XXIV. — *Sketch of the Climate and Vegetation of the Himalaya.* By Thomas Thomson, M.D., Assistant Surgeon in the H.E.I.C. Service, Bengal Establishment.

The great range of the Himalaya, when taken in conjunction with the still more elevated mountains behind, which are in nowise distinguishable from it, constitutes the most stupendous mass of mountains in the world, not only from containing the highest peaks, but also, and still more remarkably, as presenting by far the greatest area of elevated land.

This gigantic mountain mass lies to the north of the great plain of India, from which it rises on the whole very abruptly. It has a direction very nearly from east to west, its west extremity is however a little more northerly than the east, the latitude rising from 26° at the east, to 33° at the west extremity.

The mountain chain to which the name of Himalaya is most properly applied, may be considered as bounded at the south by the plains of India, and on the north by the rivers Indus and Burrampooter, which have their sources in the same spot, and run one to the east, the other to the west, among lofty mountains, till they enter the Indian flat country. Nearly in the centre of this chain, in the most westerly part of Nepal proper, lies the point of separation between the two river great systems, that of the Indus and that of the Burrampooter, constituting a north and south axis, which, when better known, will probably prove to be the grand axis of Asia.

From this centre the chain of the Himalaya extends to nearly an equal distance in both directions, the central axis of the chain being the line of water-shed between the streams which run toward the plains of India on the south, and those which flow toward the Burrampooter and Indus on the north. This line of water-shed or central axis will, on inspection of a map, be seen to be in general somewhat to the north of half way between the two boundary lines of the chain, so that the distance from the axis to the plains of India, is greater than from the same place to the northern rivers. The mean width of the whole chain may be stated roughly to average about 150 miles, of which 90 are to the south of the line of water-shed and 60 to the north of it.

From the central axis of the chain, lateral ranges of mountains run both to the north and south, stretching in the latter direction as far as the plains of India, and separated from one another by deep narrow valleys, which extend far into the interior of the mass of mountains.

The number of lateral chains of the first class which form the line of division or water-shed between the basins of the great rivers on the south side of the central axis of the Himalaya, is about fourteen, separating from one another in a series from left to right the waters of the Jhelum, the Chenab, the Beas, the Ravi, the Sutlej, the Jumna, the Ganges, the Gogra, the Gandak, the Kosi, the Teesta, and the Subhansheri. These great chains, like the central axis, throw off lateral branches,

which separate from one another the different branches, by the union of which within the mountains the great rivers are formed.

The elevation of the central axis of the Himalaya is probably at a mean about 18,000 or 20,000 feet; it is nearly uniform at about these elevations throughout a great part of the chain, but gradually diminishes toward both ends. Like all mountain chains, it presents alternations of high and low portions, the lower parts or passes as they are called, from their affording the means of passage to travellers from one side to the other, being at the upper extremities of the river basins. These passes are, with a few exceptions, rarely under 17,000 or 18,000 feet. The lateral chains, starting from the more elevated portions of the central axis between the passes, gradually diminish in elevation as they approach the plains of India, not however with any exact uniformity of progression, for it is not unfrequent to find them rise into lofty peaks considerably more elevated than any known part of the central axis. The greater part of the giant peaks, which rise to an elevation of 26,000 or 28,000 feet, are situated in this manner, not on the central axis, but to the south of it; it is however by no means improbable that masses of equal elevation not yet measured or observed may occur behind them, it being unquestionable that the general elevation of the country continues to increase as we advance to the north, and that we have not yet (except in one place) attained to any point from which a descent is commenced towards the northern plains.

The direction of the principal lateral chains and of their included valleys, is on the whole perpendicular to the main axis, but with an inclination from the centre; those on the extreme east inclining to the eastward, while those on the extreme west have a very westerly direction. There are certain anomalies in the courses of the rivers, particularly at the north-west extremity of the chain; which, however, may be overlooked in a view so general and cursory of these rivers, as must necessarily be taken on the present occasion. The most marked of these peculiarities may be observed in the course of the Sutlej, which runs for a very considerable part of its course nearly parallel to the Indus before it turns toward the plains, thus separating the western part of the Himalayan chain almost from its very origin into two branches, one of which separates the Sutlej from the Indus; the other to the south of, and nearly parallel to the other, divides the basin of the Sutlej from that of the Jumna and Ganges.

From the great depth of the valleys which separate the different mountain chains, it but seldom happens that any road crosses from one valley to another, a traveller has therefore, in general, excellent opportunities of studying the direction and ramifications of the different chains, either in following the course of the valleys, or by travelling along the top of the ridges. In both cases he will find that his course is an undulating one, each chain and each branch of a chain being a curve, which bends first to one side and afterwards to the other, giving off generally a spur on the convex side, while the head of a valley insinuates itself into the concavity.

After these few words on the physical structure of the mountains, the vegetation of which it is my wish briefly to describe, it will still be necessary to devote a few minutes to the subject of climate and humidity, before I can proceed to my proper subject.

Situated in the most southern part of the temperate zone, and bounding on the north a great peninsula, which extends far into the torrid zone, the base of the Himalaya to the south possesses an almost tropical climate, tempered however when the sun is on the tropic of Capricorn by a moderately cool winter, and variously modified in different parts of the chain by the degree of humidity, a most important matter to be taken into consideration in every question connected with the phenomena of vegetable life.

The source of humidity in the Himalaya is almost entirely the Bay of Bengal, which is situated about 5 degrees to the south of the eastern extremity of the chain; and the wind which carries the humid atmosphere along the chain, is that which is known to nautical meteorologists as the south-west monsoon, a wind which begins to blow in the open sea about the month of April, but whose effects are not felt in the far interior before the month of June. This wind, though constant in its direction at sea, is not so in its inland course; at the head of the Bay of Bengal it is almost a south wind; it blows from the sea nearly due north towards the Himalaya, striking in its course upon the low chain of the Khasya hills, whose maximum elevation is scarcely 7,000 feet.

Upon this range the first force of the monsoon is expended, and the annual fall of rain at Churra Poonjee, elevated 4,000 feet on its southern slope, amounts to about 500 inches. This range, which has its origin among the mountain ranges of the south of China and north of Burmah, lies to the south of the Burrampooter, and following the course of that river, terminates in the concavity of its great bend, where it turns down toward the sea. The Khasya mountains do not therefore entirely run across the Bay of Bengal, so as to intercept the force of the monsoon from the whole of the Himalaya, a part of which wind, laden to saturation with moisture at a temperature of nearly 90° F., blows due north from the Bay of Bengal upon the district of Sikkim, which is on that account the most rainy part of the whole range of the Himalaya, for, on the one hand, the more eastern parts of the chain are protected by the Khasya range, and on the other, the more westerly parts are more distant from the source of moisture, and therefore receive a less share of it. The interception of the moisture from the province of Bootan and the independent states north of Assam, by the Khasya range, has this curious effect, that the lower ranges of this portion of the Himalaya are dry and arid, while above 7,000 feet, to which elevation only the hills to the south attain, the climate is very much more humid.

The diminution in the amount of moisture in proceeding to the westward along the Himalaya from Sikkim is extremely gradual, but also so far as our at present rather limited number of observations goes, very

regular. The effects of the south-west or rainy monsoon diminish step by step, as we advance westward, till on arriving at the valley of the Indus at the western extremity of the Himalaya, it ceases to be observed at all. In these most western portions of the chain, very little rain falls at any season of the year, and the little which does occur, falls in the spring months, and is therefore quite independent of the regular monsoon.

It is also worthy of note, that in the more western parts of the chain, the climate is extremely dry at all periods of the year, except during the monsoon or rainy season, as it is called in India, while to the eastward the climate of the mountains shares to a considerable extent the more equable and always moist climate of Bengal.

The most important point of all, however, regarding the climate in respect of its effects on vegetation which requires to be borne in mind, is that a very great portion of the rain which falls is deposited on the first range of mountains upon which the rain wind strikes. I have already pointed out that this is the case with the Khasya range, and it is there highly strikingly illustrated by the fact, that it is only on the very south side of the hills that the rain fall is so enormous, the fall twenty miles north of Churra being probably less than half what it is there.

This tendency of the rain fall to exhaust itself very considerably on the first range of mountains to which it has access, is peculiarly important in a mountain chain 150 miles in width, its effect being that the upper part of all the large valleys, and especially the interior valleys and their ramifications, are much more dry than those adjacent to the plains of India. Even in the most humid part of the Himalaya, in Sikkim, this difference is extremely marked, and in the more dry parts to the west, (the extreme east interior is not known,) the inner valleys are so dry that rain is scarcely ever known to fall.

In close connection with the increase of aridity, as we advance from the plains of India to the interior of the mountains, I may mention the increased elevation of the line of perpetual congelation, which has evidently the same cause. In the outer lofty ranges of the Himalaya, the snow line is met with at about 16,000 feet, while in the Tibetan part of the chain, many ridges of 20,000 feet of elevation are almost entirely bare of snow.

Having thus alluded in very brief and general terms to the most prominent physical features of the mountain chain of Himalaya, I shall proceed to describe, as rapidly as is consistent with clearness, the general character of the vegetation which is to be observed in its different parts at all elevations, from the plains of India to the uppermost limit of vegetable life. This would be an easy task if the vegetation were uniform throughout the whole chain, but owing to the great variations of climate to which I have just adverted, there is a very great difference in this respect, few indeed of the plants of the eastern extremity of the Himalaya being identical with those which occur in the far west. In general terms, it

may be said, that to the eastward the vegetation is very much more luxuriant and tropical, and that it changes very gradually in advancing to the westward, in exact proportion to the diminution in the quantity of rain. The same gradual transition in the vegetable world may also be observed in advancing up the valleys, or in passing across the mountains from the outer valleys to those which are further removed from the Indian plain; though in the latter case, of course, the effects of gradually increasing elevation must be taken into consideration as partly the cause of the change as well as the decrease of humidity.

The plains of northern India which skirt the base of the Himalaya, do not (if we except the belt immediately at the base of the mountains,) present by any means a rich flora. From their situation nearly on the tropics, their distance as a whole from the sea, and their proximity to the mountains, they are not very damp, and their climate has too decided a lowering of temperature in the cold season to permit them to be clothed with the dense forest vegetation which clothes the tropical plains of South America. They are in general open plains without much wood, and where not under cultivation, are covered either with a dense jungle of different species of arundo and saccharum, or with scattered trees of various tropical families, acaciæ and zizyphi being very common genera. Here and there only there are patches of forest generally low and scrubby, and without much underwood, or any of the fine parasitical plants and ferns which are so ornamental in tropical woods.

In the lower parts of Bengal, the proximity of the sea somewhat modifies this general character; a number of ferns, one or two species of pothos, and a few Orchideæ, among which Vanda Roxburghii and a large and fine Cymbidium are the most common, are to be found. In the same way the valleys of Silhet and Assam are exceptional in character, but from their being inclosed with mountains of some elevation on all sides, they are scarcely to be regarded as part of the Indian plain, but may more properly be considered as wide mountain valleys, and they in fact closely resemble in vegetation the valleys of the larger Himalayan rivers in the east part of the chain.

Close to the foot of the chain of mountains throughout its whole course from east to west, there lies a belt of forest and swampy land, which is well known in India by the name of Terai, and which, where it is developed to any considerable extent, bears a very bad character for unhealthiness, and is indeed in many places quite impassable for Europeans at most seasons of the year. This forest belt seems to be due to the greater humidity of atmosphere, and at the same time greater equability of temperature, which is produced by the proximity of the mountains. Its width is very various, from forty or fifty miles, to which I believe it attains in some parts of Nepal, to eight or ten miles, which is a more common width. Westward of the Jumna it almost disappears, being represented by a line of swampy or marshy ground, and a low jungle of bushes of the common plain species of trees.

In this belt, which occupies the base of the mountains, the vegetation is of course quite tropical in character, and is too varied to be described in detail. Large cotton trees (Bombax) are in all parts of it particularly conspicuous from the immense size of their trunks, which are not cylindrical, but buttressed all round by immense plates which project far forward from the main trunk. Numerous fig trees of very various species are also common, especially to the eastward, where many fine forms of these magnificent trees everywhere meet the eye, along with species of Dillenia, Careya, Bauhinia, and Lagerströmia.

It is from the forest which lies along the foot of the Himalaya that a great part of the timber is derived which is consumed in northern India. In the most eastern part, the most valuable timber is furnished by Lagerströmia reginæ, and perhaps other allied species; further west, the *sâl* Patica robusta, the Shorea robusta of Roxburgh, is that which is most esteemed. The sâl extends from the valley of Assam as far west I believe as the Punjab, and is found not only in the forest tract, but also in hot valleys among the mountains. It belongs to a natural order (dipterocarpeæ) which is peculiarly Indian, and which furnishes many valuable kinds of timber. None of the species, however, except the one under consideration, extend beyond the tropics; but they abound in the hilly countries of the peninsula as well as in the low ranges of the Malayan peninsula, and I believe in Java and other Indian islands. The sâl is so much valued that it has become in accessible places from whence it can easily be conveyed to the plains, very scarce, and in the vicinity of large towns where there is a great demand for timber, I believe almost extinct. It is therefore less commonly employed than the sissoo, a species of Dalbergia, which is particularly abundant along the foot of the mountains, more especially to the westward, growing in great profusion on gravelly soil, and yielding a most ornamental and valuable wood.

The forest belt which skirts the base of the mountains rests for the most part upon a dry gravelly soil, which slopes somewhat rapidly, though not perceptibly to the eye, toward the open plains, and is generally dry. Just outside the forest, or sometimes still interspersed with patches of wooded ground, there is generally a low swampy tract, which is lower than the country immediately beyond, and from which the water drains away slowly and with difficulty. This is the Terai *par excellence*, and is, from the constant dampness of the soil, and the dense heat of the summer, peculiarly unhealthy. It is too low and too unhealthy to be much cultivated, and is generally covered by a dense jungle of tall grasses, species principally of Saccharum, Arundo, Andropogon and Anthistiria, which rise high enough to cover an elephant, and afford shelter during the greater part of the year for multitudes of tigers and other wild animals; at the commencement of the cold weather, this long grass is set on fire and burnt down by the inhabitants of the hills, who at that season descend to the level country to feed their cattle and flocks. It is again abandoned to itself at the commencement of the hot season, as soon as grassy vegeta-

tion has made sufficient progress in the mountains. These swampy tracts are a series of lateral valleys which run parallel to the base of the mountains, and which, from being very slightly inclined, present great obstacles to the escape of the water discharged into them by numerous streams from the mountains.

Along many parts of the Himalaya, a similar series of valleys nearly parallel to the axis of the chain, but bounded externally by hills of from 2,000 to 4,000 feet in elevation, may be observed. These valleys are known in the western Himalaya by the name of Dhúns. One of the largest of them is the Deyra Dhún, well known to Indian travellers as being traversed en route to Masuri a favourite hill station, and now celebrated as the seat of an extensive cultivation of tea in a climate which seems to suit admirably that valuable plant. The Deyra Dhún is in its centre or highest part, from which it slopes down both to east and west towards the Ganges and Jumna, about 2,500 feet above the level of the sea, or 1,500 feet above the level of the plains, immediately outside of its bounding range.

Other Dhúns occur all along the hills to the westward. They are bounded on the north by the ancient rocks of the Himalaya, but on their outer side always by the tertiary sandstones and conglomerates, now so well known from the labours of Falconer and Cautley, as the Sewalik formation. In the north of the Punjab there are often several series of these valleys, the innermost only resting on transition rocks, the others excavated out of the tertiary sandstones, which have there often a width of from 30 to 50 miles.

The vegetation of the low ranges of hills by which the Dhúns are bounded externally, does not deviate much, if at all, from the tropical type. They nowhere exceed an elevation of 4,000 feet, which is not sufficient in isolated ridges, to bring about a sufficient change of mean temperature, to produce much alteration in the vegetation. They are only known, I believe, to the westward of Nepal, and therefore, in the drier parts of the region, they are generally covered with trees the same as those of the forest belt, with, in addition, a good deal of pinus longifolia, a subtropical species of pine, and of a dwarf species of Phœnix, almost the only palm of the western Himalaya.

From these valleys where they exist, or from the open plains in other cases, the exterior ranges of the Himalaya generally rise abruptly to a height of 7,000 or 8,000 feet, in all parts of the chain, except at the point of exit of the great rivers, where of course the outline of the mountains is much modified. I shall probably better explain the structure of the mass of mountains, by saying that the lateral chain which separates any two adjacent river basins, generally terminates abruptly towards the plains in a bold promontory 7,000 or 8,000 feet in height, from which lateral branches parallel to the plains run in each direction, gradually diminishing in elevation till they are terminated by the great rivers. After the first sudden rise, the different ridges increase much more gra-

dually, generally running nearly level for a number of miles, and then rising abruptly from 1,000 to 2,000 feet.

In ascending on the Himalaya (or indeed on any range of mountains) from the base to the line of perpetual snow, the change of vegetation is extremely gradual, and within a limited change of altitude barely perceptible, any division into groups must therefore be in a great measure arbitrary. Still some mode of subdivision is quite necessary for the purpose of description, as otherwise the mind would be puzzled by the multitude of facts. The less complicated, however, the mode of division is, the more intelligible it will be; it appears therefore quite sufficient to refer the forms of vegetation to three groups, similar to the three zones interposed between the equator and the pole, namely, tropical, temperate, and arctic; or to use the term more commonly applied in the case of mountains, *alpine* vegetation.

There is so great a diversity in the vegetation of different parts of the Himalaya, that I should entirely fail, were I to attempt to give any general idea of the vegetation of these different zones. I shall therefore select two particular spots, and by relating in some detail the gradual changes of the vegetation in each of these, I shall, I hope, be able to give a good general idea of the general appearance of the phenomena of vegetable life.

The hill station of Darjiling is distant from the plains of Bengal a little more than 36 miles, the road following a ridge which ascends in the first 13 miles rapidly to about 7,000 feet, and then runs gradually with little change of level for the remainder of the way. Throughout the whole distance the mountain sides are lined with dense forests; except in the early morning, an almost perpetual mist hangs over the trees, which collect and throw down from their foliage an abundant supply of moisture. On emerging from the dry belt of tropical forest, the ascent commences at once up a dry ridge, covered at first with the same species as grow upon the plain, species of Bombax, Terminalia; Sterculia, Emblica Duabanga, Alstonia, Gmelina, Bauhinia and others are abundant, with many figs, some species of Artocarpus, and a proportion of bamboos. By degrees a vegetation characteristic of mountain tracts, but still tropical, takes the place of those just mentioned. A Gordonia is extremely abundant, with numerous euphorbiaceous trees allied to Mappa, various species of Garcinia, the toon, (Cedrela toona or serrata,) a variety of mimoseous trees, arboreous species of Vernonia and Helicia, beautiful Bauhiniæ both erect and scandent, the latter climbing to the tops of the highest trees with a trunk nearly as thick as a man. The road runs along the top, or on one side of the ridge, looking down into deep valleys full of the densest forest. If we leave the road to enter into these dark and moist hollows, we find that there are occasionally small tracts of flat land along the banks of the streams, which, however, more frequently run through deep ravines, clothed with dense thickets of shade-loving trees, species of laurel, alder, magnolia, being mixed with the giant figs, which often form a great part of the

forest. In these more shady places the plantain and tree fern luxuriate, and a dense brushwood covers the ground. Not unfrequently large tracts are covered with thickets of Calamus, a prickly palm which attaches itself by long hooked flagelli to the trees, and often presents a formidable barrier to the traveller who tries to penetrate into its recesses. The trunks of the trees are often clothed with a dense mass of Pothos, and of the huge leaved Scindapsus, completely encircling them all round, and converting them into leafy columns, while the wide-spreading branches of the higher trees bear a profusion of Orchideæ, which overspread them even to the very top, and, when in flower, have a most gorgeous effect.

In shady valleys, as low as 2,000 feet, appear the first specimens of oaks and chestnuts, which in the equable temperature of such places, descend much further on the mountain slopes than in the more arid and variable climate of the western Himalaya.

On attaining an elevation of about 6,000 feet, the vegetation has become temperate. The purely tropical forms have almost entirely disappeared, and in their place the forest abounds in trees of temperate climes. Species of oak, holly, cherry, laurel, Rhododendron, Styrax, and Magnolia, of gigantic size, form the forest, densely covered with mosses and orchideæ, and with an underwood of species of Berberis, Daphne, Lonicera, many species of Vitis, and smaller species of bamboo than those of the tropical region. Ferns are at such elevations extremely abundant.

From the station of Darjiling, the view in every direction overlooks mountain ranges, covered with dense forest, except in a few spots where partial clearances have been made for cultivation. No bare or grassy mountains meet the eye, no rocks or precipices afford any relief from the prevailing uniformity, which, but for the magnificence of the snowy mountains behind, would be undoubtedly monotonous and fatiguing.

The ascent from the plains of north-west India to Simla, is about the same length as that to Darjiling, but presents the most marked contrast in vegetation, being throughout bare and grassy. The road ascends at first in ten miles to an elevation of 6,500 feet, then descends to about 1,000 feet, and ascends gradually to 5,000. The ascent commences from the Pinjore Dhún, a lateral valley which runs at the foot of the mountains from the Sutlej to the Jumna rivers. There is no forest in this valley, which is open, and to a great extent cultivated. The lower hills are covered with a shrubby vegetation characteristic of a dry climate. Species of Zizyphus, Carissa, Butea, Adhatoda, Bergera, Ægle, Flacourtia, and other common shrubs, with one species of bamboo, and only one fig. After the ascent commences, these bushes are only scattered at intervals over the hills, the greater part of the surface being bare and grassy. A similar open country extends all the way to Simla, except where a few fir trees (Pinus longifolia) crest the ridges, and in the more shady ravines, which are lined with a few small trees.

The transition from tropical to temperate vegetation begins, in so far as it is indicated by the small amount of shrubby vegetation, at about

5,000 feet, but on the more exposed slopes, plants of warm climates extend up 1,000 feet higher, and the herbaceous vegetation, principally grasses, is entirely composed of tropical forms.

It is only on approaching Simla, and attaining a height of nearly 7,000 feet, that forest vegetation commences; at that elevation, open forests of oak, Rhododendron, and Andromeda, intermixed with several species of pines, and a great number of temperate shrubs, of such genera as Rosa, Rubus, Viburnum, Berberis, Spiraea, Lonicera, Indigofera, Prinsepia, Salix, Daphne, and others.

The view from Simla presents a very marked contrast with that from Darjiling. The general outline of the mountains is very much the same, but they are more rocky, and very generally bare; the forests, which to the north are dense and abundant, occupying chiefly the north slopes of the mountains, so that in looking from the south the crest of the ridges only are seen to be wooded. The scenery, therefore, is more diversified than in the eastern Himalaya, and abstracting the snowy mountains, more pleasing to the eye.

Between the two extremes which I have described, every intermediate form may of course be met with, the law of alteration being apparently the following, that in advancing westward towards less humid climates, the lower hills from about 6,000 to 2,000 feet, become more and more bare and grassy, while the lower levels and the base of the mountains retain a greater degree of damp and are clothed with forest. It would appear also that above 6,000 or 7,000 feet, up to 10,000 or 11,000 feet, at which elevation mountain ranges sensibly interrupt the passage of the moist atmosphere, the temperate ranges are more moist than those below them, which do not collect the clouds, and have a higher temperature, and consequently more powerful sun. To the eastward of Sikkim, the same phenomena are very well marked, the lower ranges being extremely dry and arid, while above 7,000 feet, dense forest and a humid atmosphere prevail, just as in the mountains of Sikkim.

The valleys of the larger rivers which traverse the Himalaya from north to south, have of course a much lower elevation than the mountains by which they are surrounded; and up them, therefore, tropical vegetation penetrates very far into the interior. In the extreme west, the valleys of the Indus and Chenab, and even of the Sutlej, are up to the height of 5,000 feet, which they do not attain till more than 100 miles from their exit into the plains, hot, dry, and tropical. Further east, the tropical forest stretches far up the vallies, and they are only bare for a small portion of their extent, and in the humid atmosphere of Sikkim they are densely wooded throughout. In that province, the valleys of the Teesta and its tributaries, carry tropical vegetation far into the interior, almost within a day's journey of the line of perpetual snow, and the luxuriance of the dense and dripping forest requires to be seen to be understood.

The temperate region of the Himalaya may be said to extend from about 5,000 feet, or a little above it, to the upper limit of arboreous vege-

tation; which, to the westward, is about 12,000 feet, to the east about 1,000 feet higher. Above 9,000 feet, however, the temperate region is characterized by many remarkable forms, which do not extend lower; these are generally, in the west especially, of very European type; but in the eastern flora, it is at such levels that the magnificent Rhododendrons of Sikkim, which form so striking a part of its flora, principally occur. In this zone a great part of the trees are of European genera, alders, oaks, birch, hazel, hornbeam, horse-chestnut, and cherry, being characteristic forms. It is also especially the region of coniferous trees, very few of which, extend either below or above it. The pine which descends to the lowest level in the Himalaya, is Pinus longifolia, which is a common tree throughout the whole region from the mountains of the Punjab to the east of Bootan. It is confined in a great measure to the outer ranges of the mountains, and commences as low as 1000 feet above the level of the sea, rarely if ever attaining a greater elevation than 7,000 feet. This tree appears to have a very great power of enduring varieties of climate, for it seems equally at home in the hot, damp valleys of Sikkim, surrounded by an entirely tropical vegetation; and on the dry stony hills of the Punjab where rain hardly ever falls, and it is at all seasons exposed to a powerful and scorching sun. The only other coniferous tree of low elevations in the Himalaya is Podocarpus, one species of which is a native of the lower ranges of Nepal and Sikkim.

Pinus excelsa, which is allied to P. strobus, and Pinus Smithiana, which is near abies, are the more common species of the central zone, which are distributed throughout the whole extent of the Himalaya. In the same zone, the deodar (Cedrus deodara) is confined to the western mountains, not being, I believe, to be found indigenous in any part of Nepal, while P. Brunoniana, on the other hand, commences in the eastern parts of Kamaon, and extends as far east as Bootan. The most alpine species of the family are P. Gerardiana, P. Webbiana, and several species of juniper, of which all but the first, which is a western tree, seem universally distributed.

It would be needless to dwell at any length on the alpine zone, because luxuriant as is the vegetation, and beautiful as are the plants, the forms at least must be familiar to most of my auditors.

I must be content, in conclusion, with drawing your attention to the change produced in the vegetation in the temperate and subalpine zones as we advance towards the interior of the mountains, in consequence of the diminution in the amount of rain.

If in travelling through the Himalaya we ascend a great river, the ascent is so very gradual, that the change of climate and of vegetation in ascending is almost imperceptible, and is only detected by careful observation. If, however, on the other hand, we cross a range of considerable elevation, and descend on its northern side into another valley, the transition is often very striking, and if the chain be sufficiently elevated to intercept the greater part of the rain, the contrast between its two sides

is perfectly astonishing; when the transition is thus complete, the traveller leaves dense forests and common Himalayan vegetation on the one side, to find on the other a dry barren burnt up soil, with scattered Astragali, Boragineæ, and Cruciferæ, of forms quite characteristic of the flora of Siberia. Such is the vegetation of Tibet, which may be reached either suddenly by crossing a lofty pass, or gradually by ascending the Indus, the Chenab, the Sutlej, the Ganges, and many other of the Himalayan rivers. This arid vegetation is met on the Sutlej as low as 10,000 feet above the level of the sea, and is therefore in no way dependent upon mere altitude.

The members then adjourned to the Hall of the Andersonian Institution, to witness the experiment of the Rotatory Motion of the Earth, which was previously explained by Mr. Crum.

XXV.—*Thermometric Observations for* 1850, *made at Windsor Terrace, Glasgow, by* James King, Esq.

Height of Thermometer above the level of the sea, 94·14 feet.
Taken at 9 o'clock A.M., and 9 o'clock P.M.

JANUARY.

	A.M.	P.M.		A.M.	P.M.		A.M.	P.M.
1,	32·	36·	13,	33·25	29·	25,	39·5	42·
2,	40·	40·5	14,	30·	27·5	26,	34·5	31·
3,	43·75	43·5	15,	25·	28·	27,	25·5	36·
4,	39·	37·	16,	30·5	32·5	28,	43·5	44·
5,	33·5	32·	17,	18·	24·	29,	36·	33·5
6,	25·	25·	18,	30·	32·	30,	34·75	36·
7,	25·	25·	19,	33·5	32·5	31,	36·	44·75
8,	31·	34·5	20,	32·	30·5			
9,	31·	32·	21,	29·	31·	Mean for Month,	33·153	34·169
10,	29·	32·	22,	36·	38·5			
11,	32·5	31·5	23,	41·	42·5			
12,	34·	34·	24,	42·	41·	Mean corrected,		34°·3

FEBRUARY.

	A.M.	P.M.		A.M.	P.M.		A.M.	P.M.
1,	46·5	45·75	12,	35·	33·5	23,	45·75	45·75
2,	46·5	41·5	13,	30·5	35·	24,	45·	45·75
3,	42·	41·75	14,	42·	48·	25,	44·75	47·
4,	40·	42·	15,	49·5	45·	26,	45·	47·5
5,	37·5	38·	16,	39·5	43·	27,	46·75	47·5
6,	41·	34·	17,	45·	48·5	28,	46·25	45·75
7,	34·	33·5	18,	48·75	49·5			
8,	35·5	42·5	19,	48·5	52·	Mean for Month,	42·65	42·946
9,	45·	38·	20,	45·	43·75			
10,	35·5	37·5	21,	46·25	50·5			
11,	39·	33·5	22,	48·25	46·5	Mean corrected,		43°·6

MARCH.

	A.M.	P.M.		A.M.	P.M.		A.M.	P.M.
1,	48·5	47·5	13,	44·5	47·5	25,	29·75	34·
2,	48·5	50·5	14,	48·25	47·25	26,	31·	33·
3,	46·5	42·	15,	46·	46·75	27,	32·75	33·
4,	35·75	40·	16,	45·	43·	28,	29·25	33.
5,	42·75	48·	17,	42·5	40·75	29,	36·75	40·
6,	48·5	49·75	18,	40·5	44·75	30,	39·75	40·
7,	50·	48·	19,	46·5	48·	31,	40·5	46·5
8,	48·5	47·	20,	45·5	47·5			
9,	46·75	44·75	21,	42·5	47·	Mean for Month,	41·862	42·475
10,	45·	40·	22,	45·5	44·			
11,	37·75	38·5	23,	38·25	33·5			
12,	41·	41·5	24,	33·5	29·75	Mean corrected,		43°·1