the ground: the rest of the wall was of sun-dried brick; the whole was then covered inside and out with three coats of stucco made of lime mixed with sand, gravel, and broken pottery, a mixture which set nearly as hard as stone, and must have been a most perfect protection even in the stormiest weather. Finally, where the stucco was to be painted a thin coat of pure lime was applied as a ground for the colours, which consisted of red, yellow, and brown ochres, with charcoal-black and lime-white; and lastly, blue and green *smalti* or pigments, made of powdered glass. All these colours were of the most durable sort, and could be applied, as appears to have been done at Tiryns, on freshly-laid stucco—true *fresco*.

The painted decorations are of the very highest interest, and very characteristic examples of primitive art, which show strong traces of Egyptian or Phœnician influence. Some of these wall-paintings are evidently copied from textile patterns, and, though rudely executed, have much true decorative value. Woven stuffs such as were made in Egypt are imitated by the painter, and even the fringes are carefully copied. Other pictures, of which only fragments remain, had large figures of animals or men with wide-spreading wings, the feathers of which are painted in alternating colours in a very brilliant and skilful way. These show strong signs of Phœnician influence. The most remarkable and best preserved of all is a picture of a bull galloping at full speed, on whose back a man is riding in an acrobatic sort of way, holding on by one of the bull's horns. The whole is painted with much vigour, and with a rapid sweeping touch of the brush, which shows considerable practice and skill on the part of the painter.

Some parts of the palace were evidently decorated in a much more magnificent and costly way—that is, the walls were lined with wooden boarding, and on this were nailed plates of gilt bronze beaten into *repoussé* reliefs—very similar probably in style to the ninth century gates of Shalmaneser II., now in the British Museum, and other bronze reliefs found at Olympia. Many small fragments of these gilt metal linings were found in the burnt debris of the palace; and there is little doubt that the wooden columns in the hall and its portico must once have been cased with similar metal sheathing: very like the bronze-cased wooden column which was found some years ago among the ruins of Khorsabad.

Nothing could exceed the splendour of this mode of wall-decoration—the whole surface enriched with its gleaming reliefs would appear one mass of shining gold, and we know now that the gold and silver walls of the Homeric palace of Alcinous were not merely the offspring of a poet's fancy. Fragments were discovered by Dr. Dörpfeld of another extremely sumptuous method of architectural decoration—a frieze about 20 inches deep sculptured in alabaster with a rich and minutely worked pattern of rosettes and geometrically treated flowers, thickly studded with carefully cut bits of jewel-like transparent blue paste or glass. The effect of these deep-blue jewels flashing light from the contrasting creamy white of the alabaster must have given a most striking effect to the room which was adorned in so costly a way, especially if the wall below the frieze were one of those which were coated with the gold reliefs.

Nor was the colour confined to the walls: even the floors were decorated with simple patterns in brilliant blue and red, applied after the design had been indicated by lines incised on the surface. These floors were made of strong lime and gravel concrete carefully laid in three or four layers, each of finer material than the one below—a method exactly similar to that described by Vitruvius and used so skilfully by the Roman builders.

A very interesting point about the Tirynthian palace is its very careful method of drainage, partly with neatly fitted clay drain-pipes, and partly with large culverts built of rough stone and puddled inside with clay: this latter form was used for the main drains, while the branches which led to it were of pipes square in section, each length of clay pipe being narrowed at one end so as to fit closely into the next. All the open courts were well paved with concrete, which was laid so as to fall to a surface-gully, down which the rain-water passed, first through a clay pipe, then into the main stone drain, and so into a series of cisterns, where it was stored for use during a siege.

Much manual skill and great variety of tools were used by the masons who worked the stones for this building. Pointed hammers were used for the rough work, and chisels for the ashlar stone: the large thresholds of the various doorways were cut with a saw, with which emery must have been used, as its marks show that each stroke of the saw cut a considerable depth into the stone. Hollow drills set with some kind of hard jewel were also used here: in many of the drill-holes used to fix the pegs or dowels of the wood-work above, the stone stump of the core still exists, showing that a tubular, and not a solid, drill was used. Some of the large quoins or angle blocks were quarried thus—four drill-holes were sunk at the four corners of the future block, and then saw-cuts were made from hole to hole.

This use of tubular jewelled drills, which has recently been introduced with such effect into modern methods of engineering, dates from a very early period. As Mr. Flinders Petrie has pointed out, jewelled drills, both solid and tubular, were used in Egypt as early as 4000 years before Christ, especially in the working of the very refractory granites, basalts, and porphyries, which no unaided metal tools could possibly have cut. That jewels *fixed* in the rim of the metal tube were used, and not merely loose corundum or emery-powder, is shown by the fact that the scratch from a single projecting jewel can often be traced continuously round the spiral markings on the insides of the drill-holes.

It is not, however, only the mere technical details of the workmanship of this Tirynthian palace that bear strong witness to its early date, but also the methods of construction—the walls of sun-baked bricks set on a footing of stuccoed rubble, the use of wood instead of stone for the columns, and the magnificence of the walls lined with plates of bronze, *repoussé* and gilt.

Finally, nothing can be clearer than the evidence supplied by the semi-Oriental style of the wall-paintings, and the distinctly archaic character of the delicately sculptured alabaster frieze, studded with gem-like pieces of blue κύανος—exactly as was once the case with the central row of spirals in the well-known architrave from the doorway of the "Treasury of Atreus" in the British Museum, the remote antiquity of which is disputed by no one. In fact the methods of execution, the system of its construction, and the style of its decoration all combine to show that we owe to Dr. Schliemann and Dr. Dörpfeld the discovery of an almost new phase of prehistoric Greek art. J. H. M.

ON VARIATIONS OF THE CLIMATE IN THE COURSE OF TIME[1]

IF we examine the meteorological charts of Norway we observe at once what a great influence the sea and the mountains exercise over the climate in various parts. Nearly all the climatological lines run more or less with the shape of the coast, so that we encounter far greater variation when proceeding from the centre coastwards

[1] The following is a short abstract from various papers, viz.: "Essay on the Immigration of the Norwegian Flora during Alternating Rainy and Dry Periods" (Christiania, 1876). "Die Theorie der wechselnden kontinentalen und insularen Klimate," in Engler's *Botanische Jahrbücher*, ii. (Leipzig, 1881). "Ueber Wechsellagerung und deren mutmassliche Bedeutung für die Zeitrechnung der Geologie und für die Lehre von der Veränderung der Arten," in *Biologisches Centralblatt*, iii. (Erlangen, 1883). "Ueber die wahrscheinliche Ursache der periodischen Veränderungen in der Stärke der Meeresströmungen" *l.c.* iv. (Erlangen, 1884).

than from south to north. In keeping with the same are the variations of the flora.

The plants of Norway may be divided into certain groups of species, the species belonging to the same group having a somewhat similar extension, whilst each of these groups of species is confined to special climatological conditions, and is only found in those parts where such prevail. The Norwegian flora is in the main monotonous. On the mountains large areas are covered with only a few lichens, mosses, and heather, or copses of dwarf birch, juniper, and willows; lower down the forests are formed of birch, fir, and spruce, and have a monotonous flora, viz., heather and lichen in the fir forests, "blue" berries and a few kinds of moss in the spruce forests, whilst the west coast is covered with heather, and the numerous marshes with a vegetation, poor in species, of a few mosses and Carices.

But in spite of this general monotony of the flora of the mountain wastes, with their grayish-yellow lichens, grayish-green and green copses of willows or dwarf birch, there are certain places, particularly on slaty ground, where a rich vegetation may be found. It consists of small perennial plants some inches in height, and which are particularly distinguished by their copiousness of flowers, which are very large in proportion to the size of the plant, and have very pure and lovely colours. Outside Norway we also encounter these plants in Arctic regions, and the Alpine flora of these slaty tracts is therefore of Arctic character. But not all slate mountains have such a varying flora. The coast climate is, in consequence of the mild winters, when the temperature frequently changes, destructive to these plants, which shoot at a very low degree of heat. It is for this reason that, when we mark those places on the map which have a rich Alpine flora, they lie scattered as oases over the land with great spaces between them, but always sheltered from the sea-winds, *i.e.* on the east or north-east side of the highest mountains and greatest glaciers, which act as barriers against the mild climate of the coast. In these places the botanist may fancy himself transferred to Spitzbergen or North Greenland; he finds the principal plants encountered there, and if we follow the Arctic flora to Spitzbergen we find that here also it shuns the sea, and is most copious in the bottom of the fjords.

In the lower districts, sheltered from the open sea, we find in favourable spots another group of plants which also shun the coast, and which thrive on loose slates and warm limestone cliffs, or in screes of different kinds of rock, under precipitous mountains, facing the sun. These screes are generally full of bare boulders at the bottom, but in the finer debris higher up grows a wreath of green underwood, formed of tender deciduous trees and shrubs, hazel, elm, lime, maple, dog-roses, *Sorbus Aria*, *Prunus avium*, wild apple, &c., as well as a number of highly-scented Labiatæ, several Papilionaceæ, grasses, and a great number of other plants, together forming that part of the Norwegian lowland flora which shuns the open sea-coast, and prefers the fjords and the sunny valleys. But even this flora has a scattered extension. It is richest in the tracts around Christiania, and becomes poorer westwards along the coast, disappearing almost entirely on the coasts of the province of Bergen; but at the bottom of the Sogne and Hardanger, and along the Throndhjem fjords we find the same flora, and that in spite of these parts being entirely separated by enormous mountains.

Near the open sea the flora becomes poorer in species, most of those characteristic of the interior disappearing, whilst their number is not by far made up by those belonging to the coast. Here we shall only name a few of the coast plants, such as the holly, the ivy, and the foxglove, whilst in place of the *Primula veris* of East Norway we have the *Primula acaulis* of the west coast. In the woodless tracts of the coast the heather predominates, and besides the ordinary common one we find two other species. This group of plants belongs exclusively to the south and west coasts, and is hardly found north of the Throndhjem fjord. Most of its species are not found near Christiania, but they reappear in the south of Sweden. Some, however, are in Scandinavia only found on the west coast of Norway, and we must travel to the Faroe Islands, Scotland, England, and Belgium to re-encounter them.

We have thus seen that the Norwegian flora consists of groups of species which make different demands as to climate. If we were to colour a map according to the places where certain groups are most copious, we should at once discover that they had a scattered distribution. We should find the same colour here and there, in smaller or larger patches, but those of the same colour would be separated by great spaces of a different tint.

At one time botanists were satisfied with explaining the distribution of species through soil and climate, but as the study of their appearance proceeded it was discovered that there were great gaps in the extension of many. And these gaps were often so great that scientific men were obliged to resort to explaining the same by maintaining that such species were created in places far apart. But since the doctrine of the origin of species by descent has been accepted, such an explanation must be rejected. There remains, therefore, only two ways in which to explain these things. Either wind, animals, or sea-currents are capable of carrying the seed of plants at once across such large areas that the gaps in the extension can be explained by the means of transport at work at present, and there are even those who still believe that this is the case. In certain instances this explanation is indeed the only one possible, when, for instance, it concerns the flora and fauna of the oceanic islands which have never been connected with the great continents, and still have species more or less related to those of the mainland. But such a sudden migration is very improbable, and may even be dispensed with altogether, as we shall presently show, when it is necessary to explain such gaps in the extension of whole groups of species as those we have pointed out above in the flora of Norway.

We have, besides, another explanation of this problem, first advanced by Mr. Edward Forbes, who maintained, in common with most modern botanists, *that the climatic variations of the past are reflected in the fauna and flora of the present*. He was, we believe, the first *savant* who demonstrated that the Glacial Age has left its distinct mark on the flora of the present day. Arctic species are found on mountains in temperate climates. During the Glacial Age these species grew in the plains at lower latitudes, but as the climate became milder they receded gradually to the far north and the high mountains. In the warm plains they had to give way to the new immigrants, and this is the reason of our discovering hyperborean plants on the mountains of Europe.

If now we were to apply this explanation to the scattered extension of the species in Norway, we must bear in mind that the distances here are smaller, although at times there are several degrees of latitude between the places where the same appear. We must, therefore, see if an acceptable explanation of the extension of the Norwegian flora can be made by means of geology, and if the same be supported by other circumstances.

It is not long since, geologically speaking, that the Scandinavian peninsula was covered with an inland ice, stretching right out to sea, above which only solitary mountain-tops rose, like the "nunataks" in Greenland. It is evident that the majority of the present flora could not then exist in Norway; but the present flora is older than the Glacial Age, which is conclusively proved by specimens from the same being found in coal strata older than that period. Thus yew, fir, and spruce, hazel, willow, &c., have been found in old peat-bogs of England and Switzerland, for instance, which are covered by the bottom moraine of the inland ice. The present Norwegian flora, there-

fore, must have lived in other countries which were free from ice during the Glacial Age, and immigrated to Norway as the climate became milder and the ice receded. This is the reason of Scandinavia having no peculiarly characteristic species, *because the flora has immigrated from outside countries, and the time is so short since it settled in the country that it has not yet had time to produce new species.*

If we may now apply the geological theory of explanation to the flora, we come to the conclusion that the immigration took place during repeated changes in the climate. After several thousands of years with a severer climate which favoured the immigration and extension of northern and eastern species, other thousands of years followed with a milder climate. During this period fresh immigrants came from the south and south-west, compelling the older flora to retreat. In this manner the climate must have changed several times since the Glacial Age, and the distribution of the plants must have changed in accordance therewith. The periods of variation are reflected in the present flora, and it is the former which have led to the great gaps in the extension of coast as well as inland plants. The sunny screes, the slate districts, and the moist coast tracts are asylums where the different floras have found refuge. In the intermediary parts they have been dislodged by the newcomers. But certain species, being indifferent to the variations, extended constantly, at the expense of others, *and this is the reason of the Norwegian flora being so monotonous.*

In order to test the accuracy of this assertion we shall first turn to the peat-bogs and examine their structure. We shall, for comparison's sake, also examine the Danish ones, which are well known from the researches of Prof. Steenstrup.

In the forest and mountain districts of Norway there are innumerable marshes. In the forest districts most of them are now comparatively dry, the heather and wood covering parts of the bog, and on the surface of the latter tiny mossy knolls are often found, in the middle of which stands the old stump of a tree. An examination of the structure of the peat layers—which is easily made with a bore—shows that previous to the present time, when the surface is generally more or less dry, there was a period when the bog was much more watery. Under the present conditions the growth of the peat is arrested, at all events in dry places. But just below the lichen and heather-covered surface we find on boring a pure, unmixed white moss (Sphagnum). It is this moss in particular which has formed the peat in the Norwegian bogs; and in the upper layers—only one or two feet from the surface—flint implements from the Stone Age are often found. At the period this upper layer of Sphagnum was formed the bogs were woodless because they were too watery. We see, therefore, that the peat in these bogs has not grown very much within historical times, and that the layer of stumps of trees, which are found on the surface in the knolls, indicates an arrest of the growth of the peat, the duration of which may probably be measured by many hundreds, perhaps by thousands, of years. It might be argued that the present drier state of the bogs was simply due to the circumstance that the peat had grown so high that the moisture had run off. But this is not an acceptable explanation, because if we bore deeper in the peat we find that the oldest bogs are built of four layers of peat, *and between these stand three layers of stumps, so that these bogs are for the fourth time covered with trees since they began to form.* And as most of the bogs, if not all, are at present drier than they were before, the theory of merely local variations of the moisture is also insufficient to explain the phenomena. It remains, therefore, only to assume *that periods of dry and wet have alternated during ages.* The peat layers generally belong to the latter, and the stump layers speak of drier periods, when the bog was covered with trees.

Of these four layers of peat, which in some places measure upwards of twenty-six feet in thickness, only the two youngest inclose, as far as the researches in Norway go to show, remains of foliferous trees sensitive to cold. And this justifies the assumption that they correspond to the four layers which Steenstrup has shown in the bogs of Denmark, and which appear like geological strata with distinct fossils, viz., the aspen, the fir, the oak, and the black alder. This comparison of the peat layers of Norway and Denmark is further supported by the circumstance that layers of stumps are also found in the Danish bogs, and here, too, they stand between the peat layers of the various periods. They indicate long periods, during which also the Danish bogs were dry and partly covered with forests when the peat ceased to grow. But during these dry times the flora was changed through the immigration of new species, and when a wet time again set in, it was other trees which grew around the bogs, and which spread their boughs, leaves, and fruits over the watery bog, and the remains of which were buried by the growing layers of peat.

In this manner the structure of the peat confirms the conclusion to which the distribution of the flora pointed, and if we take the fossil plants and marine shells to our aid we may explain the gaps in the extension of the species without assuming long transports of seed.

In the freshwater clay of Scania and Seeland, Prof. Nathorst has discovered numerous remnants of Arctic plants. This clay lies *below* the peat. When it was deposited in the cavities of the old bottom moraines of the inland ice, not only the dwarf birch, but even hyperborean plants, such as the Arctic *Salix polaris* and others, flourished in the southernmost parts of Scandinavia; *therefore the Arctic flora was the first which immigrated into Scandinavia.* It entered whilst the climate was very severe; but the climate became milder and more moist; the peat began to form; then the aspen and birch entered, and, later on, under varying conditions of moisture, the fir and the spruce, with the flora of the mountains and forest glens, a series of species which have not yet been mentioned, viz. Mulgedium and Aconitum, many great ferns and grasses, wood-geraniums, and lychnis, &c. But the climate became warmer and warmer; and finally the foliferous trees, more sensitive to cold, entered, viz. the hazel, the lime, the ash, the oak, the maple, and a number of others from warmer regions. In the province of Bohus quantities of stones of sweet cherries are found in many places, in peat, where this tree is now extinct; and in the Norwegian peat-bogs hazel-nuts are very frequent in a certain layer, not only in the interior of the great coniferous forests, where not a single hazel-tree is found, but even in the heathery, woodless coast-lands. It will, therefore, be seen that the hazel and the sweet cherry were then very plentiful, and from this we may justly conclude that the trees, and shrubs, and herbs which thrive in their company were also once far more plentiful than at present. *It is this flora which has found an asylum in the above-mentioned screes.*

Following the period when Southern Norway was covered with foliferous forests to a far greater extent than now came a warm and moist one, in which the peat again began to grow. At that time the coast oak (*Quercus sessiliflora*) was far more frequent than at present, judging by the evidence of the peat-bogs, and at that time, the shell deposits inform us (as shown by Prof. M. Sars), the present marine animals of the west coast were found in the Christiania fjord. *And there is every reason to assume that the present flora of the west coast immigrated thither at that period from the south of Sweden along the Christiania fjord to the west coast.*

New changes again set in, with new immigrants, and finally came the present age with its comparatively dry climate. But all these events are prehistoric, as is shown by the stone implements lying in the uppermost peat layer, close under the surface.

Thus, the remains of plants and animals in clay, peat, and shell deposits inform us *that the gaps in the extension of the species in Norway may be explained by the varying events of times long gone by.*

Since the Glacial Age the relation between sea and land in Norway has changed. Formerly the sea was in some places upwards of 600 feet higher than at present.[1]

The clay at that time deposited on the sea-bottom, and the shell deposits formed near the shore, contain, as Profs. M. Sars and Kjerulf have taught us, remains of Arctic animals even in the southernmost parts of the country. There is a difference of opinion between *savants* whether this alteration of the shore-line is due to a rising of the land or the sinking of the sea, or to both. There is further some dispute about the manner in which the level became altered, some maintaining that it took place suddenly at intervals, whilst others believe that it is the result of a gradual and continuous process. The marks left by the sea seem at first glance to corroborate the first of these theories. Thus, in the lower parts of our valleys we find along the river-courses terraces of sand, pebbles, and clay, one behind and above the other right up to the highest old shore-line. The terraces, of which Kjerulf, pre-eminently amongst others, has given us particulars, have an even surface and a steep declivity outwards against the mouth of the valley. They contain sometimes remains of sea animals. Under a higher level of the sea the river carried down sand and gravel to its mouth, just as in the present day banks and bars are formed at the estuary of our rivers. And the terraces seem to indicate that the changes in the level were broken by periods of rest. During the latter the river had time to form a bank, which rose comparatively rapidly; the next period of rest gave occasion to the formation of another terrace, and so on. But this theory has to combat many obstacles, because the terraces lie often, as Prof. Sexe has shown, even in valleys situated near each other, *at different elevations.* The professor is of opinion that step-like terraces may be formed even under a gradual and steady rising, if the carrying-power of the river is subjected to changes. Our theory may therefore probably also be applicable for explaining the terraces, because, if long periods with milder climate have alternated with others whose climate was more severe, it is evident that the volume of water, and thus the carrying-power of the current, may have altered. Perhaps the rivers have at certain times carried down floating ice, at others not, and the thaw in the spring must have increased the carrying-power. We can thus understand why the corresponding terraces in valleys near each other do not always lie at the same elevation. Their rivers differ in size, and when the carrying-power diminishes a big river will retain the strength to form a terrace longer than a small one.

Besides these terraces, which are particularly conspicuous in the short steep valleys on the west coast of Norway, and on account of their regularity must excite the admiration of every one who sees them, there are other equally striking marks of the old sea-levels, viz. the so-called "Strandlinjer"—shore-lines—which are known chiefly through the researches of Prof. Mohn and Dr. Karl Pettersen.

When travelling through the fjords and sounds, particularly in Northern Norway, one sees here and there horizontal lines drawn along the mountain-sides, sometimes several hundred feet above the sea. They are not always equally marked, but appear often remarkably clear; sometimes they look like roads or railway-lines. They are always horizontal, or nearly so, and must, therefore, be remains of an old sea-shore. Often two parallel lines are seen running one above the other in the same place; and on closer inspection it will be discovered that they are hollowed out of the rock itself. They have a surface sometimes many feet broad, and are bounded behind by a more or less steep mountain-wall, forming thus horizontal incisions in the same. The shore-lines have also been brought to prove that the rising was broken by periods of rest, during which the sea had time to hollow out the rock; but I am of opinion *that they could be formed, too, under a gradual rising, if the climate be subjected to periodical changes.* The shore lines belong to the northern parts of the country and the deep fjords, where the winter cold is more severe, and they are only found in districts where there is a tide. They seem to have been blasted out by the influence of the cold. At high tide the sea-water fills the holes and fissures in the rock, and when the tide recedes it is left in the same. In severe winters the water will freeze, and thus burst the rock. During the rising of the land, shore-lines will be broken out in this manner, as long as the erosion is able to keep pace with the rising. When the climate becomes milder, a time will come when the erosion is unable to continue. Then the shore-lines will be lifted up above the level of the sea, and out of the reach of the blasting influence of the water. If next, after thousands of years, when the land has perhaps risen fifty or a hundred feet, a period follows with a severer climate, a new shore-line is formed below the former.

The shell-banks, too (*i.e.* deposits of shells of marine animals living in shallow water near the shore) lie, as Kjerulf has shown, in the Christiania fjord at different levels, the oldest at heights of from 540 to 350 feet, and the youngest between 200 and 50 feet above the present level of the sea. But between 350 and 200 feet none has been found. In the neighbouring Swedish province of Bohus they are found at all elevations, even between 350 and 200 feet, and it must therefore be assumed that local causes, as, for instance, the ice-formation in the more closed Christiania fjord, destroyed the shell-banks when they reached the shore-line, at a period when the land lay 350 to 200 feet lower in relation to the sea than at present. According to the evidence of the peat-bogs, there is reason to believe that this part of the rising occurred under a more severe climate.

It is therefore seen that all the facts which have been advanced in order to prove that the rising was broken by periods of rest may be easily explained, *if we assume that the land rose gradually and steadily under periods alternating with milder and severer climates.*

The University, Christiania A. BLYTT

(*To be continued.*)

[1] The depth of the peat in the parts which were formerly below the sea increases with the height above its surface, because the formation of the peat commenced long before the lowest-lying parts had risen above the surface. From the remains of plants found in the various peat layers we may therefore learn how the Norwegian flora was composed during the various phases of the rising of the land.

HYPERTRICHOSIS

I THINK all naturalists, and anthropologists in particular, will be interested in the cases of human hypertrichosis now on view at the Egyptian Hall, Piccadilly. I myself spent two hours with them on Saturday last.

This family of hairy people have been at the Court of Burmah for four generations. Crawfurd saw Mahphoon, the old woman now exhibited, an infant in 1827; the family was described by Col. Yule in his narrative of a Mission to the Court of Ava in 1855.

It is singular that the hypertrichosis of Mahphoon's grandparent should be continued not only to herself but to her son, Moung Phoset, also exhibited, inasmuch as one of the parents has always been an ordinary comparatively hairless Burman, so far as the face and body are concerned.

Mahphoon is now an old blind woman, but very lively, full of fun, and an inveterate chewer of betel; her face