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depth, so as to present half an inch of clear space all around. This ought to be stuffed with hair, with scraps of cork, or with India-rubber, or fitted up with springs—fitted up in some such way as to diminish the risks of concussion or vibration. Were the whole after this sewed round with soft leather, like the cover of a spy-glass or powder-flask, and the instrument made to sling across the shoulder, it would, I think, be so thoroughly protected as to reduce the risk incurred to a mere trifle.

In the case of this, as in that of all the other instruments, it ought to be a maxim that weight with us is always a secondary matter to security; and that all the dangers likely to be encountered should be provided against at home; and it should never be forgotten that nothing that will warp with heat, such as a thin piece of board, soften with any amount of damp combined with warmth, such as glue or gum, or attract insects, such as paste, unless thoroughly poisoned by corrosive sublimate, should be sent to India; and that as instrument-makers, or even good mechanics, are things almost unknown amongst us, that things apt to get out of order should be made as simple and as easy to take to pieces as possible.*

VII.—*On the Physical Geography of the Provinces of Kumáon and Garhwál in the Himálaya Mountains, and of the adjoining parts of Tibet.* By R. STRACHEY, Esq., of the Bengal Engineers. Communicated by Sir Roderick I. Murchison.

[Read May 12, 1851.]

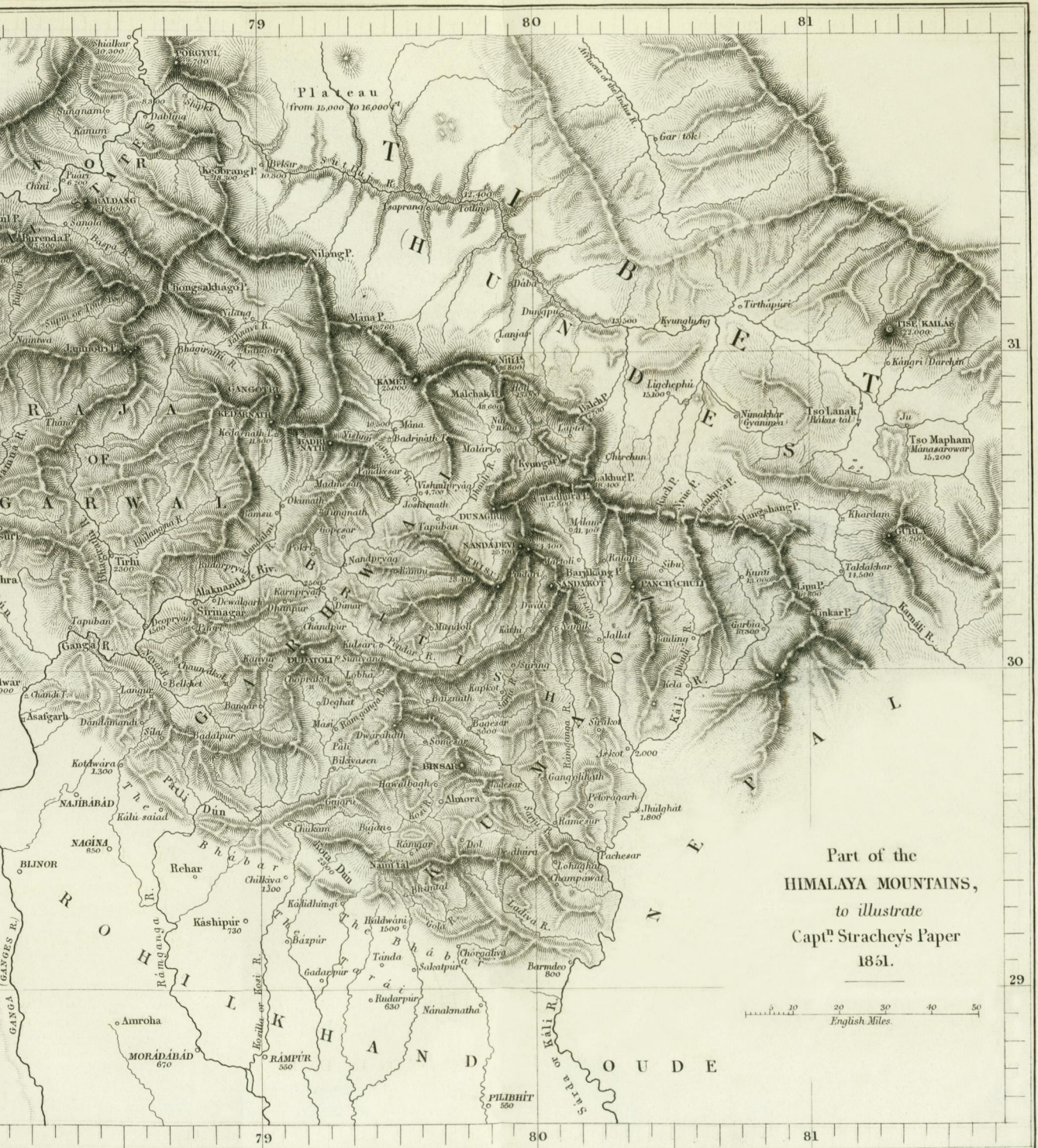
ALTHOUGH we are still almost entirely dependent upon Chinese geographers for our topographical knowledge of what has been called Central Asia, some small accessions to our stock of information are gradually being made which render it necessary for us to modify from time to time our preconceived ideas of the physical nature of this region, from which European travellers still continue to be most jealously excluded by the policy of the Chinese, who are everywhere paramount between Siberia and India.

The comparatively small elevation of the greater portion of this “terra incognita” was, I think, first pointed out by Humboldt, and we were taught by him, most correctly, that the high lands were confined to its more southern parts, which are commonly known to us under the name of Tibet.

This elevated region, to which it is that I now propose to direct your attention more particularly, extends through nearly 30° of

* See also the Paper by Lieut. Kay, R.N., Director of the Royal Observatory, Hobart Town, in the Journal of the Royal Society of Van Diemen's Land, p. 83, Jan. 1850.—ED.





longitude from the sources of the Oxus to those of the Hoang-ho, the Yellow river of China. We are familiar with the mountains that abut upon, and indeed form its southern edge, as the Himálaya; while there seems every reason to suppose that the chain that appears upon our maps as the Kouenlun in like manner forms its termination to the north. The plains of northern India, whose greatest elevation above the sea is not more than 1200 feet, are spread out for an extent of upwards of 1500 miles along its southern face; the countries around Yarkund and Khoten forming an equally striking plateau, from which it rises on the north, at an altitude that can hardly exceed 3000 feet, as we may safely infer from the nature of its vegetable productions.

The journeys of our modern travellers have been almost entirely confined to the southern or Himalayan border of this region, and its northern declivity has only once been reached. Little is known of the interior or more northern parts, with the exception of Ladák, and the countries that lie on the upper portions of the Indus. It is therefore impossible to offer any general account of it based upon actual observation, but as far as we can judge from those parts that have been explored, and from the accounts that can be gleaned of the rest, it appears to be with few exceptions broken up into a mass of mountain, the average elevation of whose surface is very great, often exceeding in altitude 15,000 feet. I would further add, that it is the opinion of my brother Captain Henry Strachey, whose prolonged residence in Ladák, and whose general familiarity with the north-western Himálaya, give him the best means of forming correct conclusions on such points, that neither the Kouenlun, nor the Himálaya, as marked upon our maps, have any definite special existence as mountain chains apart from the general elevated mass of Tibet. That rugged country thus seems to form the summit of a great protuberance above the general level of the earth's surface, of which these two chains form the north and south faces. All my own observations lead me to concur entirely in this opinion.

Having thus attempted to give some general idea of the main features of this very remarkable region, I shall proceed to illustrate rather more fully some of the more striking physical peculiarities of those parts of the mountains in which my own personal observations have been made; viz. the British Himalayan provinces of Kumáon and Garhwál, and the part of Tibet that is immediately contiguous to our frontier. And in doing this it is necessary that I should explain that, although there seems to be much general similarity in the structure of the various parts of these mountains, yet that my remarks are only to be considered as strictly applicable to the particular region that I have just specified unless the contrary is distinctly stated.

I would here also add, that it is altogether to Mr. Thomason, the present Lieut.-Governor of the north-western provinces of Bengal, that I am indebted for the opportunities I have had of making the researches of which I am about to give a short account; I having been employed by the Indian Government, at that gentleman's suggestion, for this special object, during the years 1848 and 1849.

CONFIGURATION OF SURFACE.

Plain of India.—Along the whole of the southern face of the Himálaya, from the débouche of the Indus to that of the Bráhma-pútra, extends a vast unbroken plain, which is prolonged southward to the Bay of Bengal near Calcutta on the one hand, while on the other it follows the Indus through the Punjab and Scinde to the Arabian Sea, covering in all an area of nearly 500,000 square miles. The highest portion of this plain is that between the rivers Sutlej and Jumna, and its elevation along the foot of the mountains is there probably about 1200 feet above the sea.

Siwalik Hills.—The transition from the plains to the mountains is sudden and well defined. A line of hills that has been called the Siwalik or sub-Himalayan range, and that will be well known to geologists by the striking palæontological discoveries made there by Dr. Falconer and Colonel Cautley, rise abruptly and without any intermediate undulating ground from the apparently perfectly level surface of the flat country. Their elevation varies from a few hundred to three or four thousand feet. These hills seem to have, with hardly any exception, a well-defined existence along the whole of the southern edge of the Himálaya, presenting much the same general features along the entire line of mountains.

Dúns.—The strata of which they consist usually dipping inwards towards the general mass of the mountains, a steep face is turned towards the plains, while a long gentle declivity slopes inwards and forms a shallow valley by meeting the foot of the next line of mountains that runs on the whole parallel to the outer line, but from five to ten miles further in. This longitudinal depression, as may be supposed, is by no means continuous, but is broken up into separate short valleys by the occasional partial confluence of the two ranges of hills that usually form distinct lines, and by the passage of the streams that drain the interior of the mountains. The floors of these valleys generally appear to be covered with a deposit of boulder and gravel that slopes somewhat steeply from the great mountains that bound them on the north, so that the whole is considerably raised above the level of the plain without, reaching an elevation of about 2500 feet above the sea. The drainage of these valleys usually collects along their longitudinal

axis, and either falls into some of the larger streams that cross them, or less frequently by a sudden bend to the south finds an escape for itself into the plains through a rupture in the low outer line of hills. These valleys are in the country with which I am acquainted called "Dún," and according to Mr. Hodgson they are termed "Mári" in Nepal.

Tarái.—I may here mention that in some works on Physical Geography these valleys have been confounded with what is locally called the "Tarái," or "Tariyáni,"—a thing totally distinct. Along the southern edge of the outer hills extends a band of 10 miles or so in breadth, usually covered by forest, and remarkable for its utter want of water. All the minor streams, as they leave the hills, excepting when swollen by the periodical rains, are rapidly absorbed and disappear in the sandy and shingly deposits that there prevail; and wells have to be sunk to a great depth throughout this tract before water can be met with. The surface slope of this absorbent band is very considerable near the hills, but rapidly diminishes as we recede from them, and we usually find that at a distance of from 10 to 20 miles from the foot of the hills the character of the country changes rather suddenly, the extremely dry forest belt being succeeded by a line of swamp clothed by a thick growth of reeds and grasses.

It has been often supposed that this swampy tract, which is the true Tarái, was formed by an actual depression in the general surface of the country, but this seems to be altogether an erroneous idea, the truth being that along this line the drainage of the higher country beyond breaks out in copious springs that collect into swamps, partly perhaps from artificial obstructions made for the purpose of utilizing the water for irrigation, but chiefly I conceive from the small slope of the country through which the drainage has to be carried off, which can only amount to a few inches in the mile for a distance of many hundred miles from the sea. We see accordingly that this peculiar feature is confined to the country to the east of the Ganges, the general level of which is considerably less than that to the west of that river.

Mountain Region.—The mountains that I have already alluded to as forming a line on the whole parallel to the outer hills, but from five to ten miles further in, rise somewhat suddenly to an average elevation of perhaps 7000 feet, and with these we enter the great mountain region that extends to the north over a breadth of upwards of 500 miles. For a distance of from 60 to 70 miles from the outer range of hills we find that the mountains are usually of no very great height, their summits rarely exceeding 10,000 feet in altitude. They then, however, again rise rather abruptly and form that wonderful range of snowy mountains that surpasses in its elevation all other parts of the earth's surface now known to us.

Great Peaks.—The loftiest peaks are generally met with from about the 80th to the 90th mile from the southern edge of the chain. Late measurements have shown that more than one of these peaks exceeds 28,000 feet in height : in the districts with which I am conversant, which have been more completely surveyed than the rest of the mountains, there are five or six peaks that are above 24,000 feet, and the number that exceeds 20,000 feet is very great. The great peaks in Kumáon and Garhwál, as may be seen by a reference to the map, are not found on a continuous ridge, but are grouped together in masses, that are separated one from the other by deep depressions through which flow the streams that drain those parts of the mountains that are immediately contiguous to the north. So far as we can judge from the very imperfect maps of the parts of the Himalaya to the east of these provinces, the same sort of arrangement appears to hold there also ; the great peaks being found in detached clusters arranged along the same general line at a distance of about 80 or 90 miles from the southern extremity of the mountains, while the drainage of a considerable portion of the country to the north of them passes through the deep gaps that lie between the different groups. To the west of the Ganges something of the same tendency may be traced, but much less distinctly.

Valleys.—The valleys that traverse the mountains between the snowy ranges and the plains are for the most part little more than gigantic ravines, at the bottom of which flows the river each contains, in a very contracted channel, which at intervals only opens out into an alluvial flat, capable of cultivation. The level of the bottom of these valleys is, of course, very various ; but in tracing up the courses of the larger streams we usually arrive within 10 miles in a direct line from the snowy peaks, without having risen to more than 4000 or 5000 feet. In proceeding, however, we find that where we cross the line on which the great peaks are situated the ascent very rapidly increases, and a very few miles carries the river-bed up to an altitude of 9000 or 10,000 feet : thus showing that the sudden increase of height of the mountains along this line is not confined to the peaks alone, but is a general elevation of the whole surface. As we pass to the north from the line of greatest elevation, the diminution of the altitude of the ridges is not much, while the level of the bottom of the valleys is constantly increasing in height ; it is, therefore, not improbable that the mean height of the whole may actually increase as we recede from the great peaks until we reach the watershed of the streams that flow to the S., which is found at about 25 miles to the N. of those peaks.

In passing through the most elevated portions of the mountains, the traveller, who naturally expects to see scenes of surprising

magnificence amid these gigantic snow-clad pinnacles, is too often doomed to be disappointed ; for, in his painful progress along the narrow gorges that traverse these regions, he can but seldom see anything beyond the rocks that frown immediately over his head. Exceptions however there are, though few, to this rule, and we are sometimes able to snatch from the summits of the higher passes, in the rare intervals during which they are not shrouded in mist, views of stupendous and chaotic masses of mountain that fill the mind with astonishment and awe.

Passage into Tibet.—Nor is the scene that presents itself, when we at length reach the watershed, less remarkable. After weeks have been spent in traversing mountain after mountain, of the seeming interminable succession of which the eye begins to tire, while the incessant roar of the torrents that rush by begins to weary the ear, we are here suddenly arrested by seeing spread out before us a plain, that without sign of water, of vegetation, or of animal life, stretches away, as far as the eye can reach, in a north-westerly direction ; behind which rise mountains that gradually fade away in the distance, with here and there only a peak lightly tipped with snow.

Elevated Plain.—This, in fact, is the very plain which was seen by some of the earliest missionary travellers in Tibet, and the account of whose existence gave rise to the idea that the whole country was a vast plain of immense altitude. When it became apparent, as it ultimately did from the accounts of subsequent travellers, that a great part of Tibet was a confused mass of mountain, doubts were thrown on the existence of any plains at all, and it has become necessary, so to speak, to re-discover this very remarkable feature of these mountains.

The plain immediately to the N. of the British Himalayan provinces is about 120 miles in length, and 15 to 60 in extreme breadth. The mountains that bound it to the N., as I have already noticed, hardly appear to be what we should call snowy, and they are by no means so high as the ranges of the Himalaya on its southern edge. The height of the celebrated peak Kailās has been determined by purely trigonometrical operations to be not quite 22,000 feet ; while another peak, more to the W., one of the few that just entered the region of perpetual snow, was similarly found to be little above 20,500 feet.

The surface of the plain itself, which has been traversed throughout its length by my brother Captain Henry Strachey, as well as to a less extent by myself, in company with Mr. Winterbottom, varies in elevation from above 16,000 feet along its southern edge to about 15,000 in its more central parts, where it is cut through by the river Sutlej, which flows at the bottom of a stupendous ravine furrowed out of the alluvial matter of which

the plain is composed to a depth not much less than 3000 feet. Such ravines, the slopes of which are often almost as even and straight as those of a railway-cutting for miles together, intersect the western part of the plain, in every gradation of size, up to that of the Sutlej; and such is their extraordinary magnitude that Moorcroft, a traveller of great accuracy in general, in his account of his journey across this country invariably talks of their slopes as mountains, and apparently altogether overlooked the existence of the plain out of which they are cut. The streams that flow at their bottoms are so exceedingly small when compared to the vast size of the watercourses themselves, that it is not easy to bring ourselves to believe that they have been excavated altogether by such diminutive means; and some of the ravines, of very considerable dimensions, are evidently always quite dry, excepting during the period when the winter snow is being melted off.

As we advance into the eastern parts of the plain, we find that it gradually becomes more obstructed with mountains, which rise abruptly from the level surface like islands and rocky coasts from the sea; and if at any time it requires but little effort of the imagination to reproduce to the mind the picture of the days long gone by, when an ocean rolled over this expanse, now upraised above the level of the highest of the puny mountains of Europe, even that little is sometimes not needed when the mirage that plays over the arid surface of the ground, under the influence of the intense heat of the sun's rays, unrolls before the eye its fairy vision of the things that were.

Lakes.—The lakes Rákas Tál and Mánasarowar, so celebrated in the sacred legends of the Hindús, lie at an elevation of about 15,200 feet above the sea, and form the eastern limit of our explorations in this region. The varied outline of the former lake, with its islands and innumerable headlands, the intensely lovely blue of its waters glittering in the sun under a cloudless sky, with ten thousand snow-white breakers that covered its surface and dashed against its rocky coasts, while Kailas reared its glorious dome of snow in the background, formed a picture of uncommon beauty; but the effect of the scene was greatly marred by the utter desolation of everything; and any real enjoyment was entirely destroyed by the bitter blasts of the southerly wind, which, while it lashed the water of the lake below us into admirably picturesque breakers, did not fail to chill us to the very bones.

Source of Sutlej.—A stream, the head of which we visited, flows from Mánasarowar into Rákas Tál, and the latter occasionally, when high, sends off a feeder into the Sutlej; the main sources of this river, however, are possibly in the streams that fall into it from the Himálaya, 10 or 15 miles to the W. of Rákas Tál.

Of Indus.—One of the feeders of the Indus, but not a principal one, likewise takes its rise a little to the N. of these lakes. I am informed by my brother Captain H. Strachey, that the main supply of water in the upper part of the Ladák Indus is derived from the Zangskár river, which has its origin among mountains corresponding in position to the snowy peaks of Kumáon and Garhwál; while the other affluents, though probably longer, rise in a much drier climate, and contain a far less bulk of water.*

My friend Mr. J. E. Winterbottom, who has visited the junction of the two great branches of the Indus, the Shayok and Ladak streams, is inclined to consider the former the more important.

Of Ganges.—I may here also notice that on no principle whatever can the glacier at Gangotri be considered as the true source of the Ganges. The Bhágirathi, which rises from that glacier, is usually looked upon as the main stream of that famous river, but it has, in truth, no claim to such a title, excepting inasmuch as it is the sacred stream of the Hindú mythology. The Alaknanda, the other great feeder of the Ganges, is nearly twice the size of the Bhágirathi, and the most distant sources of the former river are certainly more remote than any of the latter. Taking for granted that the Bhágirathi was the true Ganges, Captain Herbert, one of the earliest explorers of this country, suggested that the Jáhnvi, a river that joins the Bhágirathi a little below Gangotri, was the true source of the Ganges. It has also been supposed that the Jáhnvi rose from the N. side of the Himálaya, in the same manner as the Sutlej; but this is not the case, the usual watershed range being as strongly developed across its head as elsewhere. On the whole, therefore, it is certain that the true source of this great river is to be found in that of the Dhauli, which takes its rise to the N. of the village of Niti, most probably in the stream called Raikhanda.

Of Bráhmputra.—Regarding the source of the Bráhmputra we have no real information. It appears, however, most probable that a strip of Tibet, 20 or 30 miles broad, along the northern face of the watershed, drains through the Himálaya into the Ganges, as far eastward, at least, as the meridian of Calcutta, and possibly farther; and that the Sánpur Tachok-Tsangpu (Tibetan), which must surely be the Bráhmputra, rises to the N. of this belt in a manner similar to the Indus. We cannot, therefore, say with any great degree of probability that the source of the Bráhmputra is to be found in the immediate vicinity of the lake Mánasarowar, but indeed rather the reverse; though it is not unlikely that the drainage of the N.E. face of the E. portion of the Kailás range may fall into the Sánpu.

* This view is also taken by Moorcroft.

Although we have no very certain proof of the recurrence of plains, such as I have described, in other parts of the chain, there seems to be some reason for supposing that the plain of Pamir, so well known from the accounts of Marco Polo—the existence of which is fully corroborated by Lieutenant Wood, of the Indian Navy—may be its representative on the W. ;* while to the E., the plains passed over by Turner during his embassy to Tibet—the accounts of which are quite confirmed by Dr. Hooker—as well as others mentioned by Kirkpatrick as existing to the N. of Nepal, are not improbably also of a similar nature.

Systems of Drainage.—It will, I think, be found to assist us in forming a distinct idea of the general arrangement of the mountains if we observe the courses of the rivers that drain them. In doing this, we are at once struck by the circumstance that they almost universally flow in directions either parallel to the general direction of the chain, or perpendicular to it. We may thus distinguish several different orders of streams, all following this general law :—1st. Those that drain the lower parts of the mountains. 2nd. Those that rise immediately to the N. of the great peaks, passing between them in channels on the whole perpendicular to the chain ; such are the main affluents of the Ganges, and many of the rivers of Nepal. 3rd. Those that have a considerable portion of their course parallel to the chain, and then suddenly turning to the southward issue from it in a direction at right angles to their upper parts ; such are the Sutlej and the Chenab, and similar rivers are to be observed at intervals in the eastern parts of the mountains. 4th. The streams that collect the drainage of the more northern parts of the elevated region of Tibet, the upper parts of whose courses are usually longitudinal, while they also pass from the mountains to the S. in a direction nearly perpendicular to the chain. Of such rivers there appear to be two only : the Indus, that drains Western Tibet ; while it is probable that the Sánpu performs a similar office for Eastern Tibet, in like manner also passing from the mountainous region to the S., under the name of the Bráhmáputra.

GEOLOGY.

The general parallelism of so many of the main features of these mountains, such as the courses of the rivers to which I have just been alluding, and as a natural consequence of the ridges between which they pass, of the line of greatest elevation, and of the line of low hills along their southern edge, seems to indicate the probability of some general agency as the cause of all of them, a result that the examination of the geology of the country entirely confirms.

* My brother, Capt. H. Strachey, who has returned to England since this paper was sent to press, tells me that he has reason to doubt the existence of any Pamir plain.

The strike of the strata in all parts of the chain that have been examined follows its general direction, which in the districts that have been specially examined by myself, and to this region alone I shall now restrict my observations, is from W.N.W. to E.S.E. The dip is similarly most commonly to the N.N.E., but it sometimes suddenly changes to precisely the reverse, or to the S.S.W. The deviations from this rule form but a small number of exceptions, which appear to result from disturbances of limited extent. The dip to the N. of the great snowy peaks, although still on the whole northerly, seems to have a tendency to the W. rather than to the E., but from the shattered state of the strata it is difficult to come to a satisfactory conclusion as to the exact direction.

Siwalik Hills.—In following the section that I have drawn out it will be observed that the Siwalik range is tertiary, probably of the Miocene period. We next come to a band of rocks, chiefly sandstones, that is possibly of secondary age, but whose exact geological position is at present very obscure, no fossils having been hitherto found in it, at all events that I know of.

Central Region.—The first great mass of mountain which rises over the outer hills and 'Dúns' consists of argillaceous schists, grits, and limestones, all devoid of fossils, and it is not till we pass beyond the line of greatest elevation that we find any trace of organic remains to guide us in our speculations as to the age of the strata with which we meet. The whole area between the outer hills or the sandstones that succeed them, and these fossiliferous beds, is made up of every variety of metamorphic rock, amongst which several lines of eruptive action are met with, all following more or less the general line of the strike.

Two lines of granite are thus found to traverse this portion of the mountains, the more northern of which is coincident with the line of greatest elevation, while the southern, which is of a totally different mineral character, appears to have no very marked influence on the elevation of the surface. Several distinct lines of eruptive rocks of the greenstone order have likewise been traced. It may also be noticed that the actual quantity of granite in these districts is on the whole small; the granite that follows the line of maximum elevation is chiefly in the form of veins, and in very few instances expands into mountain masses, the great peaks for the most part being composed of stratified rocks, as may be very distinctly seen from a great distance.

Silurian.—Immediately following the crystalline schists that accompany the northern line of granite, we find a considerable thickness of slaty beds, both argillaceous and calcareous, on which rest strata that are certainly of Silurian age. The fossils obtained by me from these beds, the upper part of which rises to a height of between 19,000 and 20,000 feet, have been partially examined

by Mr. Salter, and he has no hesitation in ascribing them to the Silurian period. There appears even to be some reason for supposing that they may prove to contain representatives of the lower Silurian fauna, but my collection not being very large it is not easy to decide such a point, though I may add that M. Barande, who is, I suppose, better acquainted with Silurian fossils than any other naturalist, having seen it when he was in this country a few months ago, expressed his opinion very decidedly that there were many exclusively lower Silurian forms. There are, among the specimens collected from the vicinity of these Silurian strata, shells that appear to indicate the possibility of the existence of Devonian or carboniferous strata, but a more careful examination of the specimens is necessary to settle this point. The total thickness of the palæozoic rocks appears to be about 9000 feet.

Muschelkalk and Oolite.—Succeeding the palæozoic strata we find a remarkable bed, apparently quite analogous in the form of its fossils to the muschelkalk of Europe; and still ascending we come to oolitic beds, among which the presence of the Oxford clay is well marked, while the lias seems to be altogether wanting. I am indebted to Professor Edward Forbes for the examination of the fossils I collected from these oolitic beds.

The watershed of the streams that rise to the north of the great snowy peaks, where I have examined it, follows on the whole these oolitic strata, which, equally with the Silurian rocks, attain an elevation exceeding 19,000 feet above the sea.

Tertiary Plain of Tibet.—But probably the most remarkable feature of the geological structure of these mountains is that to which I shall next advert. The plain to which I have already directed your attention is found, on examination, to be a tertiary deposit of boulders and gravel, which has attained its present wonderful elevation, above 15,000 feet, without any sensible disturbance of the horizontality of the beds in which it was originally laid out. Bones of elephant, rhinoceros, and horse, the latter apparently identical with the horse of the Siwaliks, also of some large undetermined ruminant, as well as of a new species allied to the goat, are found embedded in these strata.

The existence of such animals in the country in its present state being a physical impossibility, there can be no doubt that these strata have been elevated from some lower level since the time of their deposition. There is no direct proof that these beds are marine, no shells having been got from them, and they might possibly have been laid out by some large body of fresh water at a considerable elevation above the sea; but it appears to me to be far more probable that we have a real sea-bottom to deal with.

The general extension of some of the older fossiliferous rocks

along the northern face of the Himálaya, over a very great longitudinal distance, is a fact of which we have certain proof. It follows, therefore, that the line on which they occur, distant about 20 or 30 miles to the N. of the great Himálayan peaks, has been a sea-margin from the remotest ages of the earth's history till as late, certainly, as the oolitic period. The existence of other plains, apparently of a similar nature, at distant points along the mountains, seems to indicate the probable extension of the body of water by which these tertiary strata were formed, to such dimensions as would, of necessity, show that it was the ocean and no lake.

The present interruption of the plain is no proof that it did not once have a far greater extent. This is sufficiently proved by the fact that I have, at the Niti pass and on the mountain summits near it, traced these tertiary beds to the very crest of the watershed, to a height of 17,000 feet and more; further, 2 or 3 miles below this same pass, on the S., a detached portion of this deposit is to be seen which must clearly have been separated from the general mass by the dislocations of the surface that have upheaved these vast mountains.

From a consideration of these facts it appears probable that this plain has been raised from the level of the sea to its present great elevation since the tertiary epoch, and almost as a necessary consequence it will follow that the present development of the Himálaya and of the elevated regions of Tibet dates no farther back than that period.

Eruptive Rocks of Tibet.—It only remains for me to notice, with reference to this elevated plateau, that a great outburst of eruptive rocks, in which are found hypersthene and bronzite, besides sienitic and ordinary greenstones, and various varieties of porphyry, occurs in the vicinity of the lakes. The greenstone is known to extend considerably to the W., and forms the summit, at an elevation of about 17,600 feet, of Balch, one of the Himálayan passes into Tibet, which I have crossed.

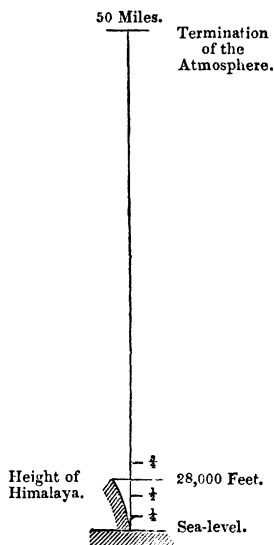
In the extremely hard and non-fossiliferous character of the rocks through which the greenstone passes, there appear to be signs of igneous action on the strata of oolitic age that are generally found along this zone of the mountains. Hot springs are of somewhat frequent occurrence in the higher parts of these mountains, both to the S. of the great Himálayan peaks, and in the plain to the N. of them.

I shall, with reference to this part of my subject, only further add, that the physical unity of the great mass of Tibet with the Himálayan range seems to me very strongly shown by the general geological structure that I have thus briefly attempted to describe; and it appears difficult to account for the peculiar parallelism of all the main features of those parts of these countries with which

we are at all acquainted, otherwise than by the supposition of forces, dependent on some common origin, having acted throughout their whole extent in a direction generally parallel to that of the Himálaya.

METEOROLOGY.

I shall now proceed to give a short notice of some of the more important meteorological phenomena of these regions. But I would first call attention rather particularly to the very small thickness of the atmosphere, or at all events of that part of it that considerably affects us, as compared to the radius of the earth. An immediate consequence of this is, that the inequalities of the earth's surface, that are so insignificant when viewed in relation to the whole globe, become objects of the greatest importance in connexion with the atmosphere. On the accompanying diagram are marked off the heights corresponding to certain definite proportions of the atmosphere, from which it will be apparent that the existence of mountains such as the Himálaya must produce very important effects in modifying the currents of the lower parts of the atmosphere, which, as they contain the great bulk of aqueous vapour, have the greatest effect in determining the character of the climate.



Perpetual Snow.—Of all the phenomena presented to the observer of Nature in these magnificent mountains, I know none that can compare in grandeur with that constantly before his eyes in the peaks covered with perpetual snow. In the months of November and December, when the perfect serenity of the autumnal air displays, in a manner with which the pencil of no artist can ever hope to compete, the glorious lights and shadows thrown by the setting sun on this wonderful scene, we may also best observe the extreme altitude to which the snow recedes on the southern face of the mountains. This appears to be about 15,500 feet, as I have shown at greater length in a paper published in the *Journal of the Asiatic Society of Bengal*, No. 29, of April, 1849. When, however, we pass to the N. of the great peaks and stand on the plain beyond them, it is not without surprise that we shall observe that, in spite of our having advanced far to the N., the snow-line has receded very considerably, so as to

reach 19,000 or even 20,000 feet of elevation. In the paper above alluded to I have already stated my opinions as to the causes of this, and have ventured to doubt the possibility of any radiation from the high land beyond having much to do with the matter. The true explanation of the facts seems to me to be, that the quantity of snow that falls to the N. of the great Himálayan peaks is very much less than that which falls on their southern slopes; and this phenomenon is again to be explained by the consideration that, the prevailing winds over these mountains being from the S., almost all the moisture contained in the air is precipitated on the exterior or southern face of the lofty ranges over which the current passes.

On the plain itself the quantity of snow that falls must be very small, and it can lie on the ground but a very short period. During the summer months it would be quite as impossible to find the least remnant of snow in any part of this tract below a height of 16,000 feet, as on the burning plains of Hindostan. The small quantity of snow is further strikingly exemplified by the fact that the inhabitants of these regions are able to support their flocks of sheep and goats, and herds of yaks, in which their wealth almost solely consists, without making any provision for their sustenance during the winter months; and the semi-nomadic portion of the population that usually congregates during the summer around the pastures that are found in the vicinity of the lakes, appears only to shift its ground a little to the north during the winter to avoid the snow that falls more heavily along the country under the more immediate influence of the lofty ranges of the Himálaya.

I am informed by my brother, who passed two entire winters at Lé, the chief town of Ladák, that the falls of snow that took place while he was there hardly ever exceeded half an inch or an inch in depth.

It is I presume to the sudden change of direction of a great body of moist air, when obstructed by a continuous range of mountains, that we are to attribute the excessive rain that characterizes the windward faces of so many mountains in tropical countries, and the comparatively very dry climate so often found in the country to leeward. The current is constrained to rise over the obstacle that it meets, a sudden condensation of vapour is thus occasioned, and little moisture remains to be deposited in the parts over which the air afterwards passes.

In these mountains this sort of cause and effect is very strikingly shown in many places; in none more than in the upper part of the course of the Dhauli, the river that flows from the Niti Pass. On the southern face of the mountains, generally at an elevation of from 8000 to 11,000 feet, the country is clothed with

dense forest, which is watered by the almost constant condensation produced by the influence of the great mass of mountains that rise suddenly behind. In the case of the Dhauli, however, a great detached line of snowy mountains projects, so as to overlap the upper part of the river course, and the result is most remarkable, for the whole of the upper part of the valley is thus deprived of its fair share of rain by the intervention of this lofty range, which causes the precipitation of almost all the moisture on its southern face, which we find covered with magnificent forest, while the country beyond is converted into what is almost a desert.

Glaciers.—In all parts of the mountains covered by perpetual snow glaciers abound, and some of them are of great magnitude. The fact that until within the last few years their existence in the Himálaya was doubted, shows, in a manner that needs no comment, what sort of examination this country, perhaps the most remarkable in the world, has received during more than thirty years of British rule. The lowest level to which I know any glacier to descend is about 11,500 feet, and from that height to 12,000 feet is the ordinary elevation of their extremities. In those parts of the mountains however to the north of the great peaks, where, as I have already observed, the elevation of the snow-line is considerably increased, we also find that the lower extremities of the glaciers recede in a somewhat corresponding degree, the altitude at which they terminate being usually increased to about 16,000 feet.

The velocity of the motion of the ice of course must greatly depend on the peculiar circumstances of each separate glacier; but an analogy with the motion of those of the Alps is sufficiently shown by the few observations that I made to determine this point. The mean of four days' observations in May on the glacier at the source of the Pindar (one of the feeders of the Ganges) gave a velocity of about $9\frac{1}{2}$ inches for the 24 hours for the central parts of the ice. The same glacier from the 21st of May to the 15th of October moved over 98·57 feet, being at the rate of just 8 inches in the 24 hours. This glacier terminates at an elevation of 11,900 feet. The motion of another glacier, that of the Gori river, close to the village of Milam, which descends to a little below 11,500 feet, was 37·92 feet between the 2nd of August and the 30th of September, being at the rate of about $14\frac{1}{4}$ inches in the 24 hours.

Their ancient Extension.—The question will no doubt occur to every one whether we here, as in the Alps, see signs of the former extension of glaciers much beyond their present limits, or beyond what may be conceived to be the limits of the oscillations to which glaciers are known to be subject in consequence of the ordinary variations of the climate from year to year. And when the reply

is given that everywhere such an extension is to be seen, and that in some places the former development of glaciers appears rather astonishing, it may be surmised that here too there seems to have been a period of cold, a glacial epoch, similar to that known to have occurred over the area of Europe.

But I think that such is not the case. In the first place, it is to be observed that neither on the plains of India nor on those of Tibet are erratic blocks to be seen. Boulders there are in any quantity, but of those great masses for the transport of which some other agency than that of the waves or tides is requisite we have no trace. It is further to be noticed that in passing through the Tibetan plain we crossed two very remarkable accumulations of earthy and stony detritus that were evidently the moraines of ancient glaciers; they extended from the N. face of the Himálaya along the courses of two streams that are known to rise in glaciers now quite withdrawn within the mountains. The ancient moraines project for a mile or two fairly out into the plain; and as the surface of this was quite clear immediately in front of them, it is manifest that the formation of these moraines must have taken place subsequently to the exposure of the plain to the air, and not while it was under water; for in the latter case we could hardly have failed to have seen the plain strewn with blocks derived from the glacier.

Now if we observe the manner in which the plains of northern India run right up to the Siwalik hills, without any sign of intermediate undulating ground, I think that it appears almost certain that the ocean that laid out and levelled this vast expanse of flat country to the south of the Himálaya must have continued to extend up to the foot of the Siwalik range after its upheaval. If again the tertiary strata of the Tibetan plain are of the same age as those of the Siwaliks, as is probable, we may fairly suppose the upheaval of the two to be geologically synchronous. We should then have had a state of things in which Tibet and the Himálaya generally might have existed much as at present, only that the ocean washed the very foot of the mountains, instead of being distant as it now is a thousand miles and more. The evident result of this would have been that the Himálaya would have then had a far wetter climate, and that the quantity of snow that fell on the highest parts of the mountains would have been greatly in excess of what now falls, thus causing a great extension of glaciers, such as we see actually to have taken place. The ultimate elevation of the plains of Hindostan above the sea would place things on their present footing, and with the diminished supply of snow the glaciers would gradually retreat to their present size.

Climate.—In a country like that under our consideration, in

which the elevation of the surface varies from less than 1000 feet to upwards of 25,000 feet above the sea, it is manifest that we shall find every variety of climate from the intense heat of the plains of Hindostan to the rigours of an unceasing winter. In the outer part of the mountains the seasons follow the ordinary course of the neighbouring flat country. The summer rains prevail in the mountains as in the plains, only commencing somewhat earlier, that is about June. The rainy months are June, July, August, and the first half of September. A few showers fall in October, while in November, and the greater part of December, the weather is usually perfectly serene. As the cold increases the sky again becomes covered with clouds; and the winter rains, which begin about Christmas, have their maximum in February, as in the plains below.

The north-westerly winds which prevail during the day over the plains, in April and May, likewise in some degree affect the mountains; and the atmosphere during these months, and until a considerable quantity of rain has fallen, is constantly charged with a thick haze, apparently the result of minute particles of dust suspended in it, and swept up from the plains below. At most seasons of the year, however, we find that in the mountains, winds blow up the valleys during the day, that is from about 9 A.M. to 9 P.M., and down them during the corresponding hours of the night. At the debouches of the principal streams into the plains these night winds blow with great violence, particularly in the winter. They diminish in force as we ascend in the mountains, and at great elevations and in the plains of Tibet the nights are almost always perfectly calm. The diurnal winds, on the other hand, in the latter country are terrific, and in travelling there we looked forward to the afternoon, when the winds are at their height, with real dread. To show the force of these winds, I may mention that on one occasion, in measuring a line with a 100-foot tape for the purpose of getting a base for calculating the height of a mountain, both ends of the tape were successively torn off by the mere force of the wind, in the hands of my friend Mr. Winterbottom, who was measuring the line. The winds, so far as I had an opportunity of observing them in this part of Tibet, commenced in the S.E. quarter about 9 A.M., gradually shifting round with the sun to the S.W., and ending in that quarter about 9 P.M. On several occasions I have noticed the wind blowing very faintly from the N. early in the morning, and a similar phenomenon may be observed in the plains of India during the prevalence of the hot north-westerly day winds, which are succeeded by a night almost calm, with a very light air from the E. early in the morning.

The influence of the summer rains extends into the country

beyond the great snowy peaks in a very limited degree, each successive ridge stopping a portion of the moisture, as can be actually seen very distinctly.

I may also mention that, though thunderstorms are not uncommon on the southern aspect of the great peaks, they appear to be exceedingly rare among the mountains to the N. of them, or even to be quite wanting. In the plain of Tibet, however, rather violent thunderstorms, accompanied by a good deal of hail, swept over the country about the hottest time of the day for two or three days in succession, when we were travelling there in the month of September.

The power of the sun's rays at great elevations is intense in the extreme, and it forms indeed one of the chief discomforts of the stranger who visits these regions.

BOTANY.

I have already alluded to one of the great agents that determines the character of the vegetation with which these mountains are clothed; the influence of altitude, I need hardly say, produces effects if possible still more striking.

Tropical Zone.—In passing from the plains of Northern India to the Himálaya a change in the physical conditions of the country is forced upon our attention long before we reach the first ranges of hills. A belt of forest that extends along the mountains, skirting them for a breadth of 10 or 15 miles, succeeds to the perfectly open and highly cultivated districts more to the S. This forest, although strictly tropical in the character of the vast majority of the individual trees that compose it, is, from the great drought that prevails over it for the greater part of the year, far from presenting those appearances of rank and luxuriant growth that are usually associated with the idea of a tropical forest, and it is necessary to penetrate into the more sequestered ravines of the outer ranges of hills to find any such vegetation. But although this and the almost entire absence of palms greatly detracts from the beauty of the forest, we are not left without compensation in the exquisitely cut foliage of the acacias and moringa, the gracefully drooping clumps of bamboo, the saul (*Vatica*) with its tall erect trunk and brilliant dark green leaves, the semal (*Salmalia*) with its deep red cup-shaped flower and curiously buttressed stem, and the huldoo (*Nauclea*) with its magnificently drooping branches spreading from the summit of its huge columnar trunk; while from the limbs of these lords of the forest trail gigantic climbers, such as the bauhinia and robinia.

The larger trees are almost entirely restricted to the plain itself and to the more level valleys that intervene between the

outer hills and the higher ranges within, the slopes themselves being usually covered by wood of a smaller size.

As we ascend the exterior face of the mountains the tropical vegetation still prevails to a height of about 4000 feet, though even from 3000 feet a few of the forms of colder climates begin to appear; the vegetation, however, is on the whole scanty on this declivity. Far different is it when we follow the same zone of elevation into the interior of the mountains along the courses of the larger rivers, which, owing to the great depth of the valleys in which they flow, carry a tropical flora into the heart of the mountains, and thus afford opportunities not often obtained of observing the transition from one extremity of the vegetable scale to the other on a single declivity. The sheltered and confined beds of these rivers, where the two great requisites for tropical vegetation, heat and humidity, are at their maximum, often afford the finest specimens of this sort of scenery, varied as it is by an admixture of the temperate forms, which here descend to their lowest level. Thus the traveller's eye may rest on palms and acacias intermingled with pines; on oaks or maples covered with epiphytal orchideæ; while pothos and clematis, bamboos and ivy, fill up the strangely contrasted picture.

In the outer part of the mountains one of the great features of the landscape is the *Pinus longifolia*, which clothes the slopes of almost every hill, often to the exclusion of everything else, from an elevation of 3000 to 6000 feet. This pine in its general appearance greatly resembles the finer specimens of the common Scotch fir, though it is much more brilliant in its colour.

Temperate.—As we ascend above 4000 feet, oaks and rhododendrons gradually increase in number, and these trees, with andromeda (*Pieris*), form the great mass of the forest from 6000 to 8000 feet. At the same time species of the deciduous trees of the temperate zone are gradually introduced as we rise, and these again, with the addition of other pines, prevail in the upper regions of forest, that is from 8000 to 11,500 feet.

The peculiarities of the climate, which even in the higher parts of the mountains partakes of a certain share of the extreme heat and wet of the tropics, produce corresponding peculiarities in the features of the vegetation in these more elevated regions. We thus still find a palm (*Chamærops*) reaching an elevation of upwards of 8000 feet, a little below which it grows to a height of more than 50 feet in a locality where it is regularly covered with snow every winter. We again have one of the arborescent grasses, an arundinaria, maintaining its position as a marked and most beautiful feature of the forest region to its extreme upper limit.

Although the character of the forest in the region of the ever-green trees, viz. from 5000 to 8000 feet, is perhaps at times somewhat sombre and monotonous, from its almost exclusively consisting of oaks and rhododendrons, yet under favourable circumstances it is beautiful in the extreme. Among the trees more commonly found associated with those I have just mentioned are the cypress, ash, birch, elm, holly, hornbeam, alder, and several laurels, all of which attain a considerable size. These latter trees are more common in the sheltered ravines and on the northern slopes of the mountains; the southern slopes, which are much drier and hotter, being usually clothed with oaks and rhododendrons alone.

Upper Forest Region.—In the upper region the various species of trees grow more mixed together than in the lower, and, on the whole, to a larger size, so that the forest has a far finer general appearance. Its most striking members are oaks, pines, yew, elm, horse-chesnut, walnut, several maples, pears like the English whitebeam, hazel growing to a large tree, and rhododendron. A birch, the bark of which is used by the people of the higher mountains as a substitute for paper, usually is the last tree met with.

The deodar, the distinctness of which from the cedar of Lebanon is still matter of great doubt, is only found in a state of nature in the more western part of the tract to which I am more particularly alluding, and at an elevation of from 8000 to 12,000 feet. It is, however, frequently planted by the Hindoos in the neighbourhood of their temples in all parts of the mountains, and attains a gigantic size. The deodar appears to be wanting altogether in the eastern half of the Himálaya.

Having passed the upper limit of forest, which comes to a rather sudden termination at about 11,500 feet, we enter a more open tract where trees are replaced by shrubs. There seems, however, here no very general tendency for the coppice to clothe the whole surface, as is the case with the wood in the lower regions, probably because the snow, which accumulates and lies for months together at such elevations, prevents the growth of the shrubs in certain places. The mountain-ash, rose, barberry, lilac, willow, juniper, shrubby rhododendrons, and potentillas, are the chief denizens of this belt. A few trees are still to be seen struggling on, even perhaps to a little above 12,000 feet, but they are mostly stunted and deformed.

Alpine.—On the mountains that project to the southward from the great snowy masses, where the precipitation of moisture is almost incessant for a great portion of the year, and the melting of the snow affords a constant supply of water, the open region above the forest is clothed with a most luxuriant herbaceous vege-

tation, which contributes very largely to the riches of the Himálayan flora, and is of no less importance to the mountain shepherd than of interest to the naturalist.

Tibetan Plain.—As we recede, however, in our progress to the N., behind the higher summits of the range, the country rapidly becomes more arid, and when we at last reach the Tibetan plain to which I have already alluded we find it to be little better than a desert, in which the only vegetation that shows any signs of activity is to be found along the edges of the scanty streams that water that desolate country. I estimated as I passed over this dreary waste that not one-twentieth of the surface of the plain was covered by the vegetation it supported, and on the mountains that flank it the proportion is still more unfavourable. The bushes that are seen at rare intervals hardly rise more than a foot above the surface of the soil, and afford a most meagre supply of fuel to the traveller, who is often forced to eke out his allowance of wood with the dried dung of cattle that is usually to be found about the ordinary halting-places.

The surprising effect of water in developing vegetation is as strongly shown at these elevations as in the tropical regions, where it may be considered to be the sole requisite of the husbandman. Along the borders of every little stream that we meet in Tibet is a margin of verdure the beauty and brilliancy of which is enhanced by the utter sterility of everything else in sight, and a country which at first seems almost incapable of supporting life is found in reality to abound with wild and domestic animals.

But however poor may be the flora of these regions, it is far from being without interest, as showing the last efforts of Nature to clothe the surface of the earth with organised beings. Nor can the mind of any one, however little versed in such studies, fail to be struck by the tendency which we everywhere have forced upon our notice, and nowhere more strongly than here, of the reproduction of similar types of organic life under similar physical circumstances. We thus observe that not only are the genera most abundant in the arctic regions again found in these extreme heights, but that the species, though different, still have the same general appearance and habit of growth; and we are thus carried forward to the very important consideration that the phenomenon of creation itself, that is of the introduction of new forms of life, is as much subject to laws as any of the other phenomena of organic or inorganic nature of which we have cognizance.

Limit of Vegetation.—At an elevation of between 17,000 and 18,000 feet vegetable life finally ceases on the mountains to the N. of the great snowy peaks of the Himálaya, though farther to the N., on the authority of my brother, Captain Henry Strachey, it appears to reach to 19,000 feet. I may here notice,

with reference to the cessation of life as we ascend in elevation, that the growth of a species appears to stop rather abruptly as we pass its natural limit, and not by a gradual degradation of size. This is probably owing to some definite condition of temperature and climate being necessary to cause the seed to germinate, without which the young plant will not be formed at all, although, if it were once formed, it might thrive well, as those individuals often do that are highest of all.

Agriculture.—The agriculture of the lower hills is very similar to that of the plains of Northern India. The cultivation of wheat and barley, which is carried on as far down the Ganges as Benares, the elevation of which is only about 300 feet above the sea, is extended with success to a height of 11,500 feet in the valleys that lie between the great snowy peaks and the watershed behind them. Here, however, the crop is a summer one, that is sown in May and reaped in September or October, while in the plains and outer mountains it is a winter one, sown in October and reaped in April. On the ranges to the S. of the snowy mountains the cultivation of these grains is not carried above 8000 feet, and seldom above 5000 feet.

The rain-crops of the plains, consisting of rice, of various species of panicum, and other grains peculiar to hot climates, of cotton and sugar-cane, all flourish up to elevations of about 5000 feet.

The cultivation of tea, which had been carried on by the government upon a small scale for many years, has lately been considerably augmented, and a manufactory has been established in which the tea is prepared by Chinese workmen. The quantity made is gradually increasing, and at present it all finds a ready sale on the spot at the prices usually paid for the best Chinese tea, to which it is much preferred by all persons accustomed to its taste.

In the higher parts of the mountains buckwheats and amaranths are very frequently cultivated, and these grains form an essential part of the food of the inhabitants of those regions; the former is also largely exported into Tibet, the people of which country are in a great measure dependent for their food on their Himalayan neighbours.

The cultivation in the parts of Tibet more particularly under our consideration is entirely confined to the bottom of the ravines of which mention has been made, where alone is the moisture to be found which is essential for vegetation. The grain most extensively sown, is the beardless variety of barley known under the name of "*Ua*." I have procured well-formed heads of this from the fields of the town of Kyunglung on the Sutlej, at an elevation of about 14,000 feet about the sea, which were nearly ripe in the middle of the month of September, when we passed near that place. This is probably not very far from the extreme altitude at which

cereal grains are susceptible of profitable cultivation in any part of the world, though my brother has seen it carried up to 15,000 feet in the more northern parts of Ladak.

ZOOLOGY.

Of Tibet.—In conclusion, I shall very shortly notice the chief forms of animal life met with in Tibet and the more remote parts of the mountains, to which region alone I shall here confine my observations. Among these, one of the most striking, from its great abundance in the plain to the N. of the *Himálaya*, is the wild ass, the *kyang* of the Tibetans. This animal roams over the country in troops of from ten to twenty, single individuals, however, being also frequently seen, sometimes bearing on them the marks of the conflicts which appear to have been terminated by their expulsion from the herd. The yak, which, in the domestic state, forms the only breed of horned cattle in the highest part of Tibet, is also met with wild in the more secluded regions, and appears to be found even among the ranges of the *Himálaya* that lie along the southern edge of the plain. The wild animal is said to differ from the domestic in its colour being constantly black, in its greater size, and the more perfect symmetry of its horns.

Of the wild sheep, the *Ovis burhel* is common both in Tibet and in the higher parts of the *Himalaya*, while the *Ovis ammon*, which, according to Mr. Grey, is probably identical with the *Ovis montana* of North America, is of comparatively rare occurrence, and is only found in the most inaccessible country. A small antelope is also met with. A hare, a large marmot (the *arctomys*), a small animal (the *lagomys*) allied to the hare, and a mouse, are not uncommon at elevations of between 14,000 and 16,000 feet.

Of the carnivora, the ounce sometimes descends from the higher parts of Tibet, which appear to be his peculiar abode, into the northern valleys of the *Himálaya*, where he commits great havoc among the flocks of goats and sheep down to 11,000 feet. A lynx, a wolf, and a fox are also found in these regions.

Among birds may be mentioned the great raven, apparently the same as that of Europe, and two choughs, found in this region and the upper *Himálaya*; also the hoopoo, which I have seen at altitudes of 16,500 feet, and which is likewise common to the plains of India and to Europe, being a bird that appears to be quite independent of climate. A large bustard, grey goose, ducks and teal in great numbers, were seen by us in the vicinity of a long shallow lake on the plain, at an elevation of about 15,500 feet. These birds seem to breed here during the summer months, taking their flight before the winter to the more genial plains of India, where they are seen in immense flights as long as the cold weather

lasts. On the great lakes were seen herons (two species), gulls, and tern; also vultures, eagles, and hawks. A blue pigeon, dove, lark, wagtail, and a few other small birds were likewise observed, as also a partridge apparently identical with the *chicor* of the *Himálaya*.

The lakes, as well as the smaller streams, abound in fish, and it is a curious point for consideration how these animals can subsist in such shallow brooks, often only a foot or two in depth, which must be frozen solid with all they contain for several months together during the winter.

Two species of lizard, grasshoppers, crickets, spiders, bees, and flies were also observed, while the lower orders of the animal kingdom have their representatives in molluscs and annelids.

Of the domestic animals may be more particularly specified the sheep and goat, which are used as the ordinary means of transport in the trade between Tibet and the Himalayan provinces. The shawl-wool of Tibet is chiefly obtained from the goat, but many other animals in this country are supplied with this provision against the intense cold and the dryness of the climate.

The cross-breed between the yak of Tibet and the Indian cow is called *jubu*, or by the Tibetans *dzo*, and it, as well as the yak itself, is commonly used by the mountaineers both for riding and as a beast of burden for the more bulky articles of their commerce. The mule race is sterile *inter se*, though the female will breed with the pure stock of either species.

Tibet is also famous for a breed of ponies, remarkable for their strength and surefootedness, commonly in the north of India known by the name of *gúnt*.

ETHNOGRAPHY.

I am indebted to my brother, Mr. John Strachey, for the following sketch of the races of men that inhabit the British provinces of Kumáon and Garhwál, in the civil administration of which he has been employed for several years.

The fact that, in the great mountain region which extends along the whole of the N. of India, we are on the ill-defined boundary of two races, makes the investigation into the ethnographical relations of its inhabitants a matter of great difficulty and complexity.

It is not necessary for my present purpose to look beyond the two great existing divisions, Indian and Tibetan, nor to search for other remoter and less evident influences that may have been at work. Of the multitude of tribes which we find scattered through the *Himálaya*, some are apparently of purely Indian origin, others of Tibetan; while more frequently the two races have become mixed

together, or one of them has been modified or influenced by the other.

Hindu Tribes.—Between Kashmir and Kumáon the populations of the Himálaya are mainly Hindu, and the admixture of any other element that can now be detected is generally doubtful; but, as we travel eastward, the tribes of mixed race become more and more numerous, until in Eastern Nepál and Sikhim the Tibetan greatly predominate over the Hindu. An excellent summary of what is at present known regarding these Mongolian tribes, derived principally from the valuable observations of Mr. Hodgson, has been given by Dr. Latham, in his work on the ‘Varieties of Man.’ I shall here say nothing of them, and shall speak only of the inhabitants of Kumáon and Garhwál, with which districts this paper is more particularly concerned, and in which alone I have had any opportunities for personal observation.

Khasiyas.—Among the tribes of Kumáon and Garhwál, by far the most important is that called Khasiya. It comprises, perhaps, nine-tenths of the whole population of the country, and the same race, more or less modified by various causes, is extensively spread over the Himálayan provinces W. of Garhwál, and over the greater part of the Nepalese territories. But in the remarks which I am about to make regarding the Khasiyas, it must be understood that I am speaking only of those of the British provinces of Kumáon and Garhwál. It has been commonly, but I think rather hastily, assumed, from apparently analogous circumstances in Nepál, that these Khasiyas of Kumáon are a people of mixed Tibetan and Indian race. I do not indeed doubt that in Nepál the Khasiya race may have been modified by admixture with the Tibetan tribes, which we find gradually to predominate as we proceed eastward. Mr. Hodgson considers that the Hindu element in the Khasiyas has been engrafted within historical times upon an original Mongolian stock—a conclusion in which I am not altogether prepared to concur, even with regard to Nepál, without additional evidence. It may even, I think, be doubted whether the traces of Mongolian origin or admixture are much more definite in the people of Kumáon than in those of the plains of Northern Hindustan. Supposed resemblances of feature and form between the Khasiyas and the neighbouring Tibetan tribes have been one of the chief causes for the adoption of the opposite opinion; but I think it exceedingly doubtful whether such resemblances actually exist, while in language, religion, and customs the Khasiyas are, I believe, Hindu. The differences between them and the people of the plains are, no doubt, often very great; but they are not, it seems to me, greater than can be accounted for by the very different physical circumstances of the two countries; while, on the other hand, some of the apparent similarities between

the Khasiyas and Tibetans may equally be explained by like considerations. It is not my intention to give here any detailed account of the Khasiya inhabitants of Kumáon. In their general manners and customs, however, they assimilate to other Hindu tribes. They are a strictly agricultural people, and we find among them, in great completeness, the village communities which have been so characteristic of Hinduism from the earliest times of which we possess any record. And although their religion and social habits seem often quite repugnant to Hindu orthodoxy, still all their sentiments and prejudices are so strongly imbued with the peculiar spirit of that faith, that it is difficult for one acquainted with them to look upon them as anything but Hindu.

Polyandry.—The custom of polyandry, which prevails in Tibet and in some of the cis-Himálayan states, does not exist in Kumáon or in British Garhwál; but habits which might pass into such a custom are often found among the people of the wilder parts of the country. Here, where the whole of a family commonly resides under the same roof, where chastity is hardly looked upon as a virtue, and where no moral sentiments interfere, it may easily be conceived how a state of things not far removed from polyandry may arise, in which intercourse with a husband's brother is regarded not only as no great immorality, but as a smaller breach of propriety than if committed with a stranger. Whatever may have been the origin of Tibetan polyandry, we see among the Khasiyas a custom, not really distinct, which seems to have been a consequence of the general social state, and from which no necessary descent from a Tibetan stock is to be inferred. Perhaps, indeed, we see here only the exaggeration of the ancient Hindu practice of raising up issue to a childless brother, which, though reprobated by the Hindus generally, still prevails among the Khasiyas of these hills.*

Language.—The language of the Khasiyas is a Hindu dialect, and, although it has not been hitherto examined with sufficient care to authorize very positive assertions regarding it, I believe

* Manu (chap. ix. 59, &c.) authorizes the begetting of a son on the widow or childless wife of a brother. A similar custom prevailed among the Jews (Deut. xxv. 5). It is not, I think, very clear, that Manu intended to confine this permission to Sudras, although Culluea's gloss so explains his meaning. Other circumstances may encourage, in a purely Hindu state of society, a system of lax morality approaching to polyandry. The practice, strongly reprobated by Manu (chap. iii. 51), and by all orthodox Hindus, of demanding the payment of a gratuity by the bridegroom when a daughter is given in marriage, which is universal in these mountains, tends, by checking the marriage of the younger brothers of the family, to this end. The great importance attached to having heirs to perform obsequial rites may operate in the same way. According to Manu, an uncle, having a nephew, cannot adopt a son. "If," he says (chap. ix. 182), "among several brothers of the whole blood, one have a son born, Menu pronounces them all fathers of a male child by means of that son."

there is no reason to suspect the admixture in it of any non-prácritic element.

History.—Historical evidence is not wanting which helps, if not to confirm the opinion that the Khasiyas are of Hindu origin, at least to show that at an exceedingly remote period these provinces were inhabited by a Hindu race, known by a name almost identical with that by which the people of the country are now distinguished. Ancient inscriptions and other historical records now existing in Kumáon and Garhwál, of which no account has hitherto been published, show that for more than a thousand years a Hindu government has existed in these provinces; that, say fifteen hundred years ago, they were ruled by Hindu kings; that the Hindu religion was then in full force there; and that they were then called Khasa, a name which may be considered identical with the Khasiya of the present day. There can be no doubt that this is the same people referred to by Manu, and in the Máhábhárata and several of the Puránas.* These ancient authorities tell us of a race of Kshatriyas called Khasa, dwellers in mountains, who have become degraded by the neglect of religious rites; and it is a curious fact that the Khasiyas of the present day uniformly give of themselves almost the same account. They profess to be Rájputs, who have fallen from their once honourable position by the necessity of living in a country where the strict observance of their religious rites is impossible. There seems, therefore, reason for surmising that two thousand five hundred years ago, when Manu's work may have been written, these provinces were inhabited, as they are now, by Khasiyas, a race of Hindus very lax in the practice of their faith.

For those who wish to learn more of the ancient Khasas, I may refer to the essay of Wilford, published, in 1799, in the sixth volume of the 'Asiatic Researches,' on Mount Caucasus, the Coh-cas, Cas-giri, or Mountain of the Khasas. I will not follow now his wild speculations on this ancient race, nor endeavour to find in Kumáon the land of Cush, and the terrestrial paradise. The wide diffusion, over a great part of Asia, of names having the apparently common root "Khas," has often been noticed; but I shall not here do more than refer to this fact, which undoubtedly opens out a wide field for investigation.

The name Khasiya is now commonly confined to the so-called Rájputs of these districts, who form the great bulk of the population; but other castes, chiefly Brahman, exist, to which the name Khasiya may be also properly applied. *Khas* was, in ancient times, the name of the country, and its inhabitants were all Khasiya, without reference to caste. The Khasiya Brahmans are

* Manu, chap. x. 43 *et seq.* Wilson's Vishnu Purána, pp. 195, 374. Langlois' Harivansa, p. 67, liv. 1; p. 384, liv. 3, &c.

considered very inferior to the Brahmans of the plains of India. The latter have immigrated into the hills in considerable numbers within historical times, and have monopolised for long past the most influential and lucrative positions in the country. But it is quite incorrect to attribute, as has sometimes been done, the Hinduism of the Khasiyas to the influence of these comparatively modern intruders.

Mixed Races.—Besides the Khasiya aborigines, if we may so call them, and the Hindu immigrants from the plains, tribes of undoubted Tibetan origin, and others of mixed Tibetan and Hindu race, are found in the northern parts of these provinces. The most important of these is generally known as Bhótiya. “*Bód*,” the Tibetan name for Tibet, corrupted by the people of India into *Bhot*, has given rise to the designation *Bhótiya* for the bordering tribes between the two countries. Here I shall refer only to those of Kumáon, and it will give a sufficiently correct idea of the limits of the Bhótiya tract in this province if we consider that it is bounded on the N. by the watershed of the Himálaya, and on the S. by a line passing a little to the N. of the great peaks of the chain. The Bhótiya villages are all situated in the valleys between the great spurs which run down from the watershed ridge, at an elevation above the sea varying from 7000 to 12,000 feet. They are occupied only during the hot months of the year, the whole population migrating every winter into the milder climate S. of the great peaks of the chain. One poor and uncertain crop, consisting chiefly of barley and buckwheat, is obtained each year at the Bhótiya villages; but the Bhótiyas are not an agricultural people, and they look almost entirely for their support to the carrying trade between Tibet and the cis-Himálayan provinces, of which their position at the foot of the passes across the snowy range gives them a monopoly. A valuable general account of the Bhótiyas, though not always a strictly accurate one, has been given by Mr. Traill in the seventeenth volume of the ‘*Asiatic Researches*.’

The language of these tribes is alone sufficient to prove for them a Tibetan origin, and the unmistakeable peculiarities of feature that belong to the Tibetan family are as strongly marked in the Bhótiyas as in the people of the adjacent parts of Tibet itself. It is unnecessary to speak of the subdivisions of the Bhótiya tribes, nor need I mention more particularly the mixed races which are found on the boundary-line between the Bhótiyas and the Khasiyas. All these, as well as the Bhótiyas themselves, affect to consider themselves Hindu; and although their claims to such honour are seldom conceded by orthodox members of that faith, the distinctive marks seem gradually to be disappearing, and the time is, perhaps, not very far distant when the descent of

the Bhótiyas from a cow-killing race will no longer be remembered. Their language, too, seems to be gradually becoming extinct; and in Juhár, the most important of the Bhótiya valleys, it has died out in the memory of the present generation.

The only other tribe that seems to demand mention is the Ráji, which it has sometimes been thought may be a remnant of the aboriginal population of these provinces. Our information regarding this tribe is very incomplete; and as there are probably not more than thirty or forty families of it living in Kumáon, it is not easy to obtain information regarding it. They are said to be more numerous in the Nepalese territories E. of Kumáon, and it is not impossible that they will prove to be a tribe of Tibetan origin, allied to some of the tribes of Nepál, of which Mr. Hodgson has given an account. The Rájis are not Hindu, either in language or in manners. They have a dialect of their own, clearly allied to the Tibetan. They are not agriculturists; they consider it unlucky to cultivate the soil, and have no permanent dwellings. They support themselves chiefly by hunting and fishing, and partly by bartering various wooden implements of furniture and husbandry for the grain of their more civilized neighbours. They are a timid and inoffensive race, avoiding as much as possible all contact with the Hindu population by living in forests in the most sequestered spots. Their religious and social customs are peculiar, and differ considerably from those of the Khasiyas, or of any other tribe found in Kumáon.

Tibet.—Of the inhabitants of the parts of Tibet adjacent to the British frontier I shall here give no account, and I only allude to their country for the sake of mentioning a mistake that is usually made in its name. It was called by Moorcroft “Undes,” *Wool Country*, and, on the great authority of Dr. Wilson, it has been said to be “Hiundes,” *Snow Country*; but there can be no doubt that the real name is “Hundes,” *the Country of Huns*. From ancient inscriptions found in Garhwál, of which I intend to give an account hereafter, it is proved that the country in question was known under the name of “Huna” probably more than 1000 years ago, and the race of Hunas often mentioned in the Purá-nas undoubtedly refers to the people of the same country. I am not aware that this apparent corroboration of the views of ethnologists as to the origin of the Huns in the countries on the northern border of the Himálaya has been hitherto noticed.
