a.m., 36°4. Having thus happily accomplished the first part of our projected expedition by reaching the *Satlaj* without interruption, we now turned off eastward towards the lakes.

As we started to-day, a stray yak was seen on the hillside just over our tents; it was forthwith taken possession of, according to the custom of these parts. The owner, if he is discovered, gets the animal again by paying half its value, and I afterwards heard that this happened in the present instance.

From the bank of the *Satlaj* we at once climbed to the level of the plain, but, among the low limestone hills by which we found ourselves surrounded, the presence of any alluvial deposit was a little doubtful. The vegetation became as scanty as before. From this position we had a fine view of the Himalayan peaks to the south-west. The morning was splendidly clear, and there was not a speck of cloud to be seen. The mountains at the head of the *Milam* glacier, and *Kamet* with its dependencies, came out very finely. Two other very distant peaks were also noted, almost directly down the course of the *Satlaj*, probably *Porgyul*, rather more than 100 miles off, opposite to which this river makes its great bend to the south. We continued for some time among low hills, and saw many *barhal*. As we were now again approaching the *Kyunglung* road, it was necessary to be more careful in our proceedings than on the previous day. The village of *Kyunglung* was not visible from our road, as it lay among the ravines near the *Satlaj*; but, understanding that it was one of the highest places in Tibet where crops of grain are produced, we sent a man round to pluck some barley from the fields. He returned to our camp in the evening with several ears nearly ripe. This grain, *Hordeum vulgare*, is the variety, *H. nudum*, the spikelets in two ranks, and grain not awned. He also brought some curious concretionary pebbles, evidently formed from fine shingle encrusted with concentric layers of carbonate of lime, derived from the water of a hot spring that issues from the south bank of the *Satlaj* opposite *Kyunglung*. These little pebbles are of all sizes, from that of a pea to a pin's head. They were quite separate one from another, though in a second hot spring at *Tirthapuri*, on the *Satlaj*, some miles higher up the river, a compact rock is formed by the agglomeration of similar pisiform spheres. In the *Tirthapuri* rock, specimens of which are often brought away as curiosities by the *Bhotiyas* who visit the place, the grains are very uniform in their dimensions, much more so than the *Kyunglung* pebbles. Both these springs are said to be very hot, that at *Tirthapuri* the hottest, so that it is disagreeable to put one's hand in it. The *Kyunglung* spring, from the accounts given of it—and it is noticed by *Moorcroft* at some length—is no doubt charged with sulphuretted hydrogen, the offensive smell of that gas affording an easy means of recognizing it. I should add that the water of

this spring, besides coating the pebbles as above explained, forms a large bed of tufaceous limestone, which is remarkable for its pure white colour and its friable texture.

Our route now lay over very uninteresting, undulating ground, dry and barren in the extreme; there was no road or even track, and the sun meanwhile was getting intensely hot. We halted about noon to rest the cattle at a place called *Gam*, where there was a small spring, and sought in vain for some shelter among the stunted bushes or rocks, none of which, however, rose high enough to afford even a little shade for our heads. The exposure during the heat of the day had by this time completed the removal of the skin from our faces. The extreme dryness of the air, and the cold winds, combine with the intense power of the sun to produce this effect, which is exhibited on the blackened faces of the Tibetans themselves, the poorer classes of whom are nearly as dark as the natives of the plains of Northern India. All about the halting-ground at *Gam* were many small pillars, built of dry stone, which we were told were erected by the Huniya shepherds to scare away the wolves and leopards from their flocks. The last-named animal is the ounce, *Felis uncia*. He is characterized by his long tail and the obscure markings of his skin, which is of a dull ash-grey colour. He is not uncommon in Tibet generally, and descends as low as 10,000 feet among the Himalayan valleys, and, it is said, often makes much havoc among the sheep. The wolf, called *shang* by the Tibetans, and the same species, I believe, as the wolf of Europe, offers curious example of the reappearance in the open regions of the Tibetan plateau of an animal which, although quite unknown on the wooded slopes of the Himalaya, is very common in the plains of North-Western India, and shows how the conditions of surface affect the development of animal-life, no less strongly than those of climate and temperature.

On leaving *Gam*, we gradually ascended. I set up the barometer on one of the highest parts of the ridge, 15,940 feet, which we crossed on our way from the *Satlaj* to *Ligchephu*, and while so employed was overtaken by a violent hailstorm accompanied by thunder and lightning. We saw this storm, like that of the previous day, driving up from the west, looking very black, and it passed on over us towards the lakes. The regular south wind had been wanting to-day also, and this had no doubt made the sun's power seem to us so excessive. During this storm the temperature of the air was not below 46°.

We now began to descend towards the foot of the hills which here separate the *Satlaj* from the great plain of *Guge*. Our route first lay over a flat piece of ground, which looked like a portion of the alluvial deposits of the plain that had been pushed up a few hundred feet more than the rest.

The halting-ground—for it is nothing more—called *Ligchephu*, soon became visible, marked only by a patch of green, under some limestone cliffs at the edge of the great barren plateau below us, while some small pools of water beyond it showed the position of the river by which we were to halt. We reached our camp at about 6 p.m.; it was pitched near the half-dried-up river-bed, on ground which, though now dry, looked as if it were at times swampy, or even altogether under water.

The evening was very fine, and the setting sun lighted up the mountains on the east and south-east most brilliantly, showing us very distinctly the towers at the place called *Lama-Chorten*, distant about 15 miles across the plain, close to which my brother passed on his visit to the lakes in 1846. *Lama-chorten* is the first halting-ground in the open plain of *Guge* on the way into Tibet from the Himalayan valley of *Darma* and *Byans*, by the passes of *Kach*, *Nyue*, and *Lankpya-lekh*. The buildings called *chorten* or *choktan* by the Tibetans are votive edifices, which are described by my brother as "little towers of dry stone, stuck

about with dogs." These particular customs, I was told, are even in the married women of *Thorma* as a wife inflicting air their husbands' absence from their travels in Tibet, and it is a common joke that the young married women also set up their husbands in hopes of getting husbands in whom they take a similar interest. It may here be mentioned that the people of *Sera-tai Nyuns* are so Tibetan that they have not adopted the Hindu customs of widow, which, however, prevail to a great extent amongst their neighbours of *Jair*. The girls of *Thorma*, accordingly, instead of being betrothed and finally disposed when more children are born amongst all they are grown up, when their parents are more or less considered.

The night of these observations, which they were enabled to see distinctly by help of a telescope, greatly amused the men instructed of our *Bhotiyas*, and they talked of it for days afterwards.

This day had been particularly barren of botanical interest, not a single variety being added to our list. The elevation of *Ligchepla* is 14,950 feet. At 922. thermometer in the air, 44° in the shade with the help of the fire, 58°. The *Hygnum* will show the effect of the fire. In general we managed to keep the temperature inside about ten degrees above that of the external air, but only so long as the fire was burning, and in the morning there was generally but little difference of temperature between the inside and outside until the sun rose.

September 11, *Ligchepla* to the *Gunda* *Yarab*. 5 miles.—At *Ligchepla* it is about 11 a.m., thermometer 25° at 7 a.m. air 33° earth, a foot below surface, 60°. The river at *Ligchepla* is the *Chu-naka* or Black river. The part of it which will be seen from the map is being suddenly back below this place, being nearly in an opposite direction to its previous course. It is locally called *Bipha* *Kha* a name meaning "contrary to way" and the *Bipha* *Kha*, therefore, is not a distinct stream, as was supposed by my accident. There is a great difference between the rivers in the eastern part of *Gya*, from the *Chu-naka* inclusive, and those in the west. The latter all flow in deep ravines, the depression of which below the surface is often exceedingly great. The beds of the eastern rivers, on the other hand, are all shallow, and not sunk more than 25 feet or so below the general level of the plain. This difference, which gives a totally different aspect of the two ends of the plateau, is readily explained by reference to the gradually increasing depth of the bed of the *Saltaj* as it flows westward, combined with the circumstance of the channels both of the minor streams and of the *Saltaj* itself being more in solid rock in the eastern parts of the plain, and more in unconsolidated alluvial matter in the west, where the thickness of these deposits is very much greater. The *Chu-naka* was at this season but a small stream, broken up into several different channels, all very shallow, and evidently considerably sinking their positions.

Leaving *Ligchepla* behind us, but still having on our left, at a distance of a mile or two, the hills from which we had descended the evening before, we forded the river and struck across the plain. Its surface was almost perfectly level, covered with small shingle, and having quite the appearance of a dried-up lake. This continued with no variation to the *Gunda* *Yarab*, a stream somewhat larger than the *Chu-naka*, with a bed 200 yards wide, its water also flowing in several different channels, and sunk about 25 feet below the plain. This section shows nothing but gravel, finer, however, than that seen in the larger ravines near *Shawa*. On the banks of this stream grows a small *Hippophae* *H. elaeagnifolia*, a species found on the east coast of England, which we had before met on the edge of the *Milam* glacier. It was here covered with small yellow fungi, which was exceedingly sour, though of a pleasant flavour, and it was eaten most voraciously by the *Bhotiyas* as they passed.

Beyond the *Gunda* *Yarab*, about 4 miles more of the plain brought us to the

rma Yankti, a stream still larger than the former, but quite similar in character. Here again approached the hills more closely, and finally encamped at an altitude of 15,230 feet, under a low ridge round which the river flows.

Our march to-day was short, and after our journey was over I attempted the observations with the theodolite to determine the height of *Gurla*, which mountain was becoming a more and more prominent object as we approached it. A cold wind, which did not subside till late in the evening, was blowing with great force all the afternoon, and made it very difficult to observe angles with any degree of nicety. From the point where I had taken up my position, I looked over the plain towards *Tisum* for not less than 25 miles, but the view was rendered very indistinct by the mirage, which was so great that objects near the horizon at their true forms even at short distances, and became quite confused, appearing quiver and flicker as much as ever I saw them do in India.

On our road to-day we again observed a wolf, and some small antelopes (*Procypra picticauda*), but too far off to come within range of Bachu's gun; many *Gyang* were of course seen. The vegetation was still most meagre, *Oxytropis tracheyana* being the only novelty. In the evening we held a council to consider our route, and determined to go on *viâ Gyanima*, intending thence to turn up to the north of *Rakas tal*; a plan, however, that we next day changed for the southern route, which we actually followed. At 9 p.m., thermometer in air, 41°-8.

September 12. *Darma Yankti to Gyanima*, 10 miles.—At 6 a.m., thermometer 28°; at 9 a.m., 53°.

Hugging a projecting point of the low hills on our left, or to the north, the summits of which barely reach a height of 15,400 feet, and leaving on our right two or three small detached hills that rise abruptly from the flat, we made directly for the so-called fort of *Gyanima*, or *Nima-khar*, the former name being a compound of the Tibetan words, *Gya*, "splendour," and *nima*, the "sun;" the latter of *Nima*, the "sun," and *khar*, "fort." The hill on which the fort stands soon became visible, though the lake at its foot did not appear till some time afterwards. The miserable slow pace of the cattle, the great power of the sun, and the extreme violence of the afternoon wind, made us heartily sick of this arid plain, which offered no novelties in any shape whatever to engage our attention during the hours we were crawling over it. At last we came sufficiently near to the lake to make us brighten up a little, for we knew that there would be Tibetans encamped with their cattle on the pastures along the water, and it was necessary to be careful where we went. The mirage, however, was so strong again to-day, that it was difficult to make out objects with a telescope any better than with the naked eye, and a solitary wild donkey standing in our way kept us on the *qui vive* for some time. When at length he was clearly distinguished, we went on with additional confidence, for his presence showed that men were still far enough away. By degrees, as we approached the water, the haziness became less, and we saw distinctly several encampments a mile or two off. There were clusters of small black tents, with cattle grazing near, and human figures were seen moving about them. We were so little elevated above the sheet of water that its form could not be made out, but we saw that it extended to the north-west many miles in length, and that its borders were fringed with vegetation, the dark colour of which contrasted with the pale bare surface of the plain beyond. On the opposite side of the lake rose fine-looking hills, bold and utterly barren; they are the highest between the Indian watershed and the *Saltaj*, and yet we could only discern a single small patch of snow on one of the highest summits, which I afterwards determined to be 18,400 feet above the sea. Their rich reddish-brown tints made it probable that they were composed of some of the igneous rocks on which we were just entering.

The plain over which we had been travelling for the last two days, its perfectly level or gently sloping surface covered with shingle, the mountain slopes which bounded it, and the detached hills that rose from it, presenting cliffs that sloop up abruptly like rocky coasts and islands, forcibly suggested that here was the dried-up bed of some great lake or inland sea, to which the effects of the mirage frequently gave a wonderful reality.

The hill of Gyanima is an isolated mass of eruptive rock, chiefly hypersthene or bronzite. The surface is much fissured, and the rock breaks up very readily into small fragments. Coatings of serpentine and siliceous matters are also common on the faces of the joints, and it weathers to a reddish-brown colour. The regular road lies through a depression in the middle of this hill, which our cavalcade therefore avoided, moving off round the south-east extremity, under the further angle of which our camp was formed.



TIBETAN TENT.

I myself went straight down to the lake, passing tolerably close to a Huniya tent, the people near which, however, took no notice of us. The ground at the north-west angle of the hill over which I passed is customarily occupied earlier in the season by the Jubari Bhotiyas, who encamp here, as I was told, this being one of the regular marts for the traffic between the Tibetans and the people of the upper Himalayan valleys, the former bartering salt and borax for grain or Indian or European commodities brought up by the Juharis. The soil was covered with green turf intersected by numerous small streams, and in some parts was even a little boggy. *Ranunculus aquatilis* and *Hippuris vulgaris*, or horsetail, both common English plants, were growing in all the pools; *Ranunculus cymbalaria*, a small creeping species with tridentate leaves, is common in all the valleys of Hunder, and widely diffused over Northern Asia and America; two *Gentians*, and a very small purple *Primula*, *P. Tibetica*, not exceeding an inch in height, were abundant amongst the herbage. In the streams, which were usually only two or three feet in depth, were many small fish. One of these we managed to catch, and our Bhotiyas said that when they are encamped here they get plenty of larger size. Men stand in the shallower parts of the streams with sticks, ready to strike at the fish, which are driven down from some distance by another party, who come along in the watercourses. I saw no large fish, however, and it was suggested that they had retired into the lake, as it was now getting cold again; and it is possible, for these small rivulets must cool down much before the general mass of water in the lake.

Not being certain whether or not there might be any one living in the remains of the old fort on the top of the hill, we did not venture to intrude upon it, but we were given to understand that it consisted only of the ruins of the walls. I did not gather that any historical or mythical interest was attached to the ruins. From the foot of the hill, however, we got a good view of the lake, which is a sheet of water 10 or 12 miles long, but nowhere probably much more than a mile in breadth. From its lower end, I was told, a stream flows off and joins the *Darma Yankti*, which soon afterwards unites with the *Gunda Yankti*; and the combined river then takes the name of *Chu-kar*. The upper end of the lake where we stood terminates in pools of water and swamps, a very small stream only flowing in from this quarter. The ground along the edges of the water was generally low, and many Huniya encampments were dotted along the banks, with immense flocks of sheep, herds of yak, and a few horses, all of which we saw very distinctly with our telescopes. Innumerable waterfowl covered the spits of mud that ran out into the lake at this southern end, and large numbers of birds were also collected about the pools and swamps. Of these may be enumerated a fine large grey bustard with black neck and tail, grey geese, ducks, teal, snipe, terns, sandpipers, curlew, a fish-ing-hawk, and small heron. The bustard refused to be shot, and walked off triumphantly as the sportsman approached; and a goose, anxious, I suppose, to support the reputation his family has earned, was the only victim of Bachu's arts. Sticking to one of the feet of the goose was a small leech.

The ground all about our camp was covered with the burrows of a small rat-like animal with a very short tail (*Cricetus songaricus*), a specimen of which I afterwards managed to catch.

Along the foot of the hill issued many copious springs, the temperature of which was $36\frac{1}{2}^{\circ}$. The open running water in the afternoon, about five o'clock, was 43° , and the temperature of the earth 9 inches below the surface, 47° . The surface of the lake was calculated to be 14,880 feet above the sea.

On returning to the tents after our short stroll to the point overlooking the lake, we found our company drinking tea in the Tibetan style. This is quite a different operation from the Chinese or European infusion system. The tea used is of the description known as brick-tea, which is tightly compressed into brick-like blocks. It is boiled with carbonate of soda and butter, flavoured with salt, and thickened with barley-meal, thus forming a sort of soup. To my taste this particular brew was simply nauseous. The compound, when concocted with proper materials and on scientific principles, is declared by competent authority to be good. I suppose, therefore, that as there certainly are differences in English tea-pots, so there are also in Tibetan kettles. Tea-drinking is a constant occupation for a Tibetan. In every tent and in every house the tea-kettle is always on the fire. The laws of hospitality bind all to present tea to their guests, and every Tibetan carries with him a wooden bowl of Himalayan maple by way of teacup. The universality of tea-drinking in Tibet is such that it would appear to offer a good market for the produce of the Himalayan tea plantations. At 8 p.m., thermometer 36° .

September 13. *Nima-khar to Jungbwa Tol, 20 miles.*—At 6 a.m., thermometer $23^{\circ}5$. This temperature may perhaps have been affected by radiation, but the cold had been rapidly increasing during the last few days, when the rainy weather on the Himalaya seems to have ended. At 8 a.m., thermometer 42° . Leaving *Nima-khar*, we crossed the plain at the head of the lake, here something under a mile in breadth, and came upon low rounded trap-hills, similar in their constituents to the hill of *Nima-khar* before described. A few isolated points also projected from the middle of the plain.

We had now reached the extreme eastern end of the great plateau of Guge, and entered a hilly country characterized by numerous valleys with perfectly flat alluvial bottoms by which it is intersected. Most of these were quite dry, small streams existing only in a few of them. This circumstance, added to the almost perfect horizontality of their transverse section, their general agreement in elevation with that of the great plateau, the abrupt rise of the rocky hills on either side of them, and their general uniformity of breadth for considerable distances, seems quite to preclude the possibility of existing agencies having caused them. They must, without doubt, have been produced by the action of currents in extensive bodies of water that have formerly been spread over large portions of the plateau, but I cannot say that there seems any decisive evidence to show how or when this action took place. I have elsewhere given my reasons for believing that the alluvial deposits of *Guge* were first laid out by the ocean. The valleys to which I am now alluding may either have assumed their characteristic forms before the elevation of the great plateau above the sea-level, or they may have been formed after some partial elevation, when lakes much larger than those now remaining still existed, the waters of which have been since drained off.

Crossing over a considerable spur from the high hills north-east of *Gya-nima*, we again descended into a broad level valley, which, by taking a more circuitous route, we might have followed the whole way from the lake. Up it we had, for the first time, a complete view of the grand dome-like peak of *Kailas*, distant from us about 35 miles. This valley, which is about half a mile wide, is called *Tara*. It had once been green, no doubt, but was now quite burnt up and yellow, and it is probably only in the spring, when the snow is melting, that the vegetation has any activity. A little further on we came to a stream in which we saw many small fish. We managed to catch a good many, but through the stupidity of one of my servants, they were unfortunately all thrown away soon after my return to Kumaon. They were of three species—the largest about 8 inches long, with scales, no doubt carp (*Cypridæ*); the others 4 or 5 inches long, with cirri and without scales (*Siluridæ*). The stream seemed nowhere to be more than three feet, and was generally only one foot deep, and during the winter it must certainly have been frozen into a solid mass, with all it contained. The question naturally arises, Do the fish live through the winter frozen up with the water? The only way of getting over the difficulty, if this be a difficulty to a fish, is by supposing that the stock is renewed every year from the lake at *Gyanima*, at a season when there is sufficient water to supply a continuous stream the whole way along. When we were there no such communication existed, and the bed of the stream was in many places dry, but while the winter's snow is melting off, the quantity of water may be larger. This valley we followed up for many miles. It was bounded on either side by trap hills covered with loose stones, and utterly bare of all vegetation. The diminutive stream at its bottom had green margins, which now afforded but scanty pasture, for the ground had been closely cropped by the flocks of the *Hunias*. The valley was now abandoned, but we everywhere saw signs of their old encampments. After a long and tedious march, in which the previous labours of the sheep and goats rendered our herborization null and void, we passed the watershed, beyond which the drainage begins to fall into *Rakas-tal*. The division of the waters is hardly marked, the two valleys running into one another with hardly any interruption. The summit level is probably not more than 200 feet above the level of *Rakas-tal*, or 15,200 feet above the sea. We here, for a short distance, went over the same ground that was passed by my brother in 1846. He, however, ultimately turned off round the north end of *Rakas-tal*, while we made for its southern border.

It was now nearly sunset, and we were rapidly approaching *Jungbwa-tol*, where

camp of Tibetan shepherds were certain to be found, and, what was worse, Tibetans who knew our Milam people. One of them was known to have left Milam only a few days before us, and if our party was discovered, it would have been at once detected that we had no legitimate business here. Nobody knew the precise localities, so it was clearly desirable to come to a halt before dark, as otherwise our difficulties might have been much increased. Scouts were consequently sent on in advance, and we anxiously looked for water, without which we could not halt, but water there was none. Thus forced to advance, we very soon received a report that we were close to some Tibetan encampments, and, turning a corner, we looked through a side ravine into a most inviting green valley with plenty of water; but it was not for us, and we passed rapidly on. Hoping to get a better idea of the localities, or to be able to discover some place where we might get water, I started up the hill on our left, from the top of which I looked down into the valley we had just seen. It was wide and open like that of Tara, with a stream or succession of pools of water tolerably near; but it was fully occupied by Tibetans, and we could do nothing but go on. In coming down the hill, I descried some large flocks of sheep in the valley directly ahead of us, so it was evident that we must run the gauntlet of our supposed enemies. We went on, therefore, as boldly as might be, the Bhotiyas in a desperate fright, and, on turning a projecting point, we found that the valley along which we had come opened into another larger one, in which we saw, within a quarter of a mile of us, two Tibetan encampments on our right and one on our left. It was now dusk, and as turning back was out of the question, we went to what appeared to be a stream in the centre of the valley, but to our utter disgust it was quite dry. However, a halt had now become quite unavoidable, and, moreover, it was plain, as the Huniya tents were so near us, that water must exist close by. So here we encamped.

Boru, the Padhan of *Tola*, who by this time had shown himself to have far the best head of the party, was immediately sent off to reconnoitre. He fell in with an old woman who was driving home a flock of sheep, and soon came back and reported that the *dong*, i.e. pastoral encampments, belonged to shepherds from *Hortol*, a place the other side of *Manasarowar*, who were pretty certain not to know any of our people. Water was also pointed out in the bed of the stream close by, and matters appeared to begin to mend. By this time the night had set in, and the moon was shining brightly. Our tents were just pitched, when from one of the camps near issued a most alarming-looking horseman, who rode straight down towards us, the long dark shadows adding to the terrors of his appearance, but the spectre dissolved into nothing more than the reality of a boy taking home a stray pony.

As it was now getting dark, and every one was tired, Boru once more started with one other Bhotiya for the nearest Tibetan tent, to see how far our more pressing wants could be supplied without further exertion on the part of our men. He very soon returned with a large bundle of firewood, and a great copper pot of water for immediate consumption. Boru had most successfully imposed upon the Huniya, but it was, nevertheless, at once noticed, from his dialect, that he came from *Juhar*—a matter, however, which was of course instantly explained away. The other Bhotiya affected not to understand Tibetan, so that he could not have awkward questions put to him. The Tibetan, though most polite in most particulars, was firm on one point—he flatly refused to give us milk, although the money was produced. It was unlucky, he said, to sell this at night, but we might have as much as we pleased in the morning. On the whole, we seemed to have got well out of our scraps, though our scanty supply of wood sent us to bed miserably cold, and with a rather less luxurious supper than usual.

September 14. *Jungbwa-tol* to *Camp south of Rukas-tal*, 8 miles.—It had been

settled beforehand that W. and I were to start by daylight, leaving the rest of the party to follow a little afterwards, so that we might escape observation as much as possible. We had a cold walk for about a mile over low hills, still composed entirely of eruptive rock, and of the same rounded forms that we had met on the previous day. On getting to the top of a ridge which we reached before sunrise, we saw in the valley below us, and the direction it was supposed we ought to go, the smoke of another Huniya encampment. As the single Bhotiya we had taken with us knew no more of the country than we did ourselves, we thought it best to stop here till the main body came up, so that we might then go on together, for in such rugged ground it might have been difficult to find our party again if we had once diverged from the proper track. We sat on the top of the hill for a long time shivering in the cold, with the thermometer some four or five degrees below the freezing-point. The only thing that could be seen was the smoke curling up from the valley below in the faint grey light of the morning, and the silence was broken only by the barking of the dogs about the tents. At length the sun rose, and we found that we were overlooking a broad flat valley, the continuation of that in which we had encamped, which manifestly led down to *Rakas-tal*. The shepherds soon were stirring, and not long after we saw their flocks driven off to graze. The appearance of the sheep on these bare hills, which present no objects of known magnitude by which the eye can rapidly form a correct estimate of their distance, was most deceptive; even till the last, when among these barren wilds, I was quite unable to distinguish offhand, even at moderate distances, between sheep and white stones, or between dark objects, such as bushes and men. In the Himalaya, in looking across a deep precipitous valley where there is no gradation of distance, owing to the centre of the picture being unoccupied, I have often found it difficult in like manner to judge of magnitudes, and have consequently mistaken goats for cows, and *vice versa*.

Our people now soon came up, having left their ground without the least suspicion being raised. We all started again together, straight across the hills, nearly due west, over such ground as no beast of burden but a jhobu could have passed; at one time climbing rocks, at another floundering down infamously steep slopes covered with loose fragments of stone, to face which on the backs of our cows required some nerve even after the apprenticeship we had gone through in the previous part of our journey. This rough riding rapidly carried us clear of the pastoral Tibetans, and it was not very long before we were rewarded by a first sight of the sacred lakes. On turning a corner on one of the ridges we had to cross, we suddenly caught a glimpse of the beautiful blue water of *Rakas-tal* sparkling within a few miles of us. Through a depression in its further shore, a small portion of the lake of *Manasarowar* could also be distinctly traced as a small dark line, beyond which rose a distant range of purple mountains.

We stopped to breakfast in a ravine, near which many of the Sikh or Dogra invaders of this country were said to have perished in the winter of 1841-1842, chiefly from the cold. Their bones and those of their cattle, with remains of clothing, etc., were pointed out to us as we went along. What we saw were the remains of some of the less fortunate parties of fugitive Sikhs. The Sikh expedition has made so strong an impression on the Bhotiyas and the people of these regions, that the year in which it took place is invariably referred to as the *Singh Sal*, i.e. the Singh or Sikh year, when allusion has to be made to events that happened about that time.

Among these ravines the vegetation was a little more vigorous, and had been less disturbed by sheep or goats, and we added a few plants to our collections, of which I may name the small willow, *Salix sclerophylla*, not uncommon; *Rheum*

Moorcroftianum, a species of rhubarb very common in Tibet; a handsome gentian, *G. nubigena*; and *Lagotis glauca*, a plant of Northern and Arctic Asia; *Arenaria Stracheyi*, and *Pleurospermum Hookeri*. The rugged nature of the hills that here flank the southern shore of *Rakas-tal*, or, as it is called by the Tibetans, *Tso-Lanak*, *Tso* signifying "lake" in their language, obliged us to keep at some distance from the water's edge, and to ascend to a considerable height above its level. In crossing one of the ridges on our route, a magnificent view of the lake at length opened out to us, though it must be confessed that the frightful south wind, that had already begun to blow with extreme violence, rendered real enjoyment very difficult. The lake of the *Rakshasas*, or "Demons," is of a somewhat irregular form, about 20 miles in extreme length from north to south, and about 12 miles in extreme breadth across its southern end; its northern half, however, nowhere exceeds 6 miles in breadth. As I cannot improve on my brother's description of this lake,



Peak of Kailas, 22,000 feet.
LAKE OF RAKAS-TAL OR TSO-LANAK, 15,000 FEET.

I extract it entire: "The snowy mass of *Momanangli*, a name now replaced in our map by the more euphonious one of *Gurla*—and the authorities on which this last name rests must not be examined too curiously—was again conspicuous to the south-east, and from the base of the mountain a lofty range of hills, partially tipped with snow, stretched north-westward, separating the lake from the head-valley of the Karnali, and forming its south-western banks nearly parallel to the course of the river." Across the spurs on the north face of this range, I may observe, we were advancing, and though a little snowy when seen by my brother, it was at the time of our visit quite bare, excepting in very few spots in the most retired ravines; the snow that he saw having no doubt fallen during the bad weather that immediately preceded his visit to this part of Tibet. The highest points of this ridge rise somewhat more than 2000 feet above the lake, or say 17,500 feet above the sea. "These hills," continues my brother, "rose abruptly out of the water in bold rocky banks, with many deep inlets, promontories, and one or two islands of the same character. This part of the lake is altogether so irregular in outline, that it could hardly be defined without detail survey and close inspection

of every point. The eastern shore was bounded by shelving ground and low hills, the south end being a good deal recessed eastward into a deep bay, the middle part advancing further westward in a rocky bank of moderate height, and the north end sweeping round to the westward as far as could be seen, with a margin of green grassy plain, from the bank of which the *Kangri* mountains rose in dark steep slopes. The main peak of *Kailas*, now beautifully developed to its very base, was seen on the extreme left of the range (so far as visible to us), and over the low hills in the middle of the eastern shore, a streak of bright blue showed a distant glimpse of *Manasarowar*. The western shore of the lake was undulating ground or low hills, over which we had been travelling this morning, at the foot of steep and lofty hills here and there streaked with snow." The highest of these hills, I may again notice, our subsequent operations have shown to rise to 18,400 feet above the sea, or above 3400 feet above the lake. "The water of the lake was of the clearest, brightest blue, reflecting with double intensity the colour of the sky above, and the northern horn of the water, overshadowed by the wall of mountain rising above it, was darkened to a deeper hue, partaking of the fine purple colour that distinguishes the rocks of *Kangri*. Fresh breezes broke the surface of the water into waves that rolled upon the shore. The surrounding hillsides, though very bare of vegetation, were tinted with many shades of red, brown, or yellow, happily varied with the margins of verdant grass in other parts of the shore, and bright sunshine spread a warm glow over the whole landscape, entirely divesting it of the cold barren aspect that might be supposed inseparable from these intemperate regions."

We halted for the night at an elevation of 15,440 feet, in one of the ravines at about a mile and a half from the edge of the lake, any view of which, however, was prevented by the precipitous character of the intervening ground. The distance we had travelled was perhaps not much more than 6 miles in a direct line, but the extremely rugged nature of the country caused us to make long *détours*, which greatly increased the length of the journey. Thus far the rocks were entirely of the same eruptive nature as before, chiefly hypersthenic, and the surface was everywhere covered with loose angular fragments, generally of a dull red colour, and utterly barren excepting in the ravines.

A further consultation was here held as to our route. The Bhotiyas protested most vehemently against passing along the northern edge of *Rakas-tal*, under the Tibetan settlements of *Darchin* or *Tarzum*, excepting during the night—an arrangement that we thought would be highly objectionable, for we found the day marches quite sufficiently painful, and very little could have been seen at night to compensate for the discomforts we must have put up with. We determined, therefore, to continue our course round the south end of *Rakas-tal*, and to go up between the two lakes as far as *Ju*, at the north-west corner of *Manasarowar*, where the point of efflux of that lake was supposed to be. This we were anxious to see, for Moorcroft had denied the existence of any opening there, though my brother had crossed a large stream some miles to the west of *Ju*, which he was informed came from *Manasarowar*. We proposed to return from *Ju* to this place, and thence, crossing the ridge to the south of us, to proceed by the *Karnali* valley back towards *Tuzang*; and we therefore here left behind us a depôt, only taking on with us eight men and ten jhobus, with supplies for five or six days. At 6 p.m., thermometer 28°.

September 15. *Along the South Shore of Rakas-tal, 10 miles.*—At 6.15 a.m., thermometer 28°·2; at 8 a.m., thermometer 29°·5. Close to our camp we came upon a direct track, said to be one of those leading from *Jungbwa-tal* to the valley of *Purang*. The road—a mere track for men and cattle, any approach to wheeled

carriages being utterly unknown in these regions—comes round this way, apparently out of the direct line, to avoid the high rugged hills along the flank of which we had been travelling yesterday, for the ridge becomes much rounder and less elevated at its eastern end. We followed this track for about a mile, and then, hoping to be able to keep along the edge of the lake, we turned down a ravine to the left, which we followed till we reached the water. We saw many wild animals as we passed through these rugged and secluded hollows—several herds of *Ovis Burrehel*, and, for the first time, a few of the larger wild sheep, *Ovis Ammon*; also a large colony of marmots. We got to the water's edge about noon; the altitude of the surface I have calculated to be just 15,000 feet—that is, about 750 feet lower than the summit of Mont Blanc. The temperature of the air was $45^{\circ}3$; that of the wet bulb, $33^{\circ}8$; and of the water of the lake, a little over 50° . The latter cannot, however, be taken as the general temperature of the lake-water, for the bottom was very shelving, and it was not possible to reach the deep water. On the following morning, at about 8 o'clock, the water was 37° , and the air 33° ; at 10 o'clock, the water was 45° , air 38° , and wet-bulb 29° ; and on our return to *Rakas-tal*, three days later, the edge of the water early in the morning was just frozen in some places for a foot or two from the shore, the air-temperature falling to $22^{\circ}8$.

We were, after all, disappointed in our hopes of being able to go along the edge of the lake, for steep cliffs shut in the little shingly bay into which we had come, and forced us to ascend again over the hills, which had now become so much less rugged that the ground was in parts almost level. At this time, the peaks of *Gurla* and *Kailas* being both quite clear of clouds, and the wind not having yet set in with much strength, I thought the opportunity might be taken to determine the heights of the two peaks trigonometrically. I therefore stopped to set up the theodolite at an elevation which proved to be 15,970 feet above the sea. But before the last angles were measured, the wind had become so dreadful, and we were all so utterly perished with cold, that I was on the point of giving it up as impracticable, and I was not surprised to find, on subsequent examination, that a mistake had been made in one of the angles. This, however, was of no real importance, as the more careful triangulation of the following year has made good the deficiency. The violence of the wind on this occasion may be conceived when I mention that a 100-foot tape, used for measuring my working base, had its ends successively torn off, one after the other, by the mere force of the wind, in the hands of my friend Mr. Winterbottom, while he was endeavouring to draw it straight.

While I was delayed at this job, all the rest of the party went on with the exception of two men and as many jhobus, one for me to ride, and the other to carry the theodolite; and I was only too glad to be off when the last angle was observed and the instrument put back into its box. By the time I came up to our camp it was very nearly dark, and as the tents were pitched in a rather out-of-the-way nook within a few hundred yards of the edge of *Rakas-tal*, and no one had remembered to look out for us, I was as near as possible passing on without finding them. Luckily, I saw a man's head appearing over the top of a hill, and on examination he proved to be one of our people getting firewood. The pleasures of a bivouac in the open air that night would have been questionable, for we found it most miserably cold in the tent, and, contrary to custom, the wind continued to blow nearly all the night. The thermometer at this time was not very low, for when I set up the theodolite at half-past two it stood at 47° , and it was probably not below 32° when I reached our tents; but no clothing will keep out these intolerable winds excepting furs or sheepskins, with which we had not provided ourselves, but which every traveller in Tibet ought to take with him, even in summer.

September 16. From Rakas-tal to Manasarowar, 14 miles.—At 6 a.m., thermometer 20°8. We started to-day over undulating ground slightly broken up by ravines, and were enabled accordingly to keep pretty near to the margin of the lake. The rock at the commencement of our day's journey was still the old hypersthenic trap, but we almost immediately came upon mica schists and fragments of granite. I cannot positively say whether we passed over any granite *in situ*, but *Gurla*, at all events, seemed in great part to be constituted of that rock. This mountain was now so close to us that the summit was possibly concealed by some outlying spur. The grey granite stood up strangely among the pure white snow, and the pale and spectral masses contrasted finely with the deep reds of the surrounding trap hills and the purples of the *Kailas* rock on the north. A long open slope brought us to *Lagan-Tung-kong*, a small ruined mud hut or dharmasala at the south-east corner of the lake; as we approached, a horseman left it apparently rather in a hurry, and went off rapidly along the road to *Purang*. He seemed as anxious to get out of our way as we were to avoid him, and in a country such as this, where there is no law, still less any police to enforce it, it is not wonderful that travellers are a little shy of making acquaintance with strange parties of men. We were by this time becoming aware of this fact, and began to calculate on not being very rigorously scrutinized by persons whom we might meet by accident on the road. We reached the water's edge at the extreme south-east angle of *Rakas-tal* about 10 a.m., and the wind now blowing lightly from the north, small waves were breaking on the shore. The thermometer was 38° in the shade.

Beyond this point the ground separating *Manasarowar* from *Rakas-tal* rises rather steeply to about 300 or 400 feet above the level of the lakes, being apparently altogether composed of alluvial deposits made up of pebbles, precisely similar to those now found on the beaches of the two lakes, of granite, mica schists, and quartzites, sometimes cemented together and forming conglomerates, but more commonly in the state of loose gravel. The general structure of this alluvial mass is so perfectly identical with that of the deposits of the great plateau that they must all be held to have had a common origin; but it is impossible to offer any opinion as to the probable time at which this particular portion assumed its present position relatively to the rest, whether before, with, or after the general movements that have elevated the whole. On this soil the vegetation was again a little more cheerful than on the miserably barren trap hills we had been passing over for the last three days, but still no novelty was seen. As we reached the summit of this ridge, we at length came into full view of *Manasarowar*, in honour of which event our followers did homage to the sacred lake by prostrating themselves at full length on the ground. All along the roadside—for we were now again following a well-beaten track—were a number of little piles of stones erected by travellers who have passed. A similar custom exists in India, and it has perhaps been introduced into Tibet by Hindu pilgrims. It is said to originate in the fancied sanctity attaching to the construction of a house at any holy spot, and those who are too poor to build substantial mansions get over the difficulty by setting up half a dozen stones one on another. Multitudes of such piles may be seen at *Hardwar*, raised by the devout Hindus in the bed of the sacred Ganges. The same thing is seen at *Badarinath*, at the point where the temple first meets the eye of the pilgrim coming from the south. These small piles must not be confounded with the larger cairns which the superstitious of so many nations, including the Hindus and Tibetans of the Himalayan regions, raise at certain spots, more particularly on mountain passes. To these every well-disposed traveller adds his contribution, usually a stone, though in some places shreds of rag are seen stuck on a bush, or the pile is made up of twigs instead of stones. Accumulations of all sorts of oddities are often found on

these piles, among which horns and skulls of wild animals, fossil shells, bits of crystal, or eccentric-looking stones invite the sacrilegious attacks of European travellers, and many of my specimens of ammonites are spoils of this description. The Bhotiyas have no scruple in assisting in such proceedings, and I may add that they generally appear to care but little, unless impelled by considerations of temporal expediency, for the superstitious practices of their Tibetan or Hindu neighbours. These votive cairns are by the Tibetans called *Lapcha*, though this word is perhaps more properly applied to a substantial tower built to receive votive offerings.

Manasarowar is the Indian name of this lake, which in Tibet is called *Mapham*. It is nearly rectangular in its general form, its shores extending from north to south and from east to west, about 12 and 15 miles respectively. Cliffs rise abruptly from the water only at its north-west angle; on all other sides it seems to be bounded by sloping banks or by a shelving beach. Though in form far less picturesque than *Rakas-tal*, it is, when viewed from the south-west corner, set off by a much finer background of mountains. Towards the east the ranges were difficult to distinguish, nor did I make out any visible depression of any importance for the passage of the road to *Lhasa*, though we know that such exists. The water is, on the whole, of the same intense blue as in the other lake, but some parts showed a quite sea-green colour, a circumstance also noticed by Moorcroft, and caused, I suppose, by shoals of yellowish gravel.

We kept for some distance along the top of the separating ridge, till a hollow that nearly cuts it through caused us to descend to the level of the lake, in doing which we met a party of Huniyas with sheep on their way to *Purang*, but we hurried by unnoticed. This depression in the ridge between the lakes marks the point where the unconsolidated gravel deposits, over which we had been travelling from *Lagan-Tung-kong*, give place to the stratified rocks which constitute the projecting headland on the east shore of *Rakas-tal*, and which are continued across to the cliffs at the north-west corner of *Manasarowar*. Where we crossed the hollow, which was close to the edge of *Manasarowar*, there were one or two small pools of water, around which the surface was muddy and covered with an efflorescence of some salt, which at a little distance gave the whole the appearance of being a solid mass of some white deposit. The outer edges of this mud were pretty firm, but in going on to it rather too far in search of some of the salt, I found, by suddenly sinking up to the knees, that it was soft enough below. Between this muddy flat and the lake is a raised beach of shingle, its top, I suppose, about 6 feet above the level of the water of the lake on the one side, and of the muddy flat on the other, between which it forms a complete raised embankment, having quite the appearance of artificial regularity, and in the middle of it has been built a small *Chorten* tower. Similar raised beaches are to be seen at many points of both the lakes, sometimes of larger dimensions, and sometimes having two or three external subsidiary lines of beach in front of them, indicating variations of level of the water-surface. These beaches are, no doubt, mainly produced by the action of the breakers caused by the violent winds that blow with such great regularity in these regions; but what is the exact reason that they are seen along particular portions of the shore only, I cannot say, nor can I further do more than suggest that their occasional great size may perhaps be in part dependent on the ice, which forms along the shores of these lakes during all the colder months of the year. Many of the lakes and rivers of Russia that are frozen over for several months at a time, are described as fringed with piles of rocks heaped together by the combined action of the waves and the packed ice, and some analogous process may go on here. The breakers formed against the cliffs on the shores of these lakes must be very heavy, as we saw their white heads distinctly at a distance of 6 or 8 miles.

I can now only regret that I have no specific note of their action on the rocks, nor of the size of the boulders they form, though my impression is that the gravel on the beaches was chiefly small.

I is continued.

A JOURNEY THROUGH ABYSSINIA TO THE NILE.*

By HERBERT WELD BLUNDELL.

APPENDIX.

NOTES ON GEOLOGY AND ANTHROPOLOGY.

By Dr. ERNEST KOKITZKY.

I. GEOLOGY.

As the line of our route begins in Senaham, I must not omit to mention some of the main features observed. At first the remainder of the country we passed over was a sandy desert, forming a belt from the seashore for about 12 to 30 miles; this is marine formed, and gradually and imperceptibly runs inland. Much of this sand is composed of disintegrated coral, small and large masses of which lie loose on the surface. Here and there, some 10 miles from the coast, rising through the desert sand are isolated rocky hills, one of which I examined closely. It was apparently a granitic boss which had pushed up and displaced the overlying, hard, compact, marbled limestone, which also appeared to have been altered by the heat of the granitic mass. The country then becomes rugged and rocky. Gneiss, granites, syenites, and quartzites are the exposed rocks; these are intersected in every direction by veins and dykes of biotite, quartz, etc. Flat-topped hills, more or less isolated, rise on the backward of our route, which are capped with basalt of compact and also vesicular type. A chalky kind of rock was also met with, and the surface occasionally is strewn with loose chips of flint and chert. Here and there, as at Jubah, a quartzite sandstone, hard slaty rock, and schists occur, these being also permeated with veins of biotite and quartz.

A noticeable and remarkable feature of the country are the extraordinarily deep, but dry river and water cuttings. These sometimes intersect the land in a bewildering manner; they are often broad and deep, with perpendicular sides. This even occurs through granitic rock *in situ*, the rock having become so disintegrated by atmospheric action as to allow the water to thus quickly cut through it, for they are evidently caused by torrential rains. Further inland we passed over considerable plains which were almost flat, and from what I observed I am inclined to think are basalt plateau surfaces which have not been raised like the hills around.

For some distance before we arrived at Jig-Jigga, as well as at that place, a chalky limestone appeared very frequently through the surface in an anomalous manner. This I frequently found contained fragments of quartz, sanidine, and quartzite embedded in it. This same substance, or similar, I also found filling up fissures in the basalt, not only on the flat, but also on the sides of hills with the basalt *in situ*, and in a position where it cannot have been recently washed into them, and where it must have been when the basalt I saw it in was first exposed, as at Sobell. It had all the appearance of having been plastered in, like mortar.

* Continued from p. 121. Map. p. 308.

In an illustrated and final chapter on hieroglyphic inscriptions Maudslay points out the considerable difference between Mexican writing and Maya hieroglyphics, translates the month signs, and signs denoting periods of time, great cycles, etc. What he has accomplished leads us to hope that, ultimately, much of the material relating to the history of a lost and interesting race will be discovered and that a key will be given to us to unlock many of the ethnological secrets of the New World.

NARRATIVE OF A JOURNEY TO THE LAKES RAKAS-TAL AND MANASAROWAR, IN WESTERN TIBET, TAKEN IN SEPTEMBER, 1848.*

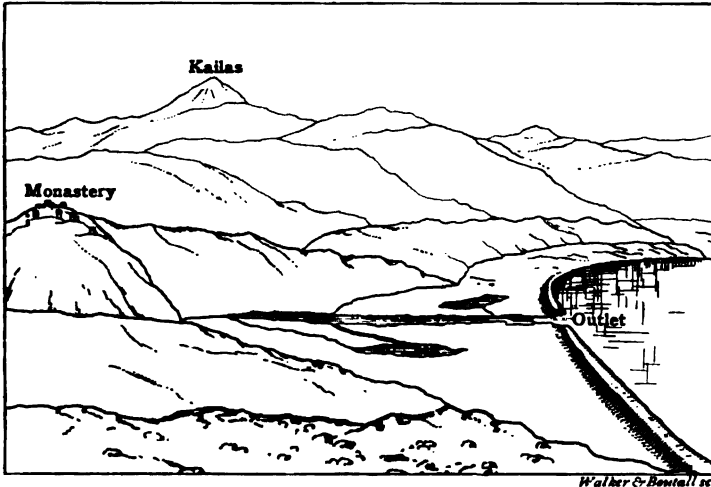
By Lieut.-General Sir RICHARD STRACHEY, R.E., G.C.S.I., F.R.S.

As we went along the edge of the lake we saw many water-birds; among them were ducks and gulls, and two species of heron, one large and grey, the other smaller and brown. The waves that roared as they rolled towards us, and, in long lines of foam, receded over the shingly beach; the broad expanse of sea-green water; the gulls riding on the swelling waves, or skimming the white crests of the breakers; and the high fresh wind blowing across the surface produced a series of impressions such as are so naturally associated with the ocean, that it would have called for but little exercise of the fancy to transport us from the banks of this mere mountain lake to the stormy coasts of some distant sea. The great snowy masses of *Gurla* formed an appropriate background to the picture, while the peaks of the Nepal Himalaya stretched away in a long series to the east as far as the eye could reach. Looking to the south, we saw a narrow line of beach thrown up into several parallel mounds, running a short distance along the foot of the steep bank of the alluvial isthmus over which we had come. A projecting point cut off our view of the south-west corner of the lake. A Buddhist monastery, *Gusur*, stands there, but it was not visible. Our march at length came to a halt about 2 miles south of *Ju*, on a narrow flat strip of land between the beach and a low line of cliffs which here flanked the lake; and the majority of the party behind to pitch the tents, etc., Mr. Winterbottom went on to examine the place where the stream that flows from *Manasarowar* enters the lake. We passed some dry stone hovels, but they bore no signs of having been inhabited lately, and near the same spot we were shown some holes said to have been old gold-pits, now abandoned. These are alluded to by my brother-in-law on his way round from the north shore of *Rakas-tal*, passed over the same ground as we had done from *Tung-kong* to this place. He mentions that the discovery of these pits was stopped in consequence of the ghostly advice of the monks of the neighbouring monasteries, and I was told that their objections were founded on the fact of pieces of gold having been discovered having the forms of men, which was considered portentous to a high degree. It is worthy of note that the alluvial deposits of Tibet generally are auriferous, though the quantity of gold which they contain has hitherto been very small. The gold seems to be found in the same manner as is usual in other alluvial deposits, in grains and nuggets of various sizes; and is therefore to be distinguished from the scales or spangles

* Continued from p. 264. Map. p. 204.

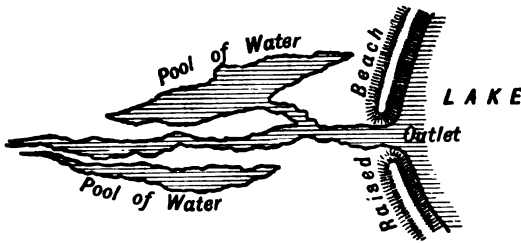
frequently obtained from washing the sands of the Himalayan rivers. The Tibetan gold-pits are worked with shafts and galleries in the alluvium, and the remains of them are to be seen in many parts of the country. The working of the pits is a Government monopoly, and considering what a Tibetan Government is, and what Tibetan workmen are, the small amount of gold now produced is no proof that the alluvium of Tibet may not be rich in gold.

As we approached Ju, a steep rocky point rising abruptly from the lake forced us to ascend. From the height to which we climbed we looked down on the

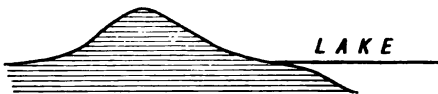


Walker & Bentall sc.

SKETCH OF OUTLET FROM MANASAROWAR, SEEN FROM THE SOUTH.



PLAN OF OUTLET FROM MANASAROWAR.



SECTION OF RAISED BEACH.

stream that connects *Manasarowar* and *Rakas-tal*. The rocks on which we stood formed one flank of the ravine through which it flowed; on its opposite bank was the monastery of Ju, looking very mean, apparently a collection of ruined mud buildings on the top of a hill, with an inhabited portion somewhat lower down towards the lake, the whole oddly stuck about with poles, decked out with rags. The ground at the bottom of the ravine was quite flat, and about on a level with the surface of the lake. A raised beach, which swept in a well-rounded curve

along the edge of the lake, was cut through by the effluent stream. This was of no great breadth, and apparently shallow and connected with several pools of still water that looked like old channels. It is strange that Moorcroft, deliberately going to look for the point of efflux, should not have noticed it. His account is as follows: "As the bank approached this angle (*i.e.* the north-west angle of the lake) it declined to gentle elevations leading to interrupted tableland, and at its base was a large bay, from the bottom of which rose a pyramidal red rock, connected with a line of ridge of high land to the higher flats to the north, and steep towards the south. Upon this was the house of a *Lama* and many *Gelums*, pitched in situations which produced a romantic effect, not a little heightened by streamers of various-coloured cloth and hair, floating from high poles, fixed on the corners and roofs of the houses. Leaving this and diverting my steps to the south, I went along the base of granite rocks amongst such troublesome, rugged, and slippery stones as had interrupted my progress in the outset, till I reached a high, level, and firm bank, which separated the water of the lake from that which accumulated by the slope of the surrounding upland directing the melted snow into it. At the end of this natural barrier I saw a point of rock running into the lake, from the top of which I flattered myself I should have a prospect that would command the whole of the shore to the south-west corner, and put an end to a task which I now found somewhat too much for the little strength I possessed." From this it would seem that he passed over the identical beach I have mentioned, and that he describes the pools of water under the monastery outside of it. The illness from which he tells us he was suffering may have interfered with his powers of observation, but for the rest it must be presumed that the water in the lake was lower than usual when he passed, or that the bar was higher, so that no water was then actually running over it; and as he walked along the edge of the lake, his eye would have been so near the level of the water that a very small irregularity of the beach might have concealed the course of the stream from his view.

There were a few small buildings on the low ground near the lake, and men moving about among them, so we did not venture down to make a closer scrutiny; it was, besides, getting late, so that I could not wait longer than was necessary to make a slight sketch of the locality. The level of the surface of Manasarowar is, of course, something above that of Rákas-tal, but my barometric observations were not sufficiently nice to enable me to determine the difference of elevation with any certainty. I have consequently thought it better to throw together the whole of the observations of the barometer made at the level of the two lakes, and to calculate the altitude above the sea as though they were on the same level.

We had started rather earlier than usual this morning, without having any proper breakfast, intending to stop on the road for this meal; but we did not do so, and before I got back to the tents I was so utterly exhausted that I could hardly drag myself along. I felt for the first time the sensations of weariness and drowsiness that are said to seize on unfortunate travellers who are overcome by cold or fatigue in crossing snowy passes; but I somehow managed to get to the end of my walk. At 8 p.m., thermometer 31°2.

September 17. Manasarowar back to Rakas-tal, 14 miles.—At 6 a.m., thermometer 23°; at 8 a.m., thermometer 34°4. The north-west angle of *Manasarowar* having been the furthest point to which we thought it expedient to extend our journey, we to-day began to retrace our steps towards *Milam*. Several causes led us thus to conclude our expedition. The most important was the lateness of the season, for it would have been rash to delay our passage of the Indian watershed later than the beginning of October. The necessity for avoiding intercourse with the people of the country prevented our obtaining

fresh supplies of food, and the risk of detection increased as we increased our distance from home. But though it was prudent on the present occasion to return when we did, yet the population is so exceedingly scanty that an expedition might, I believe, successfully penetrate to a far greater distance into this part of Tibet without interruption, if properly organized.

While the tents were being packed up, we went on to the high ground over the spot where we had encamped, and from a slight eminence on its undulating surface we saw across from one lake to the other, and could trace the hollow through which the stream that connects them runs. The peak of *Kailas* stood out prominently among the mountains that flanked the lakes on the north. The greater part of these outer ridges, among which *Kailas* is situated, were not snowed; but a mass of very high mountains was visible to the north-west of *Kailas*, and a long way behind it, thoroughly covered with snow. The peak of *Kailas* rises from a transverse outlier of a range the axis of which is much further back. The peak forms a most conspicuous object from all the southern shore of *Rakas-tal*, and from this point of view the valleys by which the snowy mass of *Kailas* is cut off from the other prominent ranges to the right and left are very distinctly seen. I have already noticed a hollow that we crossed on our way to *Manasarowar*, terminating at a little bay about halfway down the west side of this lake, into which it drains. By way of varying our homeward route a little, we turned up this towards *Rakas-tal*, and we found that its watershed was almost close to the edge of *Rakas-tal*, and hardly so much as 100 feet above the level of the lakes. It was through this depression that we had seen the water of *Manasarowar* when we first came within view of *Rakas-tal*.

Early in the day we saw a fox; later another of the small antelopes and many hares, one of which, being foolish enough to squat within 8 or 10 yards of us, was cut nearly in two by a ball from a pistol carried by one of our people. A pack of donkeys, into the middle of which we walked when suddenly turning a corner, fared better, for no firearms were forthcoming until they had got safely away. It is, perhaps, worth while for me to say that this animal, the *kyang*, is a decided ass, and not a horse. Not only is his external appearance in all respects that of an ass, but his disposition also, of which I have myself seen sufficient proof, in a young animal obtained from people at Milam, which was sent to Calcutta, but died on its voyage to England. A distinction has been drawn, I think, between the markings of the skin of the *kyang* and the common ass; but the transverse stripes across the shoulders, which is said to be wanting, is often as strongly marked as in the donkeys of these mountains.

We struck upon *Rakas-tal* close to the commencement of a great raised beach that stretches along the south-eastern angle of the lake. It has a breadth of 200 or 300 yards from the present edge of the water, and seems to be composed entirely of granitoid detritus. Several interior lines, forming a series of steps or parallel roads, lie between the present high-water level of the lake and the uppermost of the beaches, which rose above all in a great mound of very remarkable height. These features were here most strikingly developed, a consequence, no doubt, of the violent south-westerly winds which blow so regularly in the afternoon, and constitute this a permanently dead lee shore. There is no evidence available to show whether there is any considerable variation in the level of these lakes from year to year, or from one season to another; but I think that such variations as must have taken place to explain the existence of some of these beaches are hardly compatible with existing conditions, and it is probable that these lakes have been gradually drying up, as seems to be the case in most of the lakes that have been observed in other parts of Western Tibet.

As we reached the border of the high land overlooking *Rakas-tal*, we were far before us a considerable party of travellers with horses, cattle, and sheep. We halted a little to allow them to get ahead. The view of the snowy mountains *Gurla* across the bay was savage and grim. The wind had begun to blow with great force, and was gradually rising, and the whole surface of the lake was white with foam; but, as in the forenoon the direction of the wind is south-west, no waves now broke upon the shore on which we were.

In our progress along the beach we came to a place in which the surf had been levelled, and a rough pavement had been made with the rounded stones, divided into several compartments, some of which seemed to have served as courts for tents, others to have formed small open courts. We were informed that this was the spot where a Tibetan grandee from *Lhasa* had encamped not long before. He was, I think, the officer called *Zhipchet*, a sort of special commissioner, who had been sent into *Purang* on some public business.

As we reached the corner at *Lagan Tunkong*, we saw that some of the younger Tibetans had pitched a tent near the ruined *Dharmasala*, but the wind was blowing so furiously that no one would remain exposed to it who could not find shelter, and accordingly not a soul was to be seen outside the tent, close to which we passed. As a precautionary measure, and to find out the news, the headmen, *Bachu* and *Boru*, went into the tent to pay the Huniya traveller. He turned out to be a landholder of *Purang*, and had some slight acquaintance with *Boru*. His teapot being already on the fire, they were sitting tea-drinking and gossiping, and the Tibetan squire was amused with the comment of a mook bargain for sheep and wool, which was to be pursued further the following day on the road to *Purang*. Their worthy host must have been puzzled the next morning to find that his Bhotiya customers had all vanished. Another division of the Tibetan travellers had selected a more sheltered place for their camp a little further on; they turned out to be servants of a Tibetan abbot of *Darchin*, a monastery at the foot of *Kailas*, to the north of *Rakas-tal*, who had been sent to look after the getting in of the crops on the lands in *Purang* belonging to his convent. There was no suspicion afloat in the quarters of the intrusion of a "Feling," as the Tibetans term all European intruders, making a further change from the name "Feringi," the usual Asiatic corruption of the word Frank. Our Bhotiyas had accordingly become mightily courageous.

We halted about half a mile beyond the ecclesiastics in a retired little place on the edge of *Rakas-tal*, not far from where we had stopped on our outward journey. There was here again one of those raised beaches already so frequently seen, but of no great extent.

At 8 p.m., thermometer 30°·5. The vegetation along the southern shore of *Rakas-tal*, and between this lake and *Manasarowar*, was most scanty. The following will, I think, include most of the larger plants: *Caragana pinnatifida*, *Potentilla sericea*, *Thylacosperma caespitosa*, *Silene Moorcroftiana*, *Dracopis heterophyllum*, *Nepeta Tibetica* and *supina*, *Oxytropis Stracheyana*, *Astragalus liusculus*, *Senecio coronopifolius*, *Artemisia Stracheyi*, a *Tanacetum*, *Lactuca tiana*, *Androsace villosa*, *Sedum fastigiatum*, *Draba lasiophylla*, *Delyria caeruleum*, and *Allium Jacquemontii*. The addition of a few grasses and cyperuses to the above list would nearly complete the enumeration of the flora of this region.

September 18. Along the South Shore of *Rakas-tal* to the Camp at *Lagan Tunkong*, 14, 10 miles.—At 6 a.m., thermometer 22°·8; at 8 a.m., 34°. The first part of our journey to-day lay over the ground we had passed before. Ultimately we kept rather more away from the lake, following a more

course, and at times approaching the watershed between the lake and the *Karnali* river. It was during this day's journey, I think, that we had the finest views of *Rakas-tal*, its long islands and deeply indented bays, varying in apparent form with every change of position, while the eye never wearied in gazing on the heavenly blue of the water, or on the magnificent snowy dome of *Kailas*, which conspicuously crowned the rich purples of the distant mountains. In crossing some of the ridges on our way, we looked down into the upper part of the valley of the *Karnali*, and the positions of some of the chief places were pointed out to us. This appears to be in every respect a normal Tibetan valley. It is flanked on either side by the remains of alluvial deposits, the flat tops of which are very far raised above the existing river-bed, and are manifestly nearly on a level with the general surface of the great plain of *Guge*. It is difficult not to conclude that the lower part of the hollow now forming the valley of the *Karnali* must at some time have been entirely filled up with deposits, continuous with those of the great plateau, and caused by the same agencies, and that the deep channel in which the *Karnali* now flows was subsequently cut out by the river, after some great change had taken place in the conditions of the surface and the arrangements of the drainage. The mountains of the Indian watershed along the frontier of *Tibet* and the north-western angle of *Nepal* looked very fine, thickly set with snowy peaks. We now, too, obtained an instructive view of *Gurla*, which was seen to be composed of a series of masses of mountain, their north-eastern ends being precipitous, and their southern faces dipping at rather high angles to the south-west towards the Himalaya. From what I saw of the rocks myself, and from my brother's accounts, it appears certain that *Gurla*, like most of the highest peaks of these mountains, is chiefly made up of gneiss or mica schist, with a comparatively small quantity of granite. On our return to our old encamping-ground, we found that during our absence a party of *Huniyas* had passed along the road which I mentioned as having been seen a little below our camp, and they had been not a little alarmed at finding a party of men halting in so secluded a spot, thinking, with some degree of justice, that people who had no cause for concealment would not have selected such a place to stop at. They were, however, last much comforted when they discovered that our men were peaceable *Juhari* *motiyas*, and not the redoubtable *Kampa*. At 8 p.m., thermometer 30°-2.

September 19. From *Rakas-tal* to the Valley of the *Karnali*, 7 miles.—At 8 a.m., thermometer 33°. We now prepared to cross over the range separating *Rakas-tal* from the *Karnali* river, and accordingly set off straight up the ravine in which we had been encamped. To the summit of the watershed the hills were of the same eruptive rocks, with the same rounded forms and with the same miserably barren aspect, though bushes of diminutive growth succeeded in reaching the crest of the ridge, which we crossed at an elevation of about 16,850 feet. The small stream that gave life to a narrow fringe of verdure along the bottom of the ravine up which we came was now frozen into an almost solid mass by the severity of the night frosts, and at the head of the ravine lay a small patch of snow, the second, I think, that we had anywhere noticed since we crossed the *Baleh* pass. At 11 a.m., thermometer 46°-5, we crossed the ridge, and finally took leave of the lakes, not at all sorry to be once more fairly on our way out of this desolate country. A steep descent brought us very soon upon some less inhospitable-looking ground than we had seen for many days, where a *Huniya* tent was established. Keeping clear of this, we crossed some hills of no great elevation intersected by deep ravines with flat bottoms of cheerful green herbage and small clear streams full of small fish. The bushes and herbage seemed to show, by their luxuriant growth, that these retired valleys were but little frequented by the Tibetan shepherds.

Among these hills we once more got into stratified rocks, consisting of sandstones and limestones, in which no fossils could be seen, much shattered and broken, but on the whole dipping to the north-west. We encamped in a sheltered spot about a couple of miles from the *Karnali*, having made a short march in which we gave the cattle a little rest, for their feet had suffered a good deal from the constant marches over the sharp angular fragments of stone that everywhere cover the surface of this region of igneous rock.

The hills close along the south bank of the *Karnali* west of *Kharamdam* and generally to dip to the south, but they are of no great height, quite snow-covered, and generally very uninteresting in their aspect. The flat shelf-like surface of the parts of the alluvial valley-floor of *Purang* that have survived the erosion of the rivers, were here very distinctly seen. They vary greatly in extent, and it is not possible to doubt that they have been originally continuous with the plateau up to which we traced them in the next two days of our journey. I observed near the place of our encampment a very granitic or sienitic greenstone that I had not seen among the eruptive rocks we had before passed.

September 20. Up the *Karnali* to *Sing-lapcha*, 14 miles.—At 8 a.m. the barometer 37°·5. Our route lay over rounded hills of slates and limestones, showing no definite signs of fossils, as barren as ever, and altogether very uninteresting. An occasional patch of greener grass than usual gave our journey an opportunity of eating a little, an occupation in which they had been very unable to indulge for the last few days, so utterly barren had been the country as it turned out, during the remainder of the journey they were to fare still worse. We at length fell into a track said to be that from *Kangri* to *Darma*, and we entered it into the valley of the *Karnali*, which river was here as large, or perhaps larger, than any of the streams we had before crossed during our journey in Tibet. The main supply we could see to be derived from tributaries that rise on the steep slopes of the Indian watershed, in the neighbourhood of *Manghang-Lek* and the western passes of *Byans*. These feeders join the *Karnali* nearly at right angles, just opposite to *Sing-lapcha*, above which the stream in the main longitudinal valley is a very insignificant one, and no doubt occasionally dry altogether. This circumstance gives additional weight to the views I have before propounded on the nature of the alluvial deposits along the *Karnali*. For those deposits must follow the great longitudinal hollow which extends from *Kharamdam* to *Chang* beyond which they cannot be distinguished from the general mass of the *Purang* *Guge*; and they cannot, therefore, be derived from the present feeders of the rivers which enter this valley at right angles at about the middle of its length, at a point where no change of physical character is to be observed.

Sing-lapcha is so called from two or three piles of bits of stick, raised, as I have described, by travellers to form a “*lapcha*,” the ordinary word for such a pile, *sing* or *shing* being the Tibetan for “wood.” These piles, 4 or 5 feet high, stand by the roadside on a prominent shoulder of mountain, which the river crosses about 500 feet immediately above the river.

In coming into the *Karnali* valley over the last of the hills we had just passed we looked upon a flat alluvial terrace some height above the river itself, covered with one of those optical illusions, to which I have before alluded, displayed an exact picture of a Tibetan encampment. There were the black yak-hair tents, the figures of men and cattle, and the white sheep scattered over the grass. But when I had reached the green pasture, the spell was dissolved; the tents were seen to be into great square blocks of stone, the men and cattle had shrunk into dark spots, and bushes, and where the sheep had been grazing just before, only white boulders were now to be seen. Nor could I help thinking how easily, under

influence of these or similar delusions, half-savage shepherds might accept as un doubted truths the wildest fables of wizards and enchanters, when in spite of my reason, and in the least romantic mood possible, I could hardly avoid giving a momentary reality to my vision.

As far as *Sing-lapcha*, hills of considerable height rose immediately from the southern bank of the *Karnali*, but to the west of this place they are somewhat broken back, and a plateau, the surface of which seemed, on the whole, pretty level, though considerably intersected by ravines, bordered the *Chujia-Tol* valley, which, as I have already said, forms the prolongation of that of the *Karnali*. The foot of the hills on the north of the *Karnali* still kept close to the river, but their height above it gradually diminished.

The only object now remaining for us to accomplish was to return to *Kumaon*. We were satisfied that the Tibetan authorities, if by any chance they now discovered us, would simply assist us in carrying out this intention, and our people feeling, that they were by this time beyond the reach of the enemy, had no scruple in going boldly along the valley, and in encamping at a short distance from some Tibetan shepherds about a mile beyond *Sing-lapcha*.

The food of our Bhotiyas was by this time very nearly exhausted, so an expedition was at once undertaken to try to obtain a fresh supply, and at the same time to endeavour to buy a sheep or two, and, if possible, a goat with milk, the latter being a luxury that we had long been without. We were soon informed that almost all the men had gone from these tents to *Darchin*, in attendance on the Tibetan *Zhipchet*, then returning to *Lhasa* from *Gar*, which place the Bhotiyas more commonly call *Gartok*, and that only women and old men were left behind. Sheep were produced, but some difficulty was made about a goat; and we were referred to the headman of the community, whose tent was said to be 3 or 4 miles up the valley, for a supply of grain.

September 21. *Sing-lapcha* to Camp near Lama Chorten, 14 miles.—At 8 a.m., thermometer 33°; at 9 a.m., thermometer 47°. As we were preparing to start this morning, the flocks belonging to the Huniyas near us came down the valley close past our tents, escorted by a wonderful-looking shepherd dressed in sheepskins, and altogether the most uncivilized-looking creature conceivable. His dress was evidently rather limited in their range, and though he thought it rather odd, he was perfectly satisfied when he was informed that we were a peculiar sort of Juhari. He only wished to know whether we had been on a religious pilgrimage to *Manasarowar*, his education not having got so far as to make him aware of the existence even of his "*Feling*" neighbours. An attempt was made to induce him to let us have a goat. This he totally refused to do, and when our people insisted, he went back, in a violent state of indignation, to his camp to report their misconduct, and, when the matter was at last settled, returned to his flock still quite unpacified. Our road led us right up the valley, and we passed the tents where our sheep had been kept for us, and after a great deal of talk, the purchase of the goat was amicably arranged by our being allowed to carry it off at an exorbitant price.

Chujia-tol, the name of this part of the valley, was the greenest place that we had seen since we left *Gyanima*. The word *tol*, which, however, does not appear to be classical Tibetan, is applied, as well as I could make out, not merely to the locality, but to the whole pastoral establishment by which it is occupied, something as the term *village* designates a settled agricultural community, with their abodes. The population here was not by any means numerous, and we may have passed fifteen or twenty tents at the outside. The people were exclusively nomadic and pastoral, having no homes but their tents, pitching these at such distances from one another that their cattle should have grazing-ground enough, and moving their

encampment to other ground as the grass was eaten up, or as the season advanced. This community, we were told, went northward in the winter towards the lakes, or beyond the lakes, all the country along the Indian watershed and so on, the lakes being then uninhabitable from the great depth of the snow. This is the regular routine of grazing-grounds, which they occupy to the exclusion of other persons, and in which they are held to have a hereditary property.

With the exception of the monasteries about the lakes, *Kyung* and *Khordam* are the highest permanently inhabited places in this part of the country; they are between 14,000 and 14,500 feet above the sea. The fixed population of these places, other than the monks, is, as usual, agricultural; but the



TIBETAN SHEPHERDS.

of the secular inhabitants of the regions we had traversed are entirely agricultural and pastoral in their habits.

As we passed up the valley we at length reached the tent of the shepherd who, with his wife and children, came out to receive us, he presenting to us a ceremony, and the lady a bowl of milk. After a short preliminary ceremony carried on through the medium of our Bhotiyas, for I did not understand Tibetan, we proposed to go into his tent, and he was most happy to do so. We were soon joined by some of the *élite* of the society of *Chujia-tol*, but as they were being absent, our visitors were nearly all women.

The men wore a loose gown tied round the waist, which, if not black

at all events become so by dirt. They had high cheek-bones, oblique eyes, dark complexions, and their hair was worn with long tails, their rough and weathered looks showing the hard life they must lead. Among the more prominent of the various parts of their costume and its accessories were a grey felt cap, the sides of which are turned up all round; cloth boots, called *lam*, of various bright colours, mostly red and green, with leather soles; and a belt, from which is hung a great array of purses, pouches, knives, pipes with apparatus for striking a light,

Also should be mentioned the brass box almost invariably hung round their necks or over their shoulders, containing either charms or, maybe, their Penates in the form of a clay figure of *Buddh*, made at Lhasa and blessed by the great Lamas. These figures, however great may be their spiritual value, do not bear an extravagantly high price in the worldly market, for I found that a Tibetan was very willing to overcome his scruples and part with his consecrated *Buddh* for a matter of some four or five rupees.

The women—I cannot call them the fair sex—were gowned and booted much as the men; but they were chiefly conspicuous for their peculiar head-dress, apparently a triangular board covered with cloth, which is fixed on the top of the head, the sides turned behind and prolonged down the back into a tail of leather decorated with a profusion of pieces of brass, turquoises and other stones, and bits of glass, and with rows of little silver coins hanging from its edges. The hair under this artificial apparatus is plaited in front in many separate little braids, and a grand artificial tail hangs down behind, which produces, with the artificial one, an effect which would not a little surprise the coiffeurs of Paris. The ladies' toilet was completed by a tremendous chatelaine, which seemed to contain all conceivable ornaments ever invented for the use of a Tibetan household.

The tent was made of black yak-hair cloth, 15 or 20 feet long, and half as wide supported on three upright poles connected by a horizontal ridge piece. The ridge was open at the top, all along the middle, to let out the smoke, the fires being arranged between the poles on the ground below. The doorway was at one end, and closed by blankets that hung before it. At the opposite end, on a little sort of table, were set up the household gods, having a number of small brass cups arranged in front of them to contain their food, which is a mixture of butter and meal. The head of a goat lately killed lay in front of the deities for their use, and the eatable legs and shoulders had judiciously been reserved for the mortals. A large assortment of pots and pans, of wood, iron, and copper, stood along the inner range, and amongst them I need hardly say was a kettle of tea, with a mess of porridge of buckwheat flour.

Literature and the fine arts appeared not to be altogether neglected in the Tibetan camp; writing materials, ready for the man of business or the scholar, and a stringed instrument of the guitar fashion for the poet or musician, formed part of the furniture of the tent. Outside was a large wooden shovel, used to clear away the snow.

Our host's name was *Angchu*, an oldish gentleman, and as we sat in his tent, Mr. Winterbottom was engaged in sketching the inmates, while with the help of an interpreter I carried on the conversation. Although head of this community, Mr. Angchu said that he had no perquisites in that capacity—nothing, indeed, but the honour of the thing, and that he was only kept in this position for the purpose of satisfying the authorities some one through whom they could act in their dealings with his people. This statement of Mr. Angchu is, I fear, not strictly correct, but his emoluments, no doubt, are not very great, and there was probably some ground for his grumbling. These nomads appear to pay no regular taxes to the state, but to be generally squeezed. Thus they supply food and carriage to the Lhasan

officers when they move about the country; they are compelled to buy their tea and the scarfs of ceremony, and perhaps other things of which a Government monopoly is established, from the Tibetan officials, paying for them prices which they aver are three or four times what they ought to be. They also have to give up to the Government one load in ten of the salt or borax which they collect.

They are altogether dependent on barter for their supplies of grain; parties with sheep and goats are sent to the mountains north of *Kailas* to collect salt and borax, and they exchange these for the cereals which they require.

Their domestic animals comprise sheep, goats, yaks, ponies, and dogs. The sheep make butter and a sort of cheese from the goats and cows' milk. The best butter would be very good if it were not ruined by dirt, and filled with an unlimited quantity of hair. The coarser hair of the goats is used for making ropes; the down under the hair is the shawl wool, or *pashm*, and its growth is altogether



TENT OF ANGCHU, WITH HIS WIFE AND CHILDREN, RECEIVING OUR VISIT.

dependent on the cold of the climate in which the animal is bred. The sheep produce wool only. The hair of the yaks is employed in making the coarsest cloths, such as those used for tents.

The goats are usually branded in the horn. The sheep are marked with red ochre, much as in England, but not quite so neatly. Unlike the Hindu agricultural people, they only keep one bull yak in each village or nomad community, and we saw him on our way up the valley, looking very large, fierce, and shaggy, high in his fore quarters, and low behind—very much resembling the form of the bison. The young bull reserved to replace the old one was also pointed out; he was marked by a tassel fixed in his ear.

We stopped about an hour at the Huniya's tent, during which time sufficient grain had been purchased to last till we fell in with the convoy ordered to meet us at *Tazang*, where we hoped to arrive in two days' time. Starting once more, we again followed up the valley as before, its depression below the highest level of the alluvial deposits, which here had a considerable development on our right, gradually diminishing, till at length we once more found ourselves on a level with the surface of the extreme south-east angle of the great plateau itself. We encamped not far from *Lama Chorten*, about 200 feet above the plain, at the foot of a spur from the Indian watershed, which rose steeply on the south above our tent. On the north the hills terminated nearly opposite to us, so that we looked across the plain without interruption for many miles in the direction of the lake of *Gyanima*.

We had now returned to within a short distance of the *Darma Yaakti*, of which we had encamped some miles lower down on the 11th of the month on our way to *Rakas-tal*. This river rises from glaciers on the north face of the Himalaya, and the roads from the *Kach*, *Nuye*, and *Lankpya* passes all lead down

me one or other of its feeders. It appears as if there were here some suppression of the ordinary outlying spurs of the watershed ranges, and perhaps even a depression in the ridge itself. Up the *Darma Yaukti* we looked into a wild and mostly gorge, filled with snow and ice, down which howled a furious wind, pouring out a great fan-shaped mass of cloud over the gap, at the mouth of which we camped. A little snow fell near us, but the cloud was dissipated before it spread very far over the plain, reabsorbed under the influence of the greater heat and dryness of its open barren and arid surface.

September 22. From Camp near Lama-chorten to the Gunda-Yaukti, 7 miles.

At 6 a.m., thermometer $21^{\circ}5$; at 9 a.m., $43^{\circ}3$. The man sent this morning usual to bring water for our use, returned with it in a blanket, in the shape of pieces of ice, the stream from which a supply had been got the evening before having been frozen solid during the night. The cold by this time had become rather severe at night. The contents of our teapot, which we used the last thing the evening, were usually found to be frozen hard before morning, lying on the ground beside us as we slept; and to-day we had an additional example of the extreme cold. We had filled a bottle with milk got from the Huniyas of Chujiya—and it was left in a basket outside the tent. During the night it froze into a solid mass and broke the bottle to pieces, but as this was discovered before it began to melt, no harm was done, and we were more careful in future. Our tent, being made to open all along the top to let out the smoke, as I before explained, in a great deal of cold air, in spite of all attempts made to fasten up the chink, the temperature inside in the morning was nearly that of the external air; but in spite of the cold we got on pretty well.

In approaching the *Darma-Yaukti* we came upon an elevated mound of detritus the origin of which was at first difficult to understand, but I was soon satisfied that it must have been the moraine of an old glacier. The breadth of this remarkable mass of detritus was about 3 miles where we crossed it, divided down the centre of the river, to which it forms what at first sight were two ordinary alluvial banks. It extends 3 or 4 miles below the point where the river quits the mountains, and its highest points are perhaps 200 or 300 feet above the plain, from which it rises abruptly. The summit was covered in a striking manner with small hollows of more or less circular outline, in no way communicating one with another, their sides sloping steeply inwards to a flat muddy bottom, such as might have been formed by the gradual melting of ice covered by moraine detritus. In other respects, also, the material of which the mass was made up had all the characters of a glacier moraine, and was certainly neither drifted gravel nor water-worn shingle. I had satisfied myself of the true nature of these mounds, when to my surprise I found another accumulation of precisely the same nature, along the Gunda Yaukti, which river we halted for the night. The interval between the two old moraines—such they certainly are—is precisely on the same level as the great plain, or, more correctly, is actually a part of it, and it hence became evident that the mounds for which we had passed must have been formed along the rivers, and the agency of glaciers readily suggested itself. A very similar mass of detritus to that we had here would be formed now by the dissolution of a glacier such as that of Milam, the lower part of which is for many miles entirely covered with great quantities of rocky detritus, with isolated hollows and pools of water scattered over it. The disappearance of the ice from beneath this detritus would leave a condition of the surface in no way differing from that observed on the top of these mounds, the formation of which it would otherwise be difficult to explain. I shortly afterwards noticed something of the same description on the flank of one of the mountains near *Unta-dhura*, on our way back to *Milam*, where an accumulation

of rubbish, with several small pools of water on it, blocks up the end of a ravine—the result, no doubt, of the destruction of a small secondary glacier.

A very cold and violent wind again blew to-day from the recess in the mountains at *Lama-chorten*, and we saw that a fall of snow was taking place at the entrance of the gorge from which the *Darma-Yaukti* issues into the plain of *Gye*. To-day as we went along the plain we noticed the *Ephedra Gerardiana* in considerable quantity, with its red fruit now quite ripe.

September 23. *From the Gunda-Yaukti to Tasang, 9 miles.*—At 6:30 a.m., thermometer 15°·5; at 7 a.m., 23°·2. There was a good deal of ice on the *Gunda-Yaukti* as we crossed it this morning, and the stream was considerably less in volume than it had been when we came to it in the afternoon yesterday. We were here visited by a pair of great ravens, which had managed to find out our tent in the middle of this wilderness. Exhibiting the ordinary impudence of such birds, one of them fell a victim to Bachu's gun. He turns out to be identical with the great European raven. So, also, it is curious to find that the common magpie of Tibet is the ordinary English species. The simultaneous discovery, on crossing into Tibet from the Himalayan watershed, of so many European forms, whether in the animal or vegetable kingdoms, is manifestly no mere accidental coincidence.

Leaving the ancient moraines of *Gunda-Yaukti*, we again descended to the level of the plain near the origin of the ridge called *Temba-dhar*, which separates the headwaters of the *Gunda-Yaukti* from those of the *Chu-naku*. We here managed to catch one of the rat-like animals we had seen at Gyanyima. The only new plants were *Biebersteinia emodi*, *Euphorbia tibetica*, and *Scirpus caricis*, with *Agropyron longe-aristatum*, a grass which is found at all elevations above 5000 feet. The botanical and zoological curiosities of this barren region were by this time well-nigh exhausted, and the tedium of our last few days was chiefly relieved by the consciousness that we were very speedily to be released from the discomforts of our Tibetan journey.

The *Chu-naku* was a small clear stream sunk only 20 or 30 feet below the general level of the plain, and shortly after crossing it we once more entered the outer ranges of the Indian watershed, and, following up a ravine with low hills on either side, we encamped at last at *Tasang*. This is one of the chief places where the Juhari Bhotiyas carry on their traffic with the Huniyas, bartering grain for salt and borax. It is said to be a good grazing-ground earlier in the season, but not a vestige of anything for the cattle to eat was now to be seen. The men were more fortunate, for we found that the provisions we had ordered had been waiting for us for the last day or two, and as the weather seemed quite settled, it looked as though our expedition would end with complete success. A little anxiety had at times been evinced by our Bhotiyas lest bad weather should come on, in which case we might have got into difficulties, for the passes from *Milam* into Tibet are sometimes permanently blocked up with snow for the winter by a fall late in September. In that case we might have had to go round by the *Niti* pass, which can be crossed in fine weather all the year round, but this would have been excessively inconvenient, as we could not then have got back to *Milam*, where we had left our servants, tents, and other effects, under three weeks or a month, there being no passage from *Niti* to *Milam* after *Unta-dhura* is closed, except by making a *détour* to the south of 150 miles.

It will serve to show the somewhat indefinite character of the names of places in these regions when I mention that the term *Tasang* is applied to three distinct localities in this vicinity, within 2 or 3 miles of one another. To prevent confusion they are distinguished by the Juharis by the additional affixes *Sukha*—"dry;" *Lam*, "snow-boot;" and *Huniya*, Tibetan. That at which we encamped was

at *Tazang*, where the tents of the *Patwari*, or headman of Milam, are commonly pitched. Others of the Bhotiyas go to *Sukha-Tazang* or to some intermediate point in the ravine between these two places, and the *Huniyas* frequent the spot called *er* them. It will be easily understood that, with the numbers of sheep employed in this trade, it is necessary that there should be a certain amount of elbow-room allowed between the different camps.

As we arrived at the end of our march rather earlier than usual, the following observations were made of the temperature :—

p.m.	Air.	Wet Bulb.
At 4.0	42°·7	29°·8
„ 5.0	35°·4	25°·1
„ 6.0	30°·2	24°·6

This indicates the extreme dryness of the air.

September 25. *Tazang* to *Chirchun*, 10 miles.—At 8 a.m., thermometer 32°; at 9 a.m., 35°; at 10 a.m., 40°·5. We had now again fairly got among the mountains, and the road gradually became more rugged as we proceeded. The rocks



Chor-hoti pass, 18,000 feet.

Malchak peak, 19,800 feet.

RAJ-HOTI VALLEY, 14,900 FEET.

are chiefly of limestone, and the greatest confusion prevailed in the disposition of the strata, though, as usual, on the whole they dipped northerly.

In our way along one of the ravines we came upon the remains of an old dry stone wall, which we were told was a traditional boundary between Tibet and *Juhar*, though regarding the time or manner of its construction nothing was known. I do not think that our Bhotiya subjects have any definite ideas as to the boundary between the British possessions and those subject to Lhasa; nor indeed am I aware that any boundary has ever been settled between the two powers. We English in Sumaon affirm that the watershed is the boundary, and I think no one will dispute the assertion. I was indeed told that *Hoti*, a pasture ground north-east of *Niti* within the watershed, was considered by the Tibetans to be a dependency of *Daba*. But as it was convenient for me to consider it British ground when I was geologizing here in the following year, I did not find any one, either Bhotiya or Tibetan, inclined

to deny my positive assertion that it was British. A dispute about a few square leagues of snowy range will hardly give rise to a *casus belli* between us and the Government at Lhasa, and the geographers on both sides may, I think, be safely left to put the boundary in their maps where they please.

In descending into the most eastern of the main feeders of the *Chirchun* river, we crossed limestone strata filled with fossil shells. These were probably the Cretaceous beds overlying the Jurassic strata, which immediately afterwards we came upon in the Oxfordian black shales, which continued up to the main branch of the river. This runs in a very wide shingle bed, probably a mile across, through these disintegrating strata, and, following it up about a mile further, we reached the halting-ground on its left bank called *Chirchun*. A second feeder of the *Chirchun* river, rising from a glacier that we saw about 2 miles off, joins the main stream just where we crossed it.

Chirchun is about as miserable a place to stop at with cattle as can be well imagined. The flat ground is covered with loose rotten shale without a particle of vegetation on it, and on the hills around there is an almost total absence of vegetable life. At this season the leaves of the few stunted plants that were to be seen had already become parched up by the severe night frosts, and our wretched cattle had to pass another day with nothing to eat but the dry twigs of the *dama* bushes. The feet of nearly all the jhobus were getting affected by the rough ground we had been going over, and one of them to-day fell so lame that, on coming to a green bit of ground, it resolutely resisted all attempts to drive it on, and was there left for the winter, as we supposed, to perish. I confess I was rather astonished the following year, when I was told that the animal had been found again in capital condition near the place where it had been left by us. What it had found to eat during the interval is more than I can imagine, but it was, I suppose, as well off as the wild sheep and yaks and other animals of Tibet at large.

In the course of the evening a considerable commotion took place in our camp, caused by the appearance of a solitary dog, who was on his way from Milam back to his fatherland Tibet. It was supposed that he had been sold or given to some Bhotiya, but that he declined to remain at Milam, a thing said often to happen. As it was probable that the animal was hungry, there was no little alarm lest he should come and eat up anything he could find during the night; to such an extent, indeed, was the anxiety of our Bhotiyas carried, that they thought it worth while to post a sentry to keep him off.

At 9 p.m., thermometer 25°-5.

September 25. *Chirchun to Shelong, 17 miles.*—Having a long day's work before us, which included the crossing of three passes between 17,500 and 18,500 feet in altitude, we started this morning soon after seven o'clock. The ascent commenced immediately, and was pretty easy the whole way up the first pass we had to cross. At first we went over solid limestone rock, but as we rose we again came to the Oxfordian shales, which continued to the summit of the ridge, where parts of them were quite filled with belemnites. We reached the crest of the first pass, *La-Khur*, 18,170 feet, at a little before eleven o'clock, thermometer 27°-3, having been not quite four hours in accomplishing the ascent of 2410 feet. The sky at this time was quite cloudless, and though we were somewhat shut in by higher ridges close to us, we still had a wonderful view of the world of mountains by which we were surrounded. There was little that resembled the grand prospects of the outer Himalaya, where the eye may sweep at a glance over nearly 200 miles of the chain, and trace from their great snowy axis mountain after mountain and range after range gradually unfolding themselves, till the entire circuit of the horizon is filled with the outlines of their countless ramifications,

dark purples of the distance imperceptibly melting into the liveliest tints in the foreground, the ridges clothed with forest, and the valleys enlivened by villages and villages. Unlike this, we here stood in regions where the lichens on the rocks were the last refuge of vegetation. Shattered cliffs and impassable precipices, capped with eternal snow, frowned upon us from every side. Yawning gorges, long barren slopes of loose stones, and the desolation of glaciers lay at our feet. The mountains that bounded our view stood out hard and cold against the clear blue sky, piled one behind the other in a chaos of confusion, neither softened by outline or colour by atmospheric influences, nor relieved by any trace of life or verdure. Among the peaks that I recognized was *Nanda Devi*, distant about 20 miles, which rises to 25,400 feet; but our map, when we passed, was not nearly so correct as it now is, and in such a scene it is extremely difficult to distinguish the ridges and peaks without a good map to assist the eye.

On this ascent the vegetation was most scanty, the last plant seen being the little *Urtica hyperborea*, before noticed, which came up probably above 17,500 feet. From the pass we looked down over two glaciers. That to the east along the side of which we had come gives rise to the principal feeder of the *Chirchun* glacier, and communicates by a great *névé*, over the pass called *La-sar*, with another glacier, over which, as I before mentioned, ineffectual attempts had been made to establish a direct communication from *Dung* to *Chirchun*. The glacier to the west of the pass supplies the chief feeder of the stream that flows under *Topiung* and *Girthi*, and our road lay down it. The descent was fearfully steep, over a cliff of limestone interspersed with the great slopes of loose sharp fragments of rock that are so characteristic of these mountains above the limit of vegetation. For the first time since quite the beginning of our journey, I thought the descent so bad that I would not ride my jhobu down it, though, in fact, it would, I believe, have been safe enough to do so. The slopes of loose sharp angular masses of limestone lying at their natural angle of repose, between thirty and forty degrees from the horizontal, varied here and there by a step of solid rock polished by the feet of men and cattle, down which, alippery as they were, the jhobus did half to jump, half to slide, did not afford an inviting prospect for such a ride; a false step must have shot the rider over the animal's head, and he would then, without fail, and in an incredibly short time, have been added to other rubbish on the moraine of the glacier below.

We managed, however, to reach these moraines in a more convenient manner. We found them and the lower part of the glacier generally very black from the dark shales and limestones which are here the prevailing rocks. Crossing the glacier, we went up the opposite moraine, and a steep pull brought us to the summit of *Jainti dhura*, the second high ridge we had to go over, at about half-past one o'clock. This point was about 18,390 feet above the sea, and is one of the highest passes that I have crossed. The thermometer in the air stood at 31°·2, the soil one foot below the surface being 31°·5.

Jainti is merely a short projecting spur from the *Unta-dhura* watershed ridge, over which the route from *La-khur* to *Unta-dhura* crosses. From it rises a peak that reaches an elevation of perhaps 19,000 feet, a little to the north of the point where we crossed it, and beyond this it ends abruptly in a precipice over *Topiung*. Being thus thrust out, as it were, from among the surrounding great ridges, though it is probably as high as most of them, the view from *Jainti-dhura* is grand in the extreme.

In passing through the highest portions of these mountains, the traveller, who naturally expects to find scenes of surpassing grandeur in the midst of their fantastic snow-clad pinnacles, is too often doomed to disappointment, and in his

painful progress along the narrow gorges he seldom sees anything beyond the rocks that frown immediately over his head. Exceptions there are, however, and the scene that we here had presented to us was among these so often hoped for, but so seldom found; nor do I ever remember to have beheld, either before or afterwards, such a stupendous chaos of mountains, of the effect of which on the mind no description could convey an adequate conception. It was a brilliant day; the wind not too strong, and the intense power of the sun was agreeably subdued by the fleecy white clouds which hung about the higher peaks, or floated off from them in the fresh breeze until they disappeared in the blue sky of Tibet. High health, the feeling of exhilaration felt in sharp and dry air, and the satisfaction which we experienced at the successful termination of our journey, prepared us to enjoy whatever we saw. Nor are the silent and almost unperceived suggestions of scientific culture among the least important agents in producing the emotions of wonder that fill the mind in gazing on such scenes, where the relics of the ocean-beds of an almost measureless past, piled one on another at these stupendous elevations, display the vastness of the powers of nature, into the operations of which we strive not too successfully to inquire. The glacier along which we had just come descended thousands of feet below us, and gave birth to the *Girithi* river, a torrent the course of which was marked by a streak of foam along the great gulf into which we looked. A huge rock rose from the middle of this glacier, throwing off the frozen stream on either side in great wave-like cliffs of ice. *Unta-dhura*, the first pass we had crossed on our way into Tibet, we now saw, not a little to our surprise, almost at our feet, 800 feet below us. Yet no snow lay on the ridge on which we stood, neither had we hitherto crossed any snow in our ascent either on the *La-khur* pass or to the still higher spot where we then were. Of vegetation there was no vestige, excepting far down in the gorge of *Topi-dunga*, beyond which towered *Kamet*, the great peak of the *Garhwal* watershed, 25,502 feet in altitude.

The cliffs that flank *Topi-dunga* on the south are of Upper Silurian age, and are violently shattered and most precipitous. The order of succession of the beds, which extend from Silurian to Carboniferous, is strongly marked by their vividly contrasted colouring. Grey, black, and dark red, having a pale band of quartzite on the top of all, which looked almost ghastly among the snow that lay thick upon it. The escarpment of *Kyungar* facing the south-west is as abrupt as is well possible, but is topped with a less rugged and more swelling outline. It is composed of Triassic and Rhenetic capped with Cretaceous beds, and a continuation of it, no less precipitous, extends beyond *Girithi* along the north bank of the *Hoti* river. Beyond *Hoti* the continuity of the ridge is broken, but as a geological feature the escarpment can again be recognized at the *Niti* pass.

An easy descent brought us to the north foot of *Unta-dhura*, where we found that fresh snow had fallen since we had crossed. The old snow, which must have been the accumulation of former years, was distinguished by an appearance of stratification caused by the edges of a succession of icy bands projecting obliquely from the general snow surface, with as many intermediate layers of softer snow between them. The lamination may be readily understood as the effect of the freezing of the surface of successive falls of snow, and is commonly to be seen in similar circumstances. It was in the hollow between *Jainti* and *Unta-dhura* that I noticed the remains of the old glacier which I mentioned when describing the old moraines on the *Darma Faukti*. On the summit of *Unta-dhura*, which we reached at a quarter to three, there was no vegetation whatever, excepting a few lichens on the shattered rocks that crown the ridge. The thermometer was now at 31°-2.

I have already described the route from *Unta-dhura* to *Milam*, which we now

rain joined, and I need only add that our descent was undertaken under very different auspices from our ascent. Our return journey over these passes had, in fact, been anything but painful, and there was, I think, no day which we had spent agreeably since we left *Milam*. We were, however, late in reaching *Shelong*, chiefly from the cattle being generally knocked up by want of food, and from many of them having sore feet. This indeed had got to such a pitch that their track was marked over the glaciers in blood, but it was impossible to loiter; nor could we halt at *Dung*, for there was not a scrap of wood nor a blade of grass to be got there.

We ourselves arrived at *Shelong* shortly after seven o'clock in the evening, having been nearly twelve hours on the road; but the tents did not come up for a long time, and we had an opportunity, as we sat in the open air by a fine blazing fire of juniper, such as had not rejoiced us for weeks, of admiring the genial warmth of the climate of a spot only 12,500 feet above the sea-level. The following morning, September 26, we returned to *Milam*.

The day after our arrival at *Milam*, a Huniya arrived from *Dungpu*, a village near the *Satlaj*, sent by the *Zungpun* of *Daba*, who had by this time become weary of our having gone into Tibet, to inquire where we had been, and to see whether we had come back. The *zungpun* had sent his emissary from *Dungpu*, who passed that place on his return home from *Darchin*, where he had been to meet some *Lhasan* officers, probably those we had heard of at *Chujia-tol*. He had no definite knowledge of our movements, but had heard that we had crossed the frontier. I desired a message to be sent in return to tell him exactly where we had been, and I added, that if it suited me to go into *Hundes* again next year he should certainly do it. I had no idea at the time of doing anything of the sort, but that I did actually carry my threat into execution. At the same time it must be said that it is very doubtful whether my message was ever delivered to him.

Note on Himalayan Glaciers.

The largest Himalayan glacier with which I am personally acquainted is that near *Milam*, at the head of the *Gori* river; but those of the *Vishnuganga*, near *Nadarinath*, and of the *Bhagirathi*, near *Gangotri*, are also extremely large.

The annexed woodcut (p. 412) will convey an idea of the size of the *Gori* and *Vishnuganga* glaciers, of which we have rough plans, as compared to some of the best-known glaciers of the Alps.

It will here be seen that the *Gori* glacier alone, the surface of which is about 11 miles long, is so large that it would about fill the whole valley of *Chamonix*, from the *Col de Balme* to *Ouches*; at the same time, while the summit of *Mont Blanc* rises about 12,300 feet above *Chamonix* in a distance of 6 miles, the peaks at the head of the *Gori* glacier rise above *Milam*, at a distance of 12 miles, only 12,200 feet. The glaciers of the valley of *Chamonix* are not by any means the largest in Switzerland, and the glacier of *Aletsch*, in the *Vallais*, must, judging from the map, be nearly as long as that of the *Gori*, or even longer, but the valley of *Chamonix* is so well known, that the comparison with its glaciers will probably be more generally appreciated.

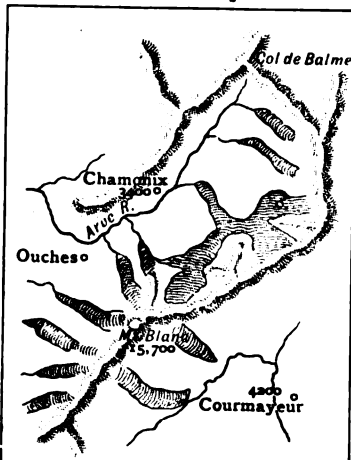
On the southern slope of the tableland, the glaciers appear to descend somewhat lower in the north-western regions than in the eastern; Dr. Hooker informing us that they seldom, if ever, descend so far as 14,000 feet in *Sikim*,* while they frequently reach below 12,000 feet in *Kumaon*. Immediately north of the *Indian* watershed, the glaciers are smaller than to the south of it, and terminate at much higher levels, varying from 15,000 to 17,000 feet; in the central parts of *Western*

* 'Himalayan Journals,' vol. ii. p. 57.

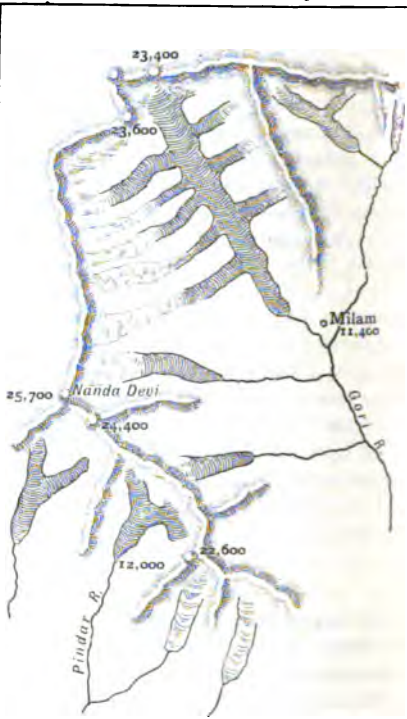
GLACIERS

Of the Alps.

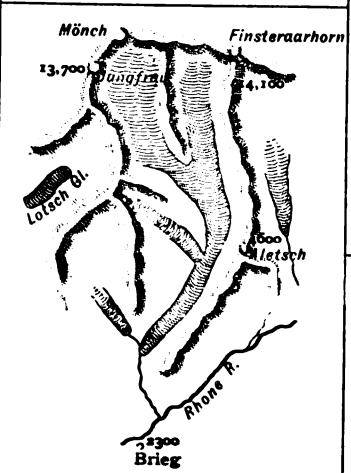
Of the Himalaya.



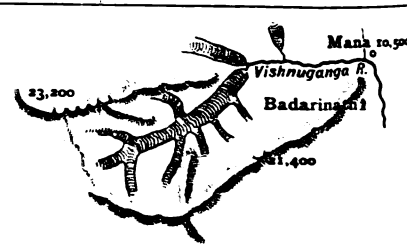
System of Mont Blanc.



Systems of the Gori and Pindar.

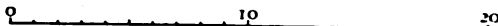


Glacier of Aletsch.



Glacier of the Vishnuganga.

Scale: Eight miles to one inch.



Tibet they appear to be comparatively rare and of small dimensions; but on the Turkish watershed they again become much larger, and some of them come down even a little below 12,000 feet, though others on the same range terminate as high as 15,000 feet.* In the countries north-west of the Indus, near Gilgit, Mr. Winterbottom found one of the glaciers to descend as low as 8600 feet.

The variations in the levels to which these glaciers descend must, in a great degree, depend on the peculiar circumstances of each individual locality, though the mean temperature of the place will of course, to some extent, regulate their general elevation, and the summer temperature will give a negative limit, beyond which they can never pass. The two chief factors of these variations will be, first, the extent and elevation of the snow-basin that feeds the glacier; and, second, the slope of the surface along which the glacier travels. It will be seen, on a moment's consideration, that if two glaciers are formed on opposite faces of a ridge like the Indian watershed, which descends on the south side from 18,000 to 11,500 feet in a direct distance of 10 miles, while on the north the descent is only from 18,000 to 16,000 feet in the same distance, a south glacier of 10 miles long will arrive at a level of 11,500 feet, and a north glacier of the same length only 16,000 feet. If the feeding snow-basin is larger on the south face, the additional waste from the glacier descending into warmer regions may be easily countervailed, but no imaginable increase in the supply of snow would be likely to carry the north glacier to such a level as 11,500 feet, which it might not be able to attain without an extension of its length of 100 miles or more. These considerations, combined with the known diminution in the fall of snow in the interior of the chain, appear to be sufficient to account for the higher level at which the glaciers terminate to the north of the Indian watershed, without supposing any special action of climate as has been suggested.

No really satisfactory conclusion can be come to regarding the cause of the lower level to which the glaciers of the Himalayan slope descend in Kumaon, as compared to Sikim. Judging from the somewhat greater elevation to which forest extends in Sikim, we may, perhaps, have some reason to infer a rather higher mean temperature at like elevations in Sikim than in Kumaon, which, indeed, might be considered a natural result of the lower latitude of the former; but our thermometric data are not sufficient to settle the point directly, and the climate of Sikim being so much more wet than that of Kumaon, it would be unsafe to make use of mere *à priori* arguments.

For similar reasons, it is hardly possible to institute any proper comparison between the glacial phenomena of Europe and the Himalaya, but the following points may be noticed:—

HEIGHTS ABOVE SEA-LEVEL.

	Europe.		Tibeto-Himalayan System.		
	Norway.	Alps.	South of Indian watershed.	North of Indian watershed.	Turkish watershed.
	Ft.	Ft.	Ft.	Ft.	Ft.
Snow-line ...	3000-5500	8500	16,000	18,000	20,000
Glaciers end ...	0-1500	3500-6000	11,600-18,000	15,000-16,000	11,800-15,000
Glaciers descend below snow-line ...	3000-4000	5000-2500	4400-3000	3500-2500	8200-5000

* R.G.S.J., vol. xxiii. p. 52; Thomson's 'Travels in Tibet.'

From these figures it will be seen that the range of glaciers compared to the snow-line, is very similar in Europe and on the Himalaya, though in Northern Tibet, in one well-ascertained instance, in Yarma-Nubra, a glacier is known to descend more than 8000 feet below the limit of perpetual snow. The glacier seen by Mr. Winterbottom, north of Gilgit, coming down to 8600 feet, that is, perhaps to more than 10,000 feet below the snow-line, is yet more extraordinary; but the elevation is not so well determined in this case; nor have we any direct evidence as to the height of the snow-line on the mountains in this quarter, though from the general arid character of the country, we have no reason to suppose the climate to be more wet than Northern Tibet generally, or that the snow would lie lower there than on the Karakorum pass, where it has been estimated by Dr. Thomson not to come below 20,000 feet. This point is worthy of the attention of travellers in these countries.

In the absence of satisfactory records of the thermometer at places on the Alps, near the termination of a glacier, I have calculated the mean temperature of three of the hottest months for Chamonix, by interpolation, in proportion to its elevation, between Geneva and the Convent of St. Bernard, and I find them to be—July, 61°; August, 61°; September, 55°. Taking Vevay as the lower station, instead of Geneva, which appears abnormally hot, the temperatures would be—July, 59°; August, 57°; September, 52°. For three years the mean temperature of Zermatt was, for July, 56°; August, 51°; and September, 49°. At Grindelwald for two years: July, 60°; August, 57°; and for one year: September, 50°. These figures may be compared with the mean observed by myself at Niti, at 11,600 feet, the extreme limit of glaciers in Kumaon, which will be seen to be nearly the same, namely, July, 58°; August, 58°; September, 55°. So, too, in Norway, the approximate summer temperatures at the termination of the southern groups of glaciers, which descend to about 1200 or 1300 feet above the sea, may be taken at 4° less than the mean of Bergen and Drontheim, that is, July, 59°; August, 55°; and September, 50°. And for the more northern regions, where the glaciers reach to the sea-level, we might have temperatures intermediate between Drontheim and Alten, or July, 60°; August, 57°; and September, 49°. From this, it would appear probable that the extreme limit to which glaciers can reach will not have a mean temperature of the hottest month exceeding 59° or 60°.

All the phenomena of glaciers seen elsewhere are to be observed on those of the Himalaya and Tibet, and, with two exceptions, they will require no special comment.

The first of these is the velocity of the motion of the ice, which must, of course, greatly depend on the circumstances of each particular case; but an analogy with the motion of the glaciers of the Alps is sufficiently shown by the few observations I have made in Kumaon. The mean of four days' motion in May, on the glacier at the source of the Pindar, gave a velocity of about 9½ inches for the twenty-four hours, for the central parts of the ice, about 1¼ mile above the terminal cave. The same glacier, from May 21 to October 15, moved over 98½ feet, being at the rate of just 8 inches in the twenty-four hours.* The motion of the centre of the great glacier of the Gori, 7 or 8 miles from its lower extremity, was 38 feet, between August 29 and September 30, being at the rate of about 14½ inches in the twenty-four hours. In juxtaposition with the above, I may add, that the motion of the Mer de Glace, as measured by Prof. J. Forbes, varied from 27 to 9 inches in twenty-four hours in different parts of the glacier and at

* For details of the first measurements made by myself of the motion of the Pindari glacier, see *J.A.B.S.*, vol. xvii. p. 203.

different times between the months of June and September ; the mean at a central point (L'Angle) being about $13\frac{1}{2}$ inches in twenty-four hours for the three months of July, August, and September.* The motion of the middle part of the glacier of the Aar is also stated by M. Martins to be 71 mètres per annum, which amounts to $7\frac{1}{2}$ inches in twenty-four hours.†

THE DATE LINE IN THE PACIFIC.‡

DR. A. M. W. DOWNING, F.R.S., has kindly supplied us with the following. He has also obtained permission for the reproduction of the interesting map which accompanied his paper.

The point to which attention is drawn in this paper is this: Where does the day change for the portion of continents and islands which are contiguous to the 180th degree of longitude? or, in other words, what is the course of the date line (as it is called) from the arctic to the antarctic regions?

It is obviously most convenient that the date line should approximate, as closely as political and geographical circumstances will admit, to the 180th degree of longitude. Prior to about the middle of the present century this was far from being the case. Up to that time the Philippines kept the American date, owing to the fact that the Spaniards originally approached those islands from the Pacific coast of America. Thus Luzon and Celebes, though on the same meridian, kept different dates, the former the American, the latter the Asiatic. To remedy this inconvenience, the Manila authorities arranged that December 30, 1844, should be immediately followed by January 1, 1845, thus adopting the American date for the archipelago.

The purchase of Alaska by the United States had also its effect in straightening the date line, as this territory, which had formerly kept the Asiatic date, from henceforth, of course, adopted that of America. Further progress in the direction of the assimilation of the date line to the 180th meridian must necessarily be slow, as the course of the line is mainly determined by the grouping of the islands, and by the particular circumstances in each group upon which depends the direction in which it has intercourse with the outer world.

A glance at the map which accompanies the paper will show the discrepancies that, at the present time, exist in the position of the date line as laid down by different authorities. The most remarkable divergence is in the case of the line given in Stieler's Hand Atlas. But as the Atlas is dated 1892, this position of the date line may, perhaps, be considered as not being quite up-to-date. The line marked "Wharton" is that of the Hydrographic Office, and was kindly communicated to the author by Admiral Sir W. Wharton; that marked "Smith" is taken from an interesting article in the *Century Magazine* for September of last year, by Mr. Benjamin E. Smith, who, however, does not give his authority for the position of the line; that marked "Davidson" is due to Prof. Davidson of the University of California, and was kindly communicated by Prof. Harkness of Washington.

* 'Travels through the Alps,' chap. vii.

† 'Revue des Deux Mondes,' vol. xvii. p. 924.

‡ Abstract of a paper entitled "Where the Day Changes," recently read to the British Astronomical Association, and which is printed in the *Journal* of that Association, vol. x. No. 4.