

XV.

 OBSERVATIONS

ON THE

SPÍ TÍ V A L L E Y

AND

CIRCUMJACENT COUNTRY WITHIN THE HIMÁLAYA.

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BENGAL NATIVE INFANTRY.

 PART I.

IT had long been supposed upon theoretical inferences and conclusions, deduced from accordant but vague information, that the chain of mountains which defines a natural boundary between *India* and *Thibet*, recognised as the *Himálaya*, had a corresponding but less rugged declivity on the north, which sinking into a table land, undulated with a downward slope and spread out into a plain, and that the whole level of the soil immediately assumed an opposite declension to that of *India* on passing that lofty crest. But on crossing various ridges at elevations between fifteen and sixteen thousand feet in altitude, by the course of rivers which had their origin on the southern slope, the snowy zone was found to be of great

breadth, and, instead of an insulated line of peaks, to present consecutive ranges, or detached clusters of summits rising in rivalry, and even transcending the hither precipitous cliffs which appear from our plains in such gigantic desolate grandeur. The passes into the interior of the country were observed to run upon a higher line of level, and the streams to ramify many days journey within the snow-girt region, as the branches of the *Ganges*, *Jamna* and *Chínáb*, or like the *Satlej*, to pursue their course through the chain, deriving supplies from its northern skirt, and the high land at the back of the peaks, or penetrating more remotely, and receiving accessions from more inward regions and higher table land, as the *Indus*. In this vast alpine tract, no line has yet been discovered that marks an opposite slope to the rivers, nor have we any grounds of inference for the probable limit of that lofty level, of which the *Ganges* and *Indus*, with the *Panjáb* streams, may be considered as defining the southern declivity, and the *Brahmapútra* and *Oxus* the eastern and western slope; but nothing is known or conjectured of a northward or north-eastern boundary, and we still remain ignorant of the extent, the altitude, and the nature of the great central platform of Asia.* Lake *Mánsarovara* may be indeed assumed as the highest point of the Indian Peninsula, forming a plane which throws off the great rivers from south-east to north-west, and the base of clusters of peaks insulated between their sources and the northern slope of the plateau, of which all our knowledge is still confined to conclusions from the upper course of the *Satlej* and *Indus*, where the basins of those rivers, and consequently the lowest depression of the soil, have been ascertained to rest upon the zone of fifteen thousand feet, and the table land, through which they roll, to rise beyond seventeen thousand. These are but approximations to the altitude of the broken plains of *Tartary*, which only serve to prolong conjecture as to the extreme verge of the highest lines of level. All the waters from the northward deflexure of

* Baron HUMBOLDT's Researches were not known to the author, when this was written.

this mass of mountains, from the great *Kylás* chain and table land on both sides of it, running into the grand rivers, which form the Peninsula of *India*, or intersect the Gangetic plain, or tending towards an aspect comprehended between the debouchures of the *Brahmaputra* and *Oxus*. In crossing the remotest accessible points of the snowy barrier, or winding round the bases of its detached peaks, we find the declension of the soil every where, towards the hollows which drain off the southern waters, marked by innumerable rapid torrents throughout a reticulation of levels, which opening into a common trunk or lateral valley, pour their tribute into the great rivers.

On the north-western frontier of *British India*, the *Satlej* is the centre of this system of rivers, collecting in its downward course from *Mansarovara*, streams from the northern skirt of the *Himálaya* on one side, and the high table land on the other, which, rising in bluff undulations, terminates in a rival crest (*Kylás*) which sends its waters to the *Indus*. At the deflexion of the *Satlej* at *Shipke*, (Chinese Government), it receives similar feeders from the high ridge of *Paralássa* on the north-west, and others from the north, to the limit which turns the declivity of the soil towards *Ladák* and the *Indus*, and on the south the liquified snow of lofty mountains which have their corresponding base washed by the streams of the *Ganges*. In this area of intersections, the river *Spítí* is the great trunk descending from clusters of peaks at the heads of the *Chandrbága* or *Chúnáb*. It meanders through an inhabited valley, and debouches into the *Satlej*, at the village of *Namgeu*, in *Kunáwer*, where the stream is elevated eight thousand six hundred feet. Like the other *Intra Himalayan* rivers, its slope decreases with the rise of its course, opening out from a narrow rock-girt channel to an expanded bed of sand and alluvial sediment, and towards its source creeping sluggishly round the roots of the cliffs. At its conflux with the *Satlej*, it emerges from a gorge, or mere fissure, between perpendicular walls of granite rock.

At the villages of *Chango* and *Shíálkar*, twenty miles up the stream, the banks exhibit horizontal strata of water-worn pebbles, loam, marl, and finely attrited sand, with occasional imperfect traces of fossil exuviae at heights from one to two thousand feet above the river's bed, or eleven to twelve thousand above the sea. The channel continues sharp, but is here little hampered by rocks. The mountains of a gravelly structure, rising out of the dell on each side to the verge of twenty-two thousand feet, are almost bare in summer, the marginal snow resting close to their tops in a narrow but well defined belt. At the fortified rock of *Dánkar*, the bottom of the valley attains its maximum expanse, which is here flat, sandy, and intersected by the stream: the mountains, forming a steep rugged boundary on each side, are indented by water courses, which, descending abruptly from the snow, swell the river to nearly the size of the *Satlej*. Villages and cultivation are thinly sprinkled along the banks. In summer, the climate is mild and even sultry, notwithstanding the great elevation of the soil, and dense crops of wheat, barley and pease ripen in August and September. The winters are proportionally rigorous, but the sun's rays are always extremely ardent, and when the ground is sheeted in snow the reflected glare is intolerable to the eyes.

The forks of the river are near the village of *Lossur*, the last inhabited spot in the dell where the stream has an actual elevation approaching to thirteen thousand four hundred feet, winding with a slow declivity in a broad pebbly bed round the feet of the mountains, here presenting an almost mural scarp to their near summits, which are flat or slightly inclined, but the ravine continues beyond *Lossur*, and receives the remotest feeders from the recesses of the *Paralássa*, which is here the limit of the plane, and gives a northward slope to the waters in the origin of the *Chúnáb*. The valley of *Spítí* is thus comprehended between the heads of that river in latitude about 33° , and the *Satlej* in $31^{\circ} 45'$. The course is south east, flanked by snowy mountains on one side and the

declivity of a loftier chain sloping to the table land of *Rúpskú* on the other; the more precise boundaries of the district being, the hill-rajship of *Kullú* and the *Himálaya* south-west, the *Satlej* and the British Territory of *Basákir* (*Kanáwer*) south-east. Snowy ridges and high tabular land to the *Indus* north and north-east, and the *Paralássá* mountains with the branches of the *Chandra Bága* north-west, including an area of about ten thousand square miles drained by the *Spítí*. From the southern base of the snowy zone to the valley of the river is a geographical distance of fifty miles, and an equal space in the same line of direction (north-east) falls over snowy mountains, belts of table land and ridges, which, though only capped with snow, do not yield in elevation. The great lines of level continue rising to the *Indus*, and the land, sloping up to the north by successive ranges, at last opens into a continuous plain inhabited by Nomade races, who live in black tents, and migrate with their flocks in search of pasturage. These are the *Huns* and *Mongols*, whose figures are described as very hideous. All hither to that limit, including the upper portion of the *Satlej* and its ramifications and even the valley of the *Indus*, considered by European geographers as table land, is but the rugged skirt of this great pláteau; a tract of country unseen by the eye of civilized man, and almost inaccessible to the natives of any other region. The skies are here so arid that little snow falls even in winter and is only perennial in the loftiest spots. The section of country made by the *Spítí* and its tributaries, though cutting the northern base of the *Himálaya*, presents a singular contrast to its opposite or plainward aspect, not only in climate and vegetation, but in the condition and character of its inhabitants, and in geological structure, the rocks themselves appearing new and all the productions of nature different.

A traveller entering the valley by the sources of the *Chínáb* and *Paralássá* chain on the north-west, and tracing down the river, particularly remarks the steep and insular form of the cliffs on each side. Where

the hollows of streams take their course, they appear like lofty islands with their erect bases, planted in the sand, and their almost mural sides ending in a flat top on a plane sloping outwards. Near the head of the valley these tabular masses are sheeted in snow. In the descent of the river the marginal rocks terminate in a sharper crest, and sink with the level, but the snowy zone upon the north, though more remote, preserves a very lofty line, displaying erect peaks with slanting summits, like the crest of a wave that has gone by. The structure of the rocks is generally a packed or scabrous limestone, the stratification of which is arrayed in nearly horizontal belts, super-imposed upon each other in layers like benches, having their vertical faces to the river, and their dip inclined outwards at a very small angle with the horizon, which gives their declivity a very regular slope, that sometimes breaks off abruptly, but commonly softens into heaps of soil, like the undulations of the sea, producing furze pasturage for cattle: but the faces towards the river are too steep and rugged for any species of vegetable covering. The entire features of the country are extremely arid, with no natural verdure or cultivation, except through the medium of irrigation. The valley is but thinly inhabited, owing to the absence of streams for agriculture; the villages are consequently far detached along the step of the river, at a varying level between eleven and fourteen thousand feet; yet cultivation which, upon the Indian exposure of the mountains, shrinks and ceases beyond nine thousand five hundred feet, here maintains its ground and assumes even a denser character at belts of elevation, which often correspond to the marginal limit of the snow upon the southern aspect of the mountains, or the line of fifteen thousand feet. These cultivable spots occur along the course of adjunct feeders of the *Spítí*, or in open hollows facing to the sun between the marginal rocks of the dell and the parent ridge which defines the levels on either side. These villages, though subjected to night frosts during more than three parts of the year, and the keen rigors of a protracted winter,

are more densely tenanted than those in the trunk of the river, where the patches of soil for cultivation are dry, rocky and baked; and the fields, eaten away by the stream on one side, and hampered by the attrited splinters of the cliffs, (which are constantly accumulating,) must in time become extinct. This desolating influence, though slow, is irresistible, and all the villages will eventually disappear under it, and the whole shelf of the river be turned into a desert: the very cause which has opened the country to the abode of mankind, will overwhelm it, and when the mountains, from gradual abrasion, no longer bear any snow, the river itself will be dried up.

The tributary villages, or those not actually in the dell, are planted high above and behind the terminal rocks upon a waving slope in the midst of a black argillaceous soil, which from its open situation, is permanent. The loftiest tenanted spots that have been barometrically determined, rest at fourteen thousand seven hundred feet, and crops of beardless barley extend to the verge of fifteen thousand. Men, animals, and vegetable productions succeed better here than in the valley below, all thriving profusely in a zone that contracts and terminates every trace of plants in the Andes under the Equator; nor is it at all improbable that the interior and flatter continuity of the country may nourish a cultivable soil in a much loftier region, where increasing aridity and solar reverberation tend to a higher limit of the Isothermal lines. At the extreme altitudes where grain ripens in *Spítí*, the summer temperature, though considerable, is of very short duration in an atmosphere where the heat dissipates so rapidly that the nights are keen even in July; hoar frost sometimes appearing near the fields upon the highland and vallies of *Rúpshú*, where the want of water for irrigation baffles all attempts at agriculture. It freezes throughout the whole year, and so early as the middle of September, the morning temperature was found between 13° and 17° , while in the day time it reached to 58° . Upon the declivity of the *Spítí* valley, in the

early part of October, at permanently inhabited spots, the thermometer usually pointed between 14° and 16°, once 12°, in a hollow surrounded by dead sand hills, and five thousand feet below the level of the eternal snow; thus giving a frightful presage of their winter, against which the people are, however, well provided through the Sun's unintercepted rays and their comfortable houses, their clothing, and even their food; but fuel is so sparingly procured, that during the day a fire is rarely to be seen, though always at command amongst people who, enslaved to tobacco-smoking, are individually accoutred with flint and steel, and the furse so dry and brittle as to ignite even when growing.

Animals of every description derive a woolly covering from the effects of their arid climate. The *yák*, the dog, and even the horse, all partake of this provision of nature, but the human race in this respect is more defenceless than in other Asiatic countries, being denied all beard, while their black bushy heads seem to be insensible to the *Thermal* changes. The *Lámás* or Priesthood are, by their creed, always uncovered, and their black hair being thick set and closely cropped, give them a frightful appearance, like Banditti. There is a characteristic aspect here in every thing, which betrays a foreign influence. From the soil to the skies the whole is new to the eye and strange to the feelings. In animal life, this is peculiarly displayed in the shawl goat, the *yák*, and a species of sheep; and to the dryness of the climate more than to its rigors is owing the singular physiognomy of the landscape. The silky softness of the goat's fleece, and even its existence, depends upon the arid air and vegetation; all attempts to naturalize it even in adjacent tracts, however cold, have failed, and must continue to fail even upon a more precise principle than that which regulates the migration of plants, for it is not heat but moisture that is here inimical, and both are combined immediately on passing the snowy crest towards India. In their own country, their only pasturage is tufts of spiked gramina, so brown as to

be scarce distinguishable from the surface of the excoriated rocks—for when removed from under their native skies to however elevated a region, they cease to live. Solitary individuals out of large flocks have, indeed, by great care survived a certain period upon the hither side of the *Himálaya*, and have even reached the plains of India;—but in no country apart from their own bleak elevated pastures, can the species be preserved. It is the same with the *yáks* and the sheep which have black heads and feet: they may be acclimated upon the very border of their native soil, as in *Spítí* or *Kunáwer*, but the wool degenerates, and the animals themselves outgrow their status and proportions. On transplanting them to the southern hills where vegetation is rank and verdant, they find no nourishment, droop and die; those which survive exchanging their soft fur for one of coarse hair. Even in neighbouring districts, beyond the influence of the periodical rains, and in a very cold climate, though the animals seem to thrive, the fleece of the goat deteriorates, and upon the hither side of the *Himálaya* becomes extinct. The deserts of *Thibet* are their natural soil, where they feed upon a prickly stubble or heathy like grass, scarce visible to the eye, yet myriads of these beautiful animals checquer the almost barren slopes of the mountains to which they seem destined, and it is futile to pursue the experiment of acclimating them to European countries, which will be found a mere illusory advantage, for even if they survive, it is certain that the third or fourth generation will lose their identity, and the fine wool entirely disappear.* The sheep of the table land have an equal peculiarity of habit, and are even more difficult to naturalize.

* Captain TURNER, who visited *Thibet* in WARREN HASTINGS' Government, brought down several *Yáks* and Shawl Goats, which were transported to Europe in safety, and a *Yák* actually lived in Mr. HASTINGS' park for several years. Mr. MOORCROFT was equally fortunate in the Goats he carried away from the Table land near *Mánsarovara*, which also reached England. Those subsequently imported into France have indeed survived under the advantages of a route by the Caspian sea, through an arid country, and the care of a Physician who expressly attended them, but though the animals are considered to be thriving, it remains to be seen whether the fleece will preserve its natural softness.

They are remarkable for size, and the quality of their wool and flesh, and a long and very small black head, with legs and feet of the same colour. These immense animals are used for the transport of grain, salt, tincal, &c. &c. They pasture upon the leafless plains of *Chímurtí*, and the high table land, all along the forks of the *Indus*, being indigenous to the whole of *Thibet* from the limit of *Yarkand* to the east of *Lhassa*. They come down in vast flocks to *Spítí* in the autumn for grain, but though here in a tract of country arid and desolate to the last degree, they cannot be reared with any advantage. In the deserts occupied by the Nomade tribes, both the animal and its fleece reach a finer standard, and there the climate is drier, and vegetable productions more scanty. Horses alone undergo the transition from their elevated pastures, but they lose the woolly covering that invests the roots of their long hair: the wild animal has never been domesticated in any situation. Both would appear a priori to have a common origin, yet the circumstance of their eluding every attempt to tame them when caught, and their uniform speckled colour of fawn and white, and their wild agility, demonstrate them to be distinct species.

The inhabitants of *Spítí* afford even ampler traits of distinction than the animals; a community of condition arising from individual penury has generated reciprocal ties of social attachment. Though poor in those resources which denote easy existence, there is nevertheless a degree of comfort in the necessaries of life amongst the lowest classes unknown to the natives of the southward hills, where indolence and insulated habits have alienated those feelings of concord which make even poverty agreeable.

The common repast of the *Thibetans* consists of a greasy soup, called *Lappi*, and buttered tea: animal food is also naturally abundant in a region where pasturing flocks are almost in a state of nature, and in every house may be seen the dried carcasses of sheep and yáks, and skins

of fat and butter. They are much addicted to tobacco and fermented liquor, and upon the whole the comforts of life are in their kind neither sparing nor unsubstantial. Their manners partake of the grossness of their food ; no feeling of female delicacy prevails here, and a promiscuous familiarity and coarseness in all the habits and decorum of life reign everywhere. Their wearing apparel accords with the exigencies of the climate and the suddenness of the thermal changes. From the sheep-skin tunic to the chintzes and fine silks of *Lhassa*, which last are the insignia of the higher classes, or from the *Vazír* of the State to the Nomade of the desert, there is little in education or manners to denote distinction. Authority here, as elsewhere, claims a certain respect ; but the only courtly deference I observed in my interview with the *Khárpán* of *Ladák* (and this seemed to be due to me rather than from me) was during dinner, which we eat together in the midst of his greasy attendants, who devoured the fragments with voracious appetite, licking their fingers and then their plates, which were afterwards lodged within the folds of their woollen garments, or between them and the skin.

Strangers, especially Europeans, arriving amongst them and passing rapidly on their way, see nothing in the country or inhabitants to raise a favorable impression in their mind. They observe them in black bare-headed groupes, timid, squalid, and in rags, and every third person a priest; but, however unintelligible their conduct when debating in an unknown dialect about supplies, or the propriety of our progress, (both of which are doubtful in such a territory,) in their houses we were treated with friendship and hospitality, unaccompanied by that savage feeling which protects a traveller as a guest, and betrays him beyond the threshold of his sanctuary.

The complexion of the people is darker than might be assumed from the influence of so cold a climate, but the solar beams are equally or more

ardent in an atmosphere, which, by its want of humidity, excoriates to brittleness every trace of vegetation, and parches to a ruddy and scabrous coarseness the skin of the face, especially in the females. The people of both sexes are naturally indifferent to shame, and alienation of chastity in the females is here a mercenary interest purchaseable upon the lowest terms. In figure they are stout, waddling and dumpy; in address, presuming and indecorous, but much of their open familiarity is the offspring of immoderate curiosity. In face they are not beautiful, even when young; when past their climacteric, very unseemly; and when old, a picture of horrid ugliness; not regardless of the aid of artificial charms, their hair glistening with rancid oil hangs loosely round their sun-burnt necks: sometimes it is woven into tresses which braid the contour of the face, but is commonly unregarded and blows out in the wind, giving them a shaggy appearance like wild beasts: their black greasy heads are embellished with *lapis lazuli*; their sun-burnt necks with amber and coral, their wrists and ancles with snow white shells, and a girdle of beads and other trinkets, all shining in the sun's rays. The men, without any superior pretensions, have their peculiarities less out of place, but they are black, greasy and imbecile, without any noble qualities whatever. Poverty and their insulated situation have denied them all pride of distinction, and subdued their feelings to one uniform level. Such is their general character, and it will apply to the whole nation of *Thibetan Tartars*. The absence of female chastity is a singular commentary to their honest and pacific conduct and the other social qualities of their natural society.

The country is every where broken into steep arid peaks, uniform sterility covering alike the mountains and the vallies. There are none of those fine contrasts of scenery which we behold in the southward regions of the *Himalaya*, where all the beauties and all the horrors of Nature are

united together in a single precipice. Cultivation is here solely indebted for its existence to irrigation, and this nutritious impulse in so dry a climate is far more powerful than the spontaneous efforts of the soil, in quarters where the effect of atmospheric heat and humidity is combined. To the climate, vegetation (such as it is) owes nothing, but rather succeeds in spite of it. The few traces which are sprinkled over the dead sides of the cliffs shoot out of the rock as if impelled by their own vitality, but in the loftier zones, where the soil is better and the solar warmth mitigated, there occur upon the slope of the strata extensive tracts of a thick set prickly bush, which in appearance resembles the surface of a Highland heath.

The villages in the valley itself are planted upon an alluvial slip on each side of the river at long distances, and are indicated in summer by their verdant environs, and in winter by their black appearance in the waste of surrounding snow. The crops of this region are dense, but have little variety. The staple grain is *Ooa Jáo*, or beardless barley, peas, turnips, and in a few spots *Phapra* and mustard, the seed of which last is expressed for oil. The fields are sown in April and May, the seasons varying with the level, and in the elevated belts by the hollows of tributary streams; where the winter is protracted, the soil is cleared of snow by sprinkling black earth over it.

Notwithstanding the almost perennial night frosts at those extreme limits, and the severity of the climate during the sun's southern declination, the crops are even denser here than in the dell below.

As the cultivation of farinaceous grains chiefly depends upon a certain degree and duration of heat (which, in these regions, is found quite sufficient in July and August, without relation to the rigors of the previ-

ous or subsequent months), it was an oversight which this physical fact led to in the inference that the *Ooa Jáo*, or Tartaric barley, might be acclimated to the mountains of Northern Europe. The excessive cold that reigns at the highest cultivable levels of the *Intra Himalayan* regions during the greater part of the year, in no way cramps the progress of vegetation, since this is effected by the necessary quantity of heat during the appropriate season, and which, though perhaps never so considerable as in Southern Europe is more constant: and the solar rays of this parallel of latitude, in so thin and transparent an atmosphere, are infinitely more powerful; to such an extent, that the difference between their direct ardor and the shade is often more than one hundred degrees, and the contiguous slopes of the same ridge, within the space of a few hundred yards, present torrents of liquid snow and streams of unthawed ice.* These facts, and their effects upon the constitution of men, animals, and vegetation, are not properly understood in Europe, or if known, are explained upon theoretical assumptions which have no grounds of existence in nature.

The feebleness of the sun's rays in any part of Europe must render the mountain acclivities, of even moderate elevations, inimical to the success of the Tartaric grains, though the degree of cold there never approximates to that which reigns in the high zones of *Spíti*. Of this we have analogies

* It will scarcely be credited that in the beginning of September, upon the Northern slope of the *Paralásá*, at an elevation of fifteen thousand five hundred feet, a thermometer resting upon the rocks marked 158°, while the temperature of the air was 55°;—again in the middle of October when the Sun's Southern declination is already great, at the Chinese village of *Langtcha*, elevated more than fourteen thousand five hundred feet, the sun's rays absorbed by the sand had a temperature of 130°, while the air was 46°. In the end of the same month, in a valley flanked by lofty rocks, but at an elevation of twelve thousand feet, a thermometer stood in my pocket at 105°. Wherever we go we find the sun's rays oppressive, and much of our surprise at the high zones of inhabitants, and cultivation, ceases when we become acquainted with these circumstances.

on the Southern or Indian slope of the *Himálaya*, where, in a distance of only a few miles, and frequently within a few hours' journey on the corresponding aspects of the same ridge, we find cultivation checked, and altogether extinct on the verge of ten thousand feet, owing to the insufficiency of the summer heat at this limit, notwithstanding that the winter season here, in respect to mere cold, is far less severe, and the mean value of the climate much superior to that of the *Intra Himálayan* regions where grain is exuberantly cultivated. The climate of *Spítí*, notwithstanding the great elevation of the soil, unites the extremes of sultry heat and excessive cold; while the sun's rays are always intolerable, and in winter, strike with an ardor proportionate to the keen rigidity of the ambient air. At this period, when the country is sheeted with snow, exposure scorches the face and inflames the eyes even to the loss of sight, the glittering expanse is here made more brilliant by the reflection of skies of the deepest azure, even as black as ebony. On the first day of November, after a fall of snow, and in a temperature of 25° , I was fatigued by the sun's rays striking through a thick coat, and while feet and legs were undergoing a constant transition of thawing and freezing, to me at least the solar heat felt the most distressing, till the road deflecting round a bluff angle on the margin of the river brought us into the shade, where a bitter cold struck us to the bones, congealing the moisture of respiration, and the clothes on our backs and our legs, which in the ford of a torrent, came out at each step stiff with ice. From this time the mercury daily pointed near the zero of the scale, once two degrees below it, and probably did not rise, and must have fallen many degrees in the subsequent four months. What the cold arrives at, when the sun reaches his southernmost declination, is a conjecture that may be safely hazarded at -20° or -25° for the inhabited spots in the valley, and at the villages on either side of the limit of nearly fifteen thousand feet, it can be little above the freezing point of mercury.

The winters are followed by a degree of warmth equal to the summers of the south of England, and a far more powerful sun, but with a more variable diurnal temperature. Upon the elevated table land of *Rúpshú*, or at the tenanted environs of *Spítí*, whatever be the degree of midday heat, it flies off so rapidly in the thin air, when the sun ceases to shine, that the nights of those regions offer an extreme contrast in their chilliness, the range of temperature in the twenty-four hours often exceeding 40°. In insulated elevations this would not amount to 15°. Towards the end of August, the climate of the middle regions of *Spítí* had a day temperature of 83°; and clouds of dust wheeling along the river bed, and sometimes a weak and transitory peal of thunder gave the scene a more tropical complexion than would readily be conceived possible at an elevation between twelve and thirteen thousand feet above the sea, and in a parallel of 32½° of latitude. At *Dankar*, which verges upon this last level, my small tent was but a feeble screen against the solar rays, the thermometer on the table rising to 110°; but in so rarified and elastic a medium this accumulation of heat is very fluctuating, for, when it rains, the air at midsummer is chilled down to a degree very uncomfortable to the feelings, and the cliffs in the immediate vicinage of the villages are often sprinkled with fresh snow. In the vallies of *Rúpshú*, at a mean elevation of sixteen thousand feet, where the maximum temperature may be estimated at 75°, it snows occasionally in July, and freezes always at night*; yet such and even loftier situations

* MOORCROFT, in traversing this tract at midsummer, encountered a fall of snow, which however vanished during the sun's course. M. CSOMA DE KÖRÖS, the Hungarian traveller, had a more frightful picture of the rigor of the climate in an adjacent tract *Zanskar*, where, on the day of the summer solstice, the ground was sheeted with a fresh fall of snow, and in the beginning of September the same scene was renewed while the crops were still uncut. MOORCROFT when encamped on the shore of Lake Mansarovara, had his tents covered several inches deep with snow on the 10th of August, with frosty nights in July, when approaching the forks of the *Indus*:—facts of themselves (in so low a parallel of latitude,) demonstrating vast height, and in connexion with analogous observations upon the Isothermal lines in *Rúpshú* (if we had not Barometrical levels of the *Sallej* at *Shiphé* and *Behhar*, and Captain WEBB's depression of the river from *Niti* pass) affording presumptive inferences for placing that lake upon the very verge of seventeen thousand feet.

are the pasturing regions of innumerable flocks, where it is difficult for the eye to detect any nutritious vestige.* The marginal limit of the snow, which upon the sides of *Chimborazo* occurs at fifteen thousand seven hundred feet, is scarcely permanent in *Thibet* at nineteen thousand, and upon the southward aspect has no well defined boundary at twenty-one thousand feet. From an altitude approaching to that line, and which was bare of snow, I was in view of a distant chain, the detached peaks of which appeared under an elevation of some minutes; yet a few traces of snow, like ribbands, only remained on the last day of August. My own position was here at the edge of the snow, from which to the bed of the *Spiti*, at a perpendicular depth of ten thousand feet, was a continuous bare slope. The opposite (northern) declivity was indeed sheeted in snow to the bottom of a deep dell, and all beyond me was uniformly white.† If the objects

* A late traveller, M. *TEPLAND*, has discovered in the Peruvian Andes similar scenes to those in *Thibet*, the level of towns and cultivation having there an altitude of between twelve and fourteen thousand feet, and the highest inhabited villages and fields rising to nearly sixteen thousand. The crest of the mountains is proportionally elevated, two peaks having been determined at twenty-four thousand and twenty-five thousand five hundred feet respectively: the *Himálaya* are still superior in actual height, and greatly surpass the Andes in the medium of a large tract of lofty level, and the interior regions, which already begin to present a more gigantic display, are wholly unexplored.

† This spot is upon the northern verge of *Kunáwer*, conterminous with the Chinese frontier, and immediately above the Hamlet of *Changrezing*. The extreme ascent was effected upon the 31st of August, the preceding night having been passed at an elevation of eighteen thousand feet: even here we found ourselves so much exhausted by the rarefaction of the air that every movement was an exertion. Though the wind had a temperature of 42°, the sun's rays were so harassing as to force us to screen our faces, and for my own part literally to envelope myself in a blanket.—Somnolency, languor and sickness affected us so much that we lay all day in hollows amongst the rocks, without thinking of our situation or the chilliness of night. We slept in the open air under a calm resplendent sky and a temperature of 19°, that of the ground we lay upon being 14°, yet we did not suffer great inconvenience except when the puffs of cold wind crept in upon us, and congealed the moisture of respiration. The ascent from this spot (short as it was) occupied us upwards of three hours, and latterly our progress was beset by debility and such a sense of suffocation from the partial inflation of the lungs as almost overpowered our utmost efforts to move. I do not think we could have ascended much higher at that time, had it been practicable. At 1 P. M., the Barometer stood at 14,220 inches in a temperature of 30°, which computed from cotemporary observations at Calcutta, indicates an altitude exceeding twenty thousand and four hundred feet, a result which may be depended upon as being

I beheld from this lofty station were fifty miles distant (and the eye traversed a large tract of intervening country,) the difference between the apparent and true level would of itself amount to fifteen hundred feet,

farther verified by the observation of several contiguous peaks, whose height had been fixed trigonometrically from various lofty positions by my brother, Captain ALEXANDER GERARD. One point, in particular, which flanks a pass communicating between *Kunáwer* and *Spítí*, and elevated twenty thousand and five hundred feet, had the smallest appreciable depression, and the convexity of the level at the distance of my station, absorbed the trifling excess of height in the peak. On my north was a detached group of white tops concluded, from the angles they subtended, to be twenty-four thousand feet above the sea; the marginal snow occupying a very narrow belt, but the surface unbroken by a single dark peak. Beyond them appeared the chain of bare peaks in a very sharp outline. I took the angles of various points. Some were upon the plane of my own level, but generally all were a few minutes higher, and as the view was intercepted by an adjoining ridge, I could not ascertain the limits of their height or extent. Their sides were very precipitous, and from their reddish and often pale appearance, I concluded their structure to be gravelly or of sandstone, of which their configuration gave every sign. Their steep and conical crests seemed to have assumed that form by the wearing away of the surface: some were entirely naked, and where the snow rested, it was in patches or stripes in the course of hollows. The ground at their base was very rugged, and had an apparent elevation of eighteen thousand feet, the rock displayed itself below like granite, overtopped by the red formation; whatever it was, I am the more inclined to this belief from the occurrence of vast blocks of granite in a gorge which crossed my ascent, having been disclosed by torrents from the snow; while, at my nearest appulse to the summit, the rock was not connected, and seemed to run into a secondary series. The extreme tops at an estimated altitude of between fifteen hundred and two thousand feet higher were perfectly white, and had a bluff contour as if derived from the elements of their structure. The highest point of the bare ridge appeared at the verge of interception by the slope of an adjacent mass of mountain which was cut off from my position by a deep dell, but I have no doubt that loftier objects were to be seen, those in view being sufficiently indicated to authorize the inference, and being accessible points as far as physical obstacles are concerned, they hold out to adventure a prospect full of interest with relation to the structure of such elevated masses, and the observation of the unknown regions beyond them which have not even a mark in our maps. The sun's rays were very distressing here, but they seemed to be showered down with triple ardor upon the chain of conical peaks till they glowed in the effect of their desolation like a towering outline of volcanoes, to which impression their form and aspect bestowed an image of reality. Some very distant snowy peaks glittered in the horizon towards *Rúpshú*, but the great chain which lay to my north in passing over that tract was not visible, and as it runs behind the bare ridge and is sheeted with eternal snow, its summits must be vastly elevated. Part of the same chain was, however, descried from *Parkeúl*, rising out of the table land in a line of whiteness, my own level being here nineteen thousand and five hundred feet, and the intervening country between me and the objects a little under it all black:—a still more eastern portion seen from near *Bekhar*, had an appreciable angle of altitude from a base of eighteen thousand two hundred feet, and at a vast distance.

but some of the points subtended an angle approaching to half a degree, thus arguing an absolute height exceeding twenty-two thousand feet free of snow. The outline was very steep and sharp, and the peaks of a reddish colour, from a gravelly or sandstone structure, had a most desolate appearance. The contiguous level, though very lofty, was still rugged, and where the surface of the country is more even, we may conclude a greater altitude for the seat of perennial snow; and it would seem from the oral accounts of the *Lámás*, that the inward and still distant ranges confining upon the Tartaric plateaux, exhibit no snow that rests throughout the year, not owing to any depression of the soil, but to the constant shining out of the sun; and it is no vague conjecture to entertain that tracts of land will one day be discovered, where the abodes of mankind and cultivation surpass in height the summits of the Andes, having the winters of the Polar regions, without their snow, succeeded by the summers of England.

The peculiar aridity of the *Intra Himálayan* regions is a subject connected with so many meteorological phenomena, and with so much of the conveniences of life, that it seems to open a new field to the philosopher. Things do not rot in *Thibet*, but crumble in long ages. There are neither moisture nor insects to produce decomposition. Every thing desiccates, and, as it were, stands fixed: the process of decay is slow, and superficial things gradually disappear in dust. Where there are no forest trees, timber is of great value, but here it lasts for centuries, and the roofs of the houses constructed of an argillaceous earth are actually baked by the sun's rays, till they harden like the *kankar* of the plains. Where little rain or snow falls, there are few natural agents of destruction, and we see neglected Monasteries yielding slowly to time, each winter eating away portions of the walls, while the timbers remain unchanged. Ruins in *Thibet* are the records of far antiquity; books are imperishable, for no insects attack them, and there is every probability

that literary memorials of the earliest periods may be extant in a climate and position alike favorable to their preservation. If any Antediluvian relics of the human skeleton are to be found at all, they are likely to be discovered in some part of this elevated platform.

The hygrometrical state of the air produces more important physical effects than either heat or cold, for it gives a new aspect to a country; and, in this respect, *Spítí* may be taken as an index of the physical constitution of the vast regions lying beyond the *Himálaya*, and its consideration will assist to explain some of those anomalies which have opened upon us in that hitherto unexplored quarter.

The traveller in *Thibet* is struck with the difference in the aspect of opposite sides of a ridge having in many places not more than twenty miles in breadth. The masses of ice resting in hollows of the bare rock near which no snow is visible, where the sun's rays are scorching, and the temperature of the air is very mild, for though elsewhere it would thaw in a temperature above 32° it remains permanent here at nearly 50°. I have seen torrents frozen solid in the beginning of September, where the ambient air of the spot kept the thermometer at 57°, and the ice did not appear to drop. In the southern hills, in the dry and clear months of November and December, it is usual to see water freezing in a temperature of 46°, at an elevation of four or five thousand feet above the sea, or under a barometric pressure of twenty-five to twenty-six inches,—but by increasing the density of the air by descending to a lower level it requires a much greater degree of cold to produce the same effect, and under circumstances of excessive moisture, a thermometer will fall below the freezing point and no frost take place. Contemporaneous observations made between various parts of the hills and stations on the neighbouring plain in the latitude of 31°, have verified a fact which theory has scarcely indicated, and scientific inductions (as far as I am acquainted,) are almost silent upon.

The different effects produced by various degrees of rarefaction of the atmosphere and its relations to moisture are such as make the thermometer cease to be a correct measure of temperature, for it is not the actual, but the sensible quality of it that is so important to philosophical studies. The superincumbent atmosphere upon the surface of the *Gangetic* plains in the months of November and February, when the thermometer frequently falls below the freezing point without ice being formed, is an instance of cold without its due effects, while in the mountains at a height of seven thousand feet, as at *Simla*, a much higher temperature will freeze the soil a foot deep. The sensibility of our feelings to those atmospheric influences is but too delicate. Let one contrast the damp morning chill of the plains with the frigid elasticity, and even stimulating effect of the mountain air which, perhaps ten degrees higher, gives the aspect of an European winter. In one case the air being loaded with moisture, and absorption farther checked by its density, a film of ice is only produced by a temperature of 28° or 30°. In the other, the air is so dry and subtle that it freezes by the effect of evaporation more than by mere cold. In the *Intra Himalayan* regions this power is so much augmented by aridity that ice often disappears unthawed while snow has been seen to fall when the temperature pointed to 47°. In the southward hills the air must be cooled down to 37° before this takes place.

Every person in *India* is familiar with the peculiarly mouldering nature of the rainy season, though the heat is perhaps tempered fifteen or twenty degrees. It is the moisture which is here the element of structural decay and of oppression to our feelings. In *Spítí*, yaks are killed in the end of September, and hung up to dry when the mid-day air is at 66° or 68°. It is the absence of moisture here, that produces the opposite state, which is so sharply defined, that all the productions of nature, both animal and vegetable, would appear to be an effect of it rather than to owe their peculiar form to distant species. To this accelerated vaporization

is owing the fluctuation in level of the lakes in *Tartary*, in defiance of increasing cold. The lake of *Mánsarovara* celebrated in *Hindu* mythology for giving efflux to several rivers in opposite directions, (a metaphorical figure to indicate the point of their divergence) was not admitted, upon MOORCROFT'S assertion, to be land-locked, from ideas of the feebleness of evaporation at that great height then unknown and unsuspected;* and though the lake does appear to have an outlet in the *Satlej*, this does not alter the question in regard to basins (inferior it is true to *Mánsarovara*, but under similar circumstances) having been found wholly inclosed; and MOORCROFT was right as to the fact, though his reviewers could not reconcile it with their preconceived opinions. *Chamoreríl* (which is probably fifty miles in circuit) has no passage outward, though it is fed by streams which have a broad channel, and run with great volume in their season. † Evaporation by an atmosphere which from its extreme rarity and dryness, greedily drinks up moisture, is here amply sufficient to graduate the marginal limit of those lofty reservoirs to the extent of four or five feet, which was the maximum

* The table land of *Thibet* was estimated by European theorists, at eight thousand feet above the sea, though Captain TURNER had shewn the unprecedented rigors of the climate even in so low a latitude, and MOORCROFT'S Narrative had given us a sufficiently frightful idea of midsummer in that country.

† This lake occurs in *Rápshú* at an elevation of fifteen thousand feet. It is a long sheet of blue water with a varying breadth. My route took me by its margin for a whole day's journey, and I encamped at its eastern extremity where the shore was of turf. No water mark appeared above five feet, and as I was here in the end of September, that may be considered as the limit of fluctuation, a circumstance which was assumed by theorists in regard to *Mánsarovara* as proving the reverse of what Mr. MOORCROFT asserted, or that there must be a drain from the waters of the lake. *Chumoreríl* has likewise no efflux, though several streams pour the liquified snow of the neighbouring mountains into its basin. Evaporation in this dry air is fully sufficient to preserve the balance, and it is more surprising that any water should remain at all, than that no outward communication should exist. The northern margin of the lake is hemmed in by a mass of mountain which shoots up in a nearly mural precipice of bare rock to a height of twenty thousand feet and upwards. The snow rested close to the summit, but in vast bodies, having a cliff of several hundred feet, and but for its dazzling whiteness might have been confounded with the rock itself. It had ceased to melt. In winter the lake freezes, and remains fixed for several months, the snow then accumulates upon the ice and

fluctuation that MOORCROFT observed, and I myself have found to prevail. The hot winds are even there far less parching than the air of the interior *Himálaya* in autumn,—wood, books and shoes warping under it. At *Shipke*, upon the verge of the table land, this dryness was quite withering, and every thing flexible was converted into a coriacious hardness, and we felt a sensation of intense cold when the thermometer pointed between 40° and 50°, and, under the influence of a strong wind, the effect of a temperature but a few degrees lower was quite benumbing. In the British territory of *Kunáwer*, laying beyond the *Himálaya*, all the fruits are dried upon the tops of the houses at the season of the periodical rains in India. Even turnips are preserved in this way. To this state of the climate is owing the superiority and preservation of all the northern fruits of *Kashmír*, *Kábul*, and *Kandahár*. A circumstance still more surprising in this atmospheric vicissitude upon the immediate verge of an Indian sky, came under my own observation. The fresh roots of the *Rheum palmatum* which I dug up from amongst patches of snow at the solstice in the *Himálaya* ridge, were so brittle in August as to be easily reduced to powder, and moist opium received in *Kunáwer* in the middle of July, was pulverised to an impalpable fineness in the subsequent month,—thus at the most humid period of the year was effected a process that in India is

with the return of spring the gelid expanse breaks up with a noise like thunder, and thaws away, and torrents from the surrounding high land contribute their accessions and rise the surface to its maximum limit. Evaporation now exerts the combined influence of an ardent sunshine and a dry attenuated atmosphere, and by the end of August the lake has sunk to its greatest depression. *Mánsarovara* is precisely similar, but upon a much larger scale in respect to the volume of its waters, its elevation and magnitude of the scenes around it. The water is well tasted, which would seem to argue some outlet, which the oral accounts of the *Lámás* would confirm to be that of the *Sallej*;—as to the egress of any other river in such a situation,—it is a supposition bordering so closely upon a physical impossibility that it need not be entertained. The waters of *Lake Chamoretil* (as might be expected from their having no drain) are unfit to drink, though barely differing in taste from that of running streams. Another lake, two days journey west of *Chamoretil*, at an elevation of fifteen thousand five hundred feet, was found very bitter and brackish, and I was surprised to see wells of the finest water, in the very midst of the salt marshes: innumerable wild fowl covered the entire surface.

scarcely attainable by any length of time, while in Calcutta opium cannot be dried for medical purposes without artificial heat. In Europe the rhubarb roots, at the end of a year, generally require to be baked in an oven before they can be pulverized.

Hygrometrical considerations seem to have been entirely neglected by travellers in India. I was fortunate enough in being put in possession of KATER's hygrometer, in the tour I made to the sources of the *Hyphasis* and *Chunáb*, and across the high land of *Rúpshú* into *Spítí*, which afforded me an opportunity of comparing the state of the air on both sides of the *Himálaya*, and the degree of humidity that belonged to different elevations and situations; the general conclusions from which were, that the atmosphere of the interior regions was more than twice as dry as that which rested upon the southern hills;—that the aspect of vegetation and the rocks corresponded with the indications of the hygrometer, and that the climate of the valley of *Spítí* at an elevation of between twelve and thirteen thousand feet, in October, was infinitely more arid than that of *Subáthú* at four thousand feet, in May and June, when the wind becomes heated and the country parched up. The temperature in the former was between 40° and 45°;—in the latter 80°. The minimum of the hygrometer, in a scale that indicated 1,200, as the point of saturation was .038,* the barometer being then 19.270, thermometer 53°. For a succession of days the range varied between .042* and .055* for the least, and 170 to 190 the greatest, which last always occurred sometime after sunrise†. At elevations of nearly fifteen thousand feet, the results were not so decisive owing to the presence of clouds in the air and to the great difference of temperature, the correction for which I have

* So written in the MS.; perhaps intended for 38, 42 and 55.

† At *Subáthu*, KATER's hygrometer seldom fell under 100 in a temperature exceeding 90°.—In *Spítí*, in October, the depression was generally 45 in an atmosphere of 50 degrees.

never ascertained.—In these last situations the weather was very cold and unsettled, the thermometer varying from 12° to 44°, with occasional sprinklings of snow. Under analogous conditions the dryness of the air increases with the elevation. I regret having overlooked the wet bulb thermometer which from its principle and simplicity is, without a doubt, the most correct measure of atmospherical humidity: a compensation may however be suggested for the effect of the wind in accelerating absorption.

The face of the country, as far as it has been seen, affords a desolate view to the botanist, but the field is not so unproductive as it looks, and vegetation though scanty, will be found to exhibit many new species and peculiarities. A generic character prevails: most of the plants being armed with spiculæ: furze and spartium form the general clothing of the soil. In animal nature, the scene is equally fertile in variety: and in geology, there is much to interest inquiry; and if elevation is an object of science, the mountain ranges here offer facilities of ascent, which the steepness of the southward *Himálaya*, the snow and the cloudy climate, entirely oppose. It is obvious that angles taken from an altitude of twenty-one thousand feet, would be subject to little or no refraction where the visual ray passes through so thin a medium. From such a position, the highest levels of the country would be accurately indicated, assuming the base to be correct, which barometrical observations would sufficiently establish. Objects visible upon the plane of the horizon, at a distance of one geographical degree, would be actually elevated three thousand feet: the extreme height of the mountain range would thus be readily determined, as the observations would be liable to little discrepancy from atmospheric causes. The climate in summer is sufficiently favorable for a stationary residence, and at twenty thousand feet, one would rarely be exposed to a severer night temperature than 20°, or during the day, to one of ten below 45°, very commonly much higher, from the power of the sun's rays. Observations might be made on the diminished pressure of the air upon

the organs of life and matter, evaporation, and many meteorological phenomena.

The hope of new discovery increases the feeling of gratification we experience in treading over spots unvisited by man. No precious ores have yet come to light, but if analogy is any guide to expectation there is nothing against the supposition, that metallic riches may be concealed in the lofty masses of the interior, which in configuration and structure, correspond to those that produce them in America. This is not a new conjecture, and if they do exist, their site will probably be found in the highest zones of the limestone or clay slate. The lenticular particles of gold which are daily washed from the sand of the *Satlej* and other rivers, afford no clue to the solution of the problem, but together with the conformation of the mountains and the fact (orally related) of auriferous ores having been discovered in *Thibet*, there is no reason to discard the idea. Copper has already been found at *Súngnam* in *Kúnáwer* and in *Spítí*; which is here at least as presumptive of the existence of precious metals as galena is of their mines upon the hither side of the *Himálaya*, which though discovered, seem doomed to oblivion through the timidity and poverty of the chiefs of the soil.

It is to the inner ranges that we must direct research for the germs of metallic wealth, and especially where the great lines of level mark the highest continuity of the country. There is nothing to expect from the primitive formations which shoot up in hard compact masses into the peaks recognised from the plains of *India* as the *Himálaya*.

In the mountains verging on the table land, the rocks are all of the order considered as secondary and of the very class which envelope the treasures in the Andes. In those formations we have in a general view horizontal sandstone, wacke clay, and micaceous slate, and varieties

of limestone, even down to the transition structure that displays itself in caverns, stalactites, &c. &c. and contains animal remains and traces of plants, being often entirely composed of vegetable matter. The soil itself appears in argillaceous earth, beds of gravel, clay, and marle, deposits of gypsum, and a cineritious looking rubble, indicating coal or plumbago. Though no traces of ore are visible upon the surface, those mountains may only differ from the American chain in containing it in the loftiest zone, untrodden by man ; but the mineral state of the interior has not yet been examined, and neither the scenes of savage beauty in some places, nor the grandeur of their barrenness in others, have urged adventure to explore scientifically their lofty strata. The fossils of the *Himálaya* in respect to variety, extent, and elevation, are amongst the most curious objects to the naturalist, who sees here the great mass of secondary formations, and even portions of the table land itself, rising higher than the primeval peaks. This is sufficiently remarkable in the lofty level of *Rúpshú* between *Ladák* and *Spítí*, and the still higher belt of country intersected by the *Satlej* between the Chinese frontier at *Shipke* and lake *Mansarovara*, supported by the *Himálaya* on the south, and flanked by the great *Kylas* or *Laochi* chain washed on its northward base by the Indus, beyond which all our knowledge ceases ; but information, and conclusions together vague and unprecise as they are, hold out the ground and idea of still loftier ranges, the nature and limits of which we cannot even conjecture. The eternal snows are there repelled to an incredible height, resting partially or entirely vanishing, from the face of the country, very little being here precipitated from skies almost bare of clouds. The rounder and more lumpy configuration of the mountains and gentler undulations of the soil would seem to indicate their structure to be analogous to that of the regions which have come under observation, and the accounts of the *Lamas* confirm the report of calcareous deposits, gravel, clayish, or *kankar*, rubble, and alluvial formations, wherein shells and various organic remains, with petrified bones, are found intermixed with

decomposed felspar and the fossil exuviæ of animal matter. From the vast extent of the homogeneous tract, as inferred from the narratives of travellers and the productions of distant points of the plateaux, there is every probability that the whole country lying at the back of the *Himálaya*, the mountain ridges and plains of the interior from the skirt of *Ladák*, and even the limit of *Túrkistán* to the table land of the *Brahmaputra* at *Teshú Lúmpú*, abound with fossil relics, the living prototypes of which have disappeared from the earth. The grounds of this belief are not comprised in the productions of the *Spítí* valley; several of the most curious shells having been obtained from remote parts of the interior, but not being objects of appreciation by the people as the *Salagráma* stones are in India, they pass unregarded, or are viewed with superstitious reverence as in the case of the fossil bones of the *Mammoth*, considered to have fallen from the clouds. The very few shells which have thus come to light, are chiefly interesting as insulated specimens of the varied resources of the country; being from their unknown situs and position deprived of their value to the geologist, though still identifying the continuity of character, and pointing out an intimate analogy with the fossil geology of opposite regions of the globe.

The valley of *Spítí*, though remarkable for the poverty of its soil and inhabitants, claims consideration in a physical view, the river rolling over a plane, the extremities of which have a difference of level exceeding one mile in a distance of one hundred, a fall unindicated by the appearance of the stream. The declivity is to the south east, and the course so nearly parallel, that with the exception of a single deflection above *Shealkar*, a straight line would almost lie within the whole channel, a feature in perfect conformity with the homogenous nature of the rocks through which it passes; and wherever an obtrusive formation occurs there the velocity of the stream undergoes a change, all the harder or primitive rocks which enter into the structure of the channel uniformly hastening

the slope, giving the river an impetus, which often roughens to a torrent. In the secondary or softer strata, the channel is less jogged and the surface of the stream smoother, and where the district is limestone, gravelly, or argillaceous, it meanders silently, threading its way in the sand by numerous intersections: a corresponding character is imprinted on the landscape, the mountains betraying their structure in their configuration. The lower region of the dell is very rugged and abrupt, the granite rocks on each side at the conflux with the *Sallej* cut into mural precipices, hang like vast gates over the slowly emerging river. The eastern wall of this chasm runs up with an unequal slope till it is crowned by the sharp cliffs of *Parkyúl*, bordering upon twenty-three thousand feet, and repelling the snow from their arid sides to within three thousand feet of their summits.* With the exception of a few miles at the embouchure, the river upwards, as far as the village of *Chango*, is much inclined, appearing in a line of whiteness. In this neighbourhood, especially at *Shíalkar*, the mountains exhibit their sides of rotten argillaceous slate, and at their

* Two of the peaks have been found by measurement, respectively, twenty-two thousand five hundred and twenty-two thousand seven hundred, but it is probable that there are still loftier points in the back ground where it abuts upon the table land. The ridge trends along the *Spítú* as far as *Chango*, where it is deflected to the north east, and softens into vast heaps, being no longer peaked, and the granite evidently running into the secondary class of rocks, and giving the bluff contour to the masses which have a waving gravelly appearance, with a regular slope. Their summits which seem to exceed twenty-one thousand feet are forsaken by the snow. Even after a heavy fall in the beginning of November which covered the face of the country—those arid mountains presented the lightest drapery like hair powder. My lofty position above the cottage of *Changrezing* was upon the slope of one of those enormous heaps, and they extended towards the chain of red peaks with an ascending elevation.

In a notice by Mr. COLEBROOKE in some English publication, upon the comparative results of various measurements in the *Himálaya* regions, made by Captains HERBERT and GERARD, he remarks that the only great difference between the observations of the two Surveyors occurred in the altitude of *Parkyul*, where this amounted to three thousand feet, which is a mistake either on the part of Mr. C. or in the statement of the case. The station upon the slope of *Parkyul*, at nineteen thousand five hundred feet, being confounded with the crest of the peak which is twenty-two thousand five hundred feet, a discrepancy of sufficient magnitude to lessen the dependence to be placed upon the accuracy of all the results.

bases we see tumuli of loam like potter's clay protruding through the black soil. The eternal snow (summer line) here recedes to nearly twenty thousand five hundred feet, on a south western exposure, the bottom of the valley being itself ten thousand feet above the sea, but the effect of solar radiation in this arid concave modifies a climate, which, in insulated elevation would be unproductive of grain, to a temperature capable of rearing consecutive crops in the proper season.

Upwards from *Sheealkar*, the river has a slower acclivity. The marginal rocks crumbling at their surface terminate in smooth slopes of finely comminuted matter, and finally in steep dead sand, which repels both vegetation and snow, till near *Dánkar*, where the valley making a sharp flexure, resumes its natural direction, deriving a new feature from the transition of the rocks which now mark the fossil district, and open out at their base to a flat pebbly expanse of three furlongs.

The scene now begins to wear a desolate grandeur; every object is arid, the parched and thirsty soil ceases to shew a glimpse of verdure. The river winds its course in streamlets through a bed of sand and pebbles. The section of the rock being very steep exposes the stratification, which is here slightly inclined from the horizon. *Dánkar* itself is perched upon a projecting ledge of conglomerate limestone, rising out of the valley in steep indurated masses, which the erosion of time has filed into slender spires and the percolation of snow eaten away at their bases till they present a groupe of turrets and ravines almost deceiving the senses by the effect of natural agents. These lofty piles have a compact solidity which resists the hammer. Their sides are often scooped into places of abode, and the natural excavations are taken possession of by monks and a vagrant priesthood, who detaching themselves from the rest of the world like the Druids of old, are to be seen peeping out from their isolated niches.

The valley beyond this point preserves a considerable expanse, varying with the structure of the mountains, which sometimes jut out in hard black masses, contracting the river, but the bed continues pebbly and unhampered by rocks. The near cliffs on each side rise to about sixteen thousand feet, and are entirely bare, the snow resting at twenty thousand feet upon southern aspects, and except in hollows, not greatly lower on shaded sides.

At the village of *Rangrit*, two days journey about *Dánkar*, the basin of the river has a fine spread, and is here intersected by sandy islets, bearing Tamarisk bushes and a turfy vegetation, whereon the flocks feed in winter by scraping through the snow. The country has the same arid complexion, and encroaching barrenness alone marks the course of the valley, while gleams of the snowy frontier of *Rúpshú* are seen through the defiles of torrents, and a sharper section of the mountains foretells approach to its recesses. The cultivable step is greatest upon the right bank, the cliff of which, on both sides, from one to two hundred feet high, is worn into pillars like gigantic minarets. Their composition is an aggregate of gravel, pebbles, or calcareous rubble; the left alluvial sediment of the river baked to a rugged hardness by the sun's rays, and tapering into cones which are frequently crowned by a flat stone like an entablature; their bases eaten away till they fall within the perpendicular, and altogether so frail as to appear to the spectator who passes them, an impending danger which hastens on his steps; yet they stand erect, crumbling only at their surface, and, subsiding imperceptibly to the surrounding level, vanish amidst their own ruins, from which others again take their rise, and in their slow formation and slower decay, they record long periods of time, being the last remains of a bank or entire section that has thus worn away. These groupes of tumuli which are often left insulated upon the steepest slopes of the mountains, where all around is uniformly smooth and bare of vegetation, are viewed with timid curiosity by the traveller,

who descries them from afar through the loaming air like fortified castles, but here man is not his enemy.

At this point of the valley the river has an actual elevation of twelve thousand feet, and the narrow inhabited slip, from two to four hundred feet higher, trends on each side with a steep cliff to the stream, backed up by the bases of the mountains which here assume a perpendicular form, and the gradual erosion of their surface has thrown up heaps of finely attrited matter that reaches high upon the sides of the rock no longer visible, and in the course of time will overtop the loftiest peaks, and the whole country be thus buried in its own dust by a process of nature, which, however slow, is inevitable and irresistible.

The rise of the level continues beyond *Rangrik*, at the rate of thirty feet a mile; the river winding with a varying expanse and making sharper flexures; the rocks of a packed structure assume a bolder and more lumpy form, their inward faces steep and scabrous, terminate in flat summits, or are deflected in a slanting plane at a medium height between sixteen and seventeen thousand feet, a limit which is occasionally whitened by snow at mid summer. These are but the cheeks of the river, and the roots of a parent chain on each side which towers majestically in the back ground. The villages of *Hayl* and *Hansi* rest at an elevation between twelve and thirteen thousand feet: here the river is still of considerable volume, but fordable with some exertion; and at *Lossur*, the last inhabited spot, a few miles higher, the stream was found so much reduced that I crossed it with ease upon a man's back in the month of August, but the width of its bed argued its much greater size at an antecedent period of the year. Beyond *Lossur* the river has not been traced. On coming down upon the village from the heads of the *Chunáb*, I found its bed, at a spot nearly a mile higher, to have an elevation approaching to thirteen thousand five hundred feet, and the slow rise

of the river onwards, as shewn by the flatness of the channel and creeping progress of the stream, indicated the forks to be still at some distance, and the valley, before it breaks into a gorge, to have a vast altitude, perhaps not under seventeen thousand feet. The nature of the country at *Lossur* partakes of the general arid display. The mountains are more continuous, and throw out their cliffs like a wall, where neither snow nor soil can rest; their tabular summits adding a new feature to a scene of calm desolate grandeur.

In August the crops were still green and the morning temperature at 42°. The village occupies a slip of soil at the feet of the mountains, and cultivation descends in a slope graduated for irrigation. The people are even darker here than in the lower and warmer regions, and when the ground is covered with snow the black figures moving into sight have a very grotesque appearance, as they glide along the sheeted surface to which they form so sad a contrast. Mankind here, like plants in other climes, groupe together for mutual comfort and protection against the pressure of the climate. Lofty as the level of *Lossur* is, there is little in the landscape to betray its position when viewed in summer embosomed in flourishing crops and herds of shawl-wool goats. Yaks and horses meet the eye upon the high acclivities of the mountains, and an ardent sunshine keeps the air loaming from the effect of mirage. The *Spítú* below in its smooth sandy bason might even be recognised as a stream in the plains of *India*.

I had no opportunity of obtaining precise information about the remainder of the river, much less of following it up; but from the conformation of the channel and glance along the stream, while I stood in its bed, I have no doubt that it penetrates several days journey beyond *Lossur*, and that it forms the base of direction to a pass into *Rúpshú*, which by inferences from another, at a lower point of the valley, may be

concluded to be upon the verge of nineteen thousand feet, and as the streams from that elevated level still flow by a circuitous course into *Spiti*, (none finding a slope to the *Indus*) there is the most presumptive proof for the supposition of higher ranges in the area included between that river and the *Satlej* than has yet been observed in the detached cliffs of the *Himálaya*, which seen from spots little elevated above the sea, in sharp towering peaks, impress by their imposing portraiture an idea of greater altitude than that which is recognised in the mountains behind them, where this effect is absorbed in the vast elevation of the soil from which they rise, and the very lofty position of the spectator who views them. The mountains upon the Tartaric frontier derive from the elements of their formation a rounder contour, appearing like gigantic sand heaps. We here behold them as it were planted upon a plain, which is itself more than half their entire height. The stream of the *Satlej* at *Shipke* has already risen to nearly ten thousand feet, and at *Bekhar*, thirty miles farther, it approaches to eleven thousand. At the town of *Daba*, under *Niti* pass, and eight days journey from *Mansarovara* it verges upon fifteen thousand; limits which, if in insulated elevation, would of themselves be considered as very lofty, are here lost in the continuity of the neighbouring surface, and the highest ridges are apparently diminutive, and where the lines of level reach a greater altitude the inequalities of the soil become quite insignificant. In the plains and vallies of *Rúpshú* I found myself surrounded by black conical hills of from three to four thousand feet, mere heaps, yet they had a positive height of twenty thousand, the flat expanse at their base being here sixteen thousand. Lake *Chamoreril*, the greatest depression of the soil was still fifteen thousand feet above the sea, while Lake *Mansarovara*, from conclusions grounded upon barometrical observations made in the course of the *Satlej*, appears to be at least seventeen thousand. It is not surprising then that the country of the *Oondes*, or *Hun-dès*, seemed to MOORCROFT to be less lofty than the *Himálaya*, and that even *Kylás*, so conspicuous an object of reverence and superstition, elicited no mark of admiration when

seen from a position so elevated, that *Chimborazo* itself would look like a mole hill, and the highest summits of the *Himálaya* cease to appear majestic. Subsequent travellers have been equally deceived by the aspect of the interior, and though aware of their own elevation, erred prodigiously in their conclusions on the height of the country. Seeing the mountains under a less abrupt form, and only capped with snow produced a conviction of their depressed altitude, and that the whole surface had a downward tendency; a knowledge of the reverse may be now safely hazarded even upon the rude approximations which have been obtained. A traveller in *Rúpshú* finds himself, for days together, upon a level between fifteen and seventeen thousand feet, which runs in flat slips, or slightly inclined valleys, formed by the intersections of the mountains which are crossed at their depression, between eighteen and nineteen thousand feet; but this broken land already borders upon *Ladák* and the *Indus*, the bed of which under *Leh*, the capital, has probably an elevation exceeding eleven thousand feet, yet the country all around was very high, and the distant mountains in sight not only uniformly white in a region where the perennial snows rest beyond twenty thousand feet, but this belt was very broad, and the aspect was more that of mountains of snow than snowy mountains, my own elevation being here eighteen thousand feet; circumstances of themselves arguing vast height and removing at least much of the uncertainty and many of the errors which the consideration of such a subject would involve under the usual elements of the problem.*

* Barometrical results from their extreme simplicity and facility of observation, have not received due estimation in Geometrical operations, while inaccuracy in the instruments or observers have justly depreciated their value. It will however be found that with the correctness of which they are susceptible, their indications will approximate so closely to Trigonometrical measurements as to leave the question of superiority doubtful. I allude here to those Mathematical operations, which, by their conditions, exclude every source of error arising from refraction or the determination of the base and angles of the triangle: in cases of considerable difference in which the triangulation involves long distances, and in instances where two of the angles can only be observed, barometrical conclusions deserve the preference, and in almost all are indispensable adjuncts, and afford satisfactory verifications, while the most interesting portion of Physical Geography, the lines of level which

The idea of other and still loftier ranges beyond those gelid scenes, extending along the southern skirt of the *Indus*, is strengthened by the information of the goatherds upon the spot; but those observed from a barometric level of 15.520, answering to eighteen thousand feet, where the

regulate climate and vegetation, the sections of river courses and the planes of water communication throughout a country admit of no other method. On comparing the circumstances which affect the conditions of the respective operations, we shall see that the refractive power of the atmosphere involves a source of error of infinitely greater extent and uncertainty than the variations in its gravity which almost alone enter into Barometrical computations, and can be compensated by the medium of a large range of simultaneous observations. In cases of small angles at great distances the uncertainty of refraction must always prevail, and in the various degrees of temperature and humidity of the medium through which a ray of light passes from an object in the *Himálaya* to the eye of an observer upon the plain of India, if the angle is less than 1° , the undeterminable quantity might be sufficient to vitiate the whole calculation, if this is made with reference to a fixed point, but without assuming the extreme limits of error which are liable to result from the deflection of the visual ray in an atmosphere, varying in temperature within the points of observations to 70 or 80 degrees, the uncertainty still remains as to the quantity to be allowed for the intercepted arc, in cases where the three angles of the triangle cannot be observed, which include all the grand points of the chain, and for which allowance there is no precise measure, and a mean from the extremes only reduces the height of an object within the limits of a very considerable space, in many cases exceeding a thousand feet. With respect to Barometrical heights, much superfluous objection has been made in regard to the variations in the specific gravity of the mercury arising from natural impurities or adulteration, but which are notwithstanding, limited to a mere imaginary compass, from the impossibility of alloying the metal to any appreciable extent, without rendering it useless for the purpose. These are however, determinable errors, which may be destroyed entirely. In the dry and brilliant regions which have disclosed the scenes of gigantic grandeur alluded to, refraction becomes a computable element; from stations elevated eighteen and nineteen thousand feet, the angles of the most distant objects would be subject to little derangement from variation in the density of the atmosphere and vertical bases which are generally within our reach, by their proximity to each other, would prevent the accumulation of error by reducing the interval between the observation of the angles to an almost cotemporary result; another advantage occurs in Barometrical levels at very lofty stations in the slight changes of atmospheric density, or at least the uniformity of the fluctuations. It is true that it requires but half the extent of the oscillations in the mercurial column here, to produce the same effect (error) as at the level of the sea, but this is equally appreciable at the highest as at the lowest regions, and the discrepancy (whatever this may be in an altitude of four or five thousand feet, is not liable to be augmented in that of eighteen or twenty thousand, a correction for the hygrometric state of the air seems still a desideratum in Barometrical calculations. Under all the circumstances of the measurement when made with accuracy and the necessary compensations, we may safely

night temperature was 13° on the 23rd September, had a sufficient angle to approximate their altitude to twenty-five thousand feet, and this not in a few detached points but a continuous line of peaks, while the paler snows which encircled the summits of the most distant, indicated them to be still loftier, and without assigning them the extreme height, (in that of

assign two hundred feet for the maximum limit of error in the greatest altitudes, and at the most remote distances from the site of cotemporary observations, a quantity not so great as results between separate Geometric operations by the same person or between different observers, and even less than the difference in the computations of separate individuals from the same premises, and infinitely less than the limits within which refraction varies in the ordinary state of the air. An application of the argument is found in the *Chúr*, an insulated mountain ridge, twelve thousand one hundred and forty-seven feet high, in the hill state of *Tirmúr*, north of *Náhn* and *Saháránpur*, chosen as the grand Trigonometrical station for the survey of the country between the rivers *Satlej* and *Jamna*, and its altitude fixed by a series of simultaneous observations made under different circumstances of seasons and temperature upon its summit, and *Saháránpur* upon the plain at an oblique distance of about fifty miles. This being an accessible spot, all the angles of the triangulation were observed and the amount of refraction determined, the greatest accuracy is therefore due to the operations. Several years after, I visited the spot on the day of the summer solstice, at the commencement of the rainy season, when the difference of temperature between the peak and the plains was about fifty Thermometrical degrees and the atmosphere variable. The Barometers I used were constructed by myself upon the spot. The tubes, though under twenty-eight inches, exhibited a perfect vacuum, the mercury having been boiled within them. The scale was a fir rod, the horary observations were made at my camp seventy feet below the summit, and several were taken upon the extreme point of the peak, the result of the whole as calculated from simultaneous observations at *Subathú* the height of which was fixed, came within three feet of that deduced by the most accurate operations of trigonometry which is perhaps proving too much. A subsequent measurement, at an interval of some years, and computed from Barometrical observations at Calcutta, was within a few feet of the same result. The uniformity in Barometrical indications proves their accuracy. Far loftier spots than the *Chúr* have been visited at different seasons of the year, and with different Barometers with the most satisfactory results. The passes in the *Himálaya* at fifteen and sixteen thousand feet, in the midst of eternal snow. Those upon the verge of the table land at elevations of eighteen thousand feet, in a bleak arid country, and stations upon *Parkhyúl* at nineteen thousand five hundred feet, and the difference in the respective heights seldom approached to one hundred feet, though the temperature under which the observations were made sometimes varied forty degrees. Upon every consideration then, the Barometrical levels taken in my journey to the skirts of *Ladák*, and at various times upon the frontier of the Chinese territories, may be depended upon as true indications, though I have not attempted to reduce them to measurement, but contented myself with general conclusions, in round numbers, as more consistent with the nature of the subject.

a solitary peak,) there is ample room to confirm their rivalry over the southward *Himálaya*.*

The snowy chain, west of the *Ganges*, is crossed at elevations of between fifteen and seventeen thousand feet, and rarely the latter. At the sources of the *Hyphasis* in *Kúlú*, the depression of the *Himálaya*, at the pass of *Rotang*, is as low as thirteen thousand feet, but the northern ramifications of the chain are traversed in an ascending series in that of the *Paralassa* and *Láitche*, long ridges, respectively sixteen thousand five hundred and seventeen thousand feet; a third which formed my nearest appulse to *Ladák*, was approached by a valley itself elevated sixteen thousand feet, and from the steepness of the slope in its winding course beyond my position, I concluded the pass in the range to border upon eighteen thousand feet. The contiguous peaks, at a far higher level, were perfectly black in the middle of September,—but before reaching *Ladák*, another range, the *Parang Lá*, is crossed, which being sheeted in snow, and the passage expressly described as attended with laborious respiration, debility, and the usual effects of a highly rarified atmosphere, we may infer to be still more lofty.† This chain runs upon the limit of the *Indus*, and is no doubt continuous with the line of cliffs already noticed, which appears to stretch away uninterruptedly to the forks of the river near *Mansarovara*. Pursuing the analogy, by going eastward, the passes to

* This measurement excludes the still loftier limits which have been assigned to *Dhawalgiri*, *Chamalári*, and other peaks in the south-eastern quarter of the chain which have not afforded the same advantages of verification, and may still be considered as desiderata. A few others have indeed been determined at twenty-three and twenty-four thousand feet, but even those detached points can scarcely be taken as a measure of the magnitude of the range as compared with the vaster continuity of the interior ridges of the table land.

† There is some uncertainty whether this range of mountains is crossed by the route I followed, but it exists and is represented as a very formidable barrier. My nearest appulse to *Leh*, the capital, appears to have been still five days' journey distant, which allows ample space for the intervention of the snowy ridge of *Parang Lá*.

Stango, Bekhar, and between different points of the *Satlej*, on the tableland, are all beyond eight thousand feet, and one from *Sungnam* in *Kundwer*, into *Spítí*, cuts the mountains at an elevation of eighteen thousand seven hundred feet, while the communication with *Rupshú*, from the valley, is still higher, shewing the barometer at 15.120 on the 30th of September at noon. This magnificent boundary is of secondary formation—if by this is understood rocks of stratified limestone, intermixed and alternating with argillaceous slate, masses of hard sandstone and a coaly looking substance. None of the primitive rocks are met with in the upper course of the *Spítí*, but near *Shialkar* they are conterminous with transition formations, where the stream of *Parátí*, from the broken land on the north, defines their limits in that direction.

The geological structure of the *Spítí* district commands a high degree of interest from its numerous fossil remains, and the singular elevation and magnitude of the scenes which represent them, the mountains in many places appearing to be formed entirely of shells, and their exuviae. Specimens of these fossils have been sent by me to Calcutta, where no doubt they will have been duly appreciated and elucidated by those who are more conversant than myself with the subject of fossil conchology. Some of the fragments were broken from masses of rock lying at the foot of a cliff from which they appeared to be detached, at a height of 15,000 feet. The cliff rose like a wall abruptly from the river, but its eastern side sloped off from a crest of 16,500 feet high, where some ammonites were found. Illness, and the languor produced by such an attenuated atmosphere, prevented my taking every advantage of my visit to this interesting region, and my journey was terminated by the limits of the British territory. Just before crossing the boundary of *Ladák* into *Basáhír*, I was gratified by the discovery of a bed of marine fossil shells resembling oysters, and clinging to the rock in a similar manner, but the suspicions of the Chinese prevented my bringing away many specimens. The loftiest position at which I

actually picked up some of the shells was on the crest of a pass elevated 17,000 feet, where also were seen numerous blocks of the calcareo-silicious matrix. I was not able to pass more than a single day at this interesting spot, but I brought away numerous fragments of the rock. If the observation of shells and mountain strata of organic remains at such an altitude be worthy of attention to the geologist, I am happy in having enjoyed the opportunity of verifying the fact—leaving to more experienced hands the recognition of the species and the age of the fossils, the classification of the strata in which they are imbedded, and the theory of their being raised to their present elevation.

NOTE.

It will be seen by the heading of this paper, that it contains only the "first part" of Dr. GERARD's observations on *Spítí*, and treats of the geography, elevation, and climate of the valley; the second part, which was to have described more particularly the geological features of the country, in illustration of the fossils presented by the author to the Society, has been delayed by Dr. GERARD's journey to the *Oxus*, and cannot now arrive in time for insertion in the present volume: the last paragraph has therefore been added from information contained in the author's letters to the Society accompanying the specimens. It may also be convenient to notice here that duplicates of many of the shells described in the Rev. R. EVEREST's memorandum, page 107, were sent at that gentleman's request to Mr. SOWERBY, author of the "Mineral Conchology," the substance of whose reply is here subjoined, with alteration of the numbers, that they may coincide with the figures of the plates of Mr. Everest's paper.

Extract from Mr. J. D. C. Sowerby's letter to Mr. James Prinsep, Sec. Ph. Cl.

"I had before seen some specimens from the same mountains in the possession of Mr. STOKES and Dr. BUCKLAND, among which were several ammonites that are as yet unnamed. The Rev. Mr. EVEREST's deductions are correct as far as they relate to the formations the fossils belong to, as will be seen by the accompanying list of names, to each of which I have added the formation in which that species occurs in England. In the genus *Terebratula* there are many species that cannot be depended upon as indicating particular formations, because very similar ones are found in several beds, and the species are difficult to determine, especially if not quite perfect. The *Pecten*

mentioned as resembling the common scallop (of which no specimen was sent home) is probably the *P. equivalvis*, which is characteristic of the inferior oolite; the *Helix* mentioned also may possibly be *Ampullaria nobilis* which accompanies the *Cirrus* in the lower beds of the mountain limestone of England and Ireland."

5, Camden Terrace, 14th October.

List of Himálayan Fossil Shells.

- Pl. I, Figs. 2, 3, 5—*Ammonites annulatus, anguinus* of Schlotheim, *Zeiten Versteinerungen Würtembergs*;—t. ix. f. 2. Min. Con. tab. ccxxii. fig. 5 is the same shell:—Lias formation. The large specimen is filled with sulphate of barytes.
- 16—*Belemnites sulcatus*, Sillot, Miller, (*Trans. Geol. Soc.*, 2d series, vol. II, pt. I, pl. 8, fig. 3, 4, and 5.) *Bel. apiciconus*, Blainville's Memoire. Lias, inferior oolite.
- 15—*Alveolus* of a Belemnite, perhaps of *B. sulcatus*.—*Orthocera conica* of Min. Con. tab. ix, although called an orthocera, is only an *alveolus* similar to this.
- Pl. II, Fig. 19—*Avicula* (rather than *pecten*), new species.
- 22, 23—*Spirifer striatus*. (Min. Con. tab. cclxx.) Mountain limestone.
- 25—Cast of the interior of the same shell.
- 24—*Producta scabricula*. (Min. Con. t. lxxix. fig. 1.) This and the *Spirifer* are in a stone strongly resembling some of the Transition slate of England.
- 26—*Astarte planata*, var. (Min. Con. tab. cclvii.) Inferior oolite. A variety of this shell is found at Bayeux in Normandy, and is called *Crassina modiolaris*.
- 28—*Nucula*, an unnamed species; similar fossils occur in the mountain lime and lias.
- 29—strongly resembles a portion of some large *Inoceramus*, but is not perfect enough to determine."

Of the other shells depicted in the plates, there were at that time no duplicates for transmission to England. The shells in Plate III, are for the same reason unnamed.

J. P.

XVI.

NOTE

ON THE

DISCOVERY OF PLATINA IN AVA.

BY JAMES PRINSEP, F.R.S., *Sec. Ph. Cl.*

THE first suspicion of the existence of Platina in the Gold Dust of *Ava*, occurred to Mr. CHARLES LANE, a merchant residing at the Burmese capital, *Amerapura*, in 1830. That gentleman transmitted through Major BURNEY, the Resident, a small button of the suspected metal, along with other minerals, to Mr. GEORGE SWINTON, who presented them to the Asiatic Society on the 15th January, 1831.

A Note on the examination of this button was published by myself in the GLEANINGS IN SCIENCE for the following month, in which it was shewn that the metallic bead was a fused alloy of platina, gold and iridium, with iron, arsenic and lead. It had a specific gravity of 17.2, and was fusible at a forge heat into a round button. At a temperature of 1900° under a muffle, it assumed a dull granular spongy texture and a dark black colour, without loss of weight. The lead had no doubt been added to render the metal fusible: and when once united, there is known to be great