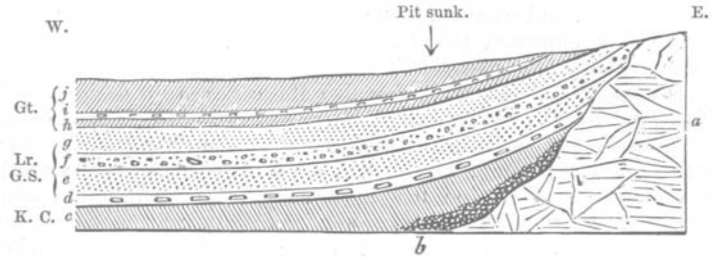
other collection that will compare with this, neither is there, to my knowledge, any other locality within the same district which gives so good a sequence from the Coral-rag to the Gault.



SECTION OF STRATA AT UPWARE ON THE CAM.

- *a* Coral Rag *in situ*.
- *b* Coral Rag intermixed with Kimmeridge Clay (the bed marked (*b*) extends as high up the denuded surface of *a* as the deposit marked *h* although not shown in the diagram.)
- *c* Pure Kimmeridge Clay.
- *d* Lower phosphatic bed of Lower Greensand, rich in fossils and often cemented so as to form hard conglomerates, and containing a large quantity of derived fossils.
- *e* Lower Greensand, with few or no fossils.
- *f* Upper phosphatic bed of Lower Greensand.
- *g* Upper layer of Lower Greensand.
- *h* Gault of about one foot in thickness.
- *i* Phosphatic bed in Gault of five inches in thickness.
- *j* Non-fossiliferous Gault, seven feet.

NOTICES OF MEMOIRS.

I.—ON THE MIOCENE FLORA OF THE POLAR REGIONS. Two Lectures given at the Annual meeting of the Natural History Society of Switzerland on the 9th and 11th September, 1867, at Rheinfelden, by Professor OSWALD HEER, of Zürich.

(Translated by JOHN EDWARD LEE, F.S.A., F.G.S.)

I.

PROFESSOR HEER has had the opportunity of examining a large number of fossil plants from the museums of Dublin, London, Copenhagen, and Stockholm, which have been discovered in the north of Canada (on the Mackenzie), in Banksland, in North Greenland, in Iceland, and in Spitzbergen. They reveal to us valuable information both as to the diffusion of plants in the early ages of the world, and also as to the climate which prevailed at that time in the far north. This Arctic Miocene flora, so far as can be ascertained from these specimens, consists of 162 species:[1] 18 species belong to the cryptogamia, and amongst them we notice small fungi, which have formed spots and dots on the leaves of trees, just as the leaf-fungi do at the present day; and 9 species of fine large plants of the fern tribe, with which the ground under the forests was probably clothed. The phanerogamous plants consist of 31 species of trees allied to the fir tribe, 14 monocotyledons, and 99 dicotyledons. Judging from their analogy with the nearest living plants, there

[1] These species are described and drawn in the work of Professor Heer, Ueber die fossile Flora der Polarlände." Zürich; Fr: Schulthess, 1867.

were 78 kinds of trees, and 50 shrubs: consequently, at that period, 128 species of woody plants had been diffused over the far north. Amongst the pine or fir tribe we find silver firs (Tannen), spruce firs (Fichten), and common or Scotch firs (Föhren)—most of which very nearly approach the American species. We may especially mention the *Pinus MacClurii*, which looks uncommonly like the *Pinus alba* of Canada, and of which the cones were discovered in Banksland by Mr. McClure and his companions. This tree, doubtless, contributed no little to the features of the mountain forests of that country. Iceland, however, in the Miocene times, was the richest in species of pine, for the remains of seven different kinds have been discovered there—viz., species of silver fir, of spruce and of common fir. The *Sequoiæ*, however, were far more abundant than the pines; and, in the Miocene times, it can be proved that they were very abundant in Europe, Asia, and America; while at the present day this genus is confined to California. Only two living species are known (*S. sempervirens* and *S. gigantea*)—the last survivors of this remarkable type of plants, which contains the greatest trees in the world. In the Miocene times four species lived in the polar regions; three of which, however, were spread over middle Europe. The *Sequoia Langsdoffii* is the chief tree of North Greenland; and not only branches with leaves upon them, but even the flowers, the cones, and the seeds, have been discovered. In the Miocene age it lived also in North Canada and in Vancouver's Island; and, on the other hand, it can be proved also to have existed in Germany, Switzerland, and Italy. It is uncommonly near to *Sequoia sempervirens*, and is only distinguished from it by the cones being somewhat larger. The *S. Sternbergi*, which was very abundant in Iceland, is, on the other hand, closely related to *S. gigantea* (the "*Wellingtonia*"); while the *S. Couttsiæ*, which is found at Disco and Atanekerdluk, fills up the gap between *S. Langsdorffii* and *S. Sternbergi*. The trees allied to the cypress are largely represented; and we find three genera, *Taxodium*, *Thujopsis*, and *Glyptostrobus*. The home of the two last is in Japan, while that of *Taxodium* is in North America. The *Glyptostrobus Europæus* had precisely the same range as the *Sequoia Langsdorffii*; and the same may be said of *Taxodium dubium*; of which twigs, leaves, and cones were found at Atanekerdluk, and its remains were found in Spitzbergen, even at Bell Sound (nearly 78 degrees north lat.). The *Thujopsis Europæa* (a kind of evergreen) is much rarer, and yet very pretty branches of it were found in Northern Greenland, which agree with those found in amber, and at Armissan (Narbone). Amongst the *Taxinæ* may be especially mentioned a *Salisburea* from Greenland, as this genus at present grows wild only in Japan.

The number of foliaceous trees of the Arctic zone in Miocene times was so great, that only a few species can be specified here. Many of them are very similar to those of our own country; as, for instance, the beech and the chestnut, which are found in North Greenland up to 70 degrees north lat. One kind of beech, *Fagus Deucalionis*, was very nearly related to our common species: the leaves have the same form size, and nervation, but the edge in front is dentated. It was apparently diffused over the whole north, for it can be proved to have existed in Greenland, Iceland, and Spitzbergen. The species of oak are found in still greater variety: there were eight kinds in North Greenland; most of them had large leaves, beautifully indented, and they bear the greatest resemblance to American species. One of them (*Quercus Olafseni*), which can be traced from Northern Canada to Greenland and Iceland, corresponds with the *Q. Prinus* of the United States. A plane tree also (*Pl. aceroides*) had spread over all these countries—nay, was found even in the Icefiord of Spitzbergen. Numerically, however, the poplars were far more abundant than the beeches, the oaks, or the planes. Two species (*Populus Richardsoni* and *P. arctica*), together with the *Sequoia Langsdorffii*, were amongst the commonest trees of the polar zone, and can be traced from the Mackenzie to Spitzbergen. It is a striking fact that very few remains of willows are found, while at the present day willows form one-fourth part of the ligneous plants of the Arctic zone. Birches were abundant in Iceland; and a tulip tree, and a maple with large berries (*Acer otopteryx*), also flourished there. Remains of the walnut tree; of a coriaceous-leaved *Magnolia;* and of a *Prunus* (*P. Scottii*) came from Greenland: and a large-leaved lime-tree was found in Spitzbergen (*Tilia Malmgreni*): its leaves were found at Kingsbay in 79 degrees N. Lat.

These types of trees, which approach those of living species, are accompanied with others of a different kind, the determination of which is somewhat difficult. One species with remarkably large coriaceous leaves (the *Daphnogene Kanii*), belongs probably to the *Lauraceæ*, and four others (*Mc Clintockia* and *Hakea*) to the *Proteaceæ*. It is doubtful whether the last-named plants took the form of trees or shrubs; the others, judging from the analogy of living forms allied to them, very probably were the shrub-growth of that age. To these may be added a species of hazel (*Corylus M'Quarrii*), which was spread over the whole of the north, and is found in Spitzbergen, even 78 degrees N. Lat.; also an alder (*Alnus Kefersteinii*), which was diffused equally far and wide. From Greenland up to 70 degrees N. Lat., we know of species of buckthorn (*Rhamnus*), *Paliurus, Cornus, Cratægus, Ilex, Andromeda,* and *Myrica.* Climbing plants also were not wanting. A species of ivy (*Hedera M'Clurii*) was found on the Mackenzie and in Greenland; there were also found here the remains of two kinds of vines, and a third flourished in Iceland. All three correspond with American forms.

It would not be difficult, from this list of species, to draw a picture of the vegetation in these high northern latitudes; it would show us a mass of foliage of various tints, made up both of pines and other forest trees—trees with great leaves of varied forms, their stems twined round with vines and ivy, and under their shade there are numerous shrubs, mixed with elegant ferns.

How very different is the picture now presented to us in the polar regions! At the present day an enormous glacier covers Northern Greenland, leaving only a narrow strip of coast free from ice in the summer, and this glacier every year sends out into the ocean thousands of icebergs, which lower the temperature of the southern latitudes; but at one period this very country was covered with a luxuriant primæval forest, composed of a great variety of trees, such as we now find only in the warmer parts of the temperate zone! In fact we find *Taxodiæ* and plane-trees in Spitzbergen in 78 degrees N. Lat., nay even a lime-tree and a poplar in 79 degrees N. Lat., consequently only 11 degrees distant from the pole. The lime-trees, the *Taxodiæ*, and the plane-trees may here have reached their most northern limits; but this was certainly not the case with the firs, and the two kinds of poplar, which were living in Spitzbergen; for we know that at the present day firs and poplars go 15 degrees further north than plane-trees. There is no ground for doubting that it would be the same in the Miocene ages; and if so, these trees will have reached the pole, provided land then existed there. The Miocene limits of trees were therefore very different from those of the present day. This was made very evident by a glance at a large map of the Arctic zone, exhibited by Professor Heer, on which he had laid down the limits of trees; he pointed out that this boundary coincides with the July isothermal of 10 degrees centigrade (50 Fahr.): this falls under the normal parallel of 67 degrees N. Lat., so that at present the normal limit of trees is but a short distance within the polar circle, while in the Miocene age it reached to the very pole. This indicates a great change in the climate, and this was proved more definitively by the lecturer from the evidence given by the fossil flora of Spitzbergen and Greenland. From the character of the specimens brought from Spitzbergen, he concluded that it must, in 79 degrees N. Lat., have had at that time a mean annual temperature of 5 degrees cent. (41 Fahr.). He had formerly estimated that in those ages Switzerland must have had a mean temperature of 21 degrees cent. (69.8 Fahr.), so that the difference between the two is 16 degrees cent. (28.8 Fahr.), or a decrease in going northward of 0.5 cent. (0.9 Fahr.) per degree. According to this calculation we should have in Spitzbergen, in 78 degrees N. Lat., an annual temperature of 5.5 cent. (41.9 Fahr.), and in Greenland, at 70 degrees N. Lat. an annual temperature of 9.5 cent. (49.1 Fahr.); but in Iceland, and on the Mackenzie, in 65 degrees N. Lat., the temperature of 11.5 cent. (about 53 Fahr.), which enables us to explain all the phenomena in the vegetable world just described.[1] At present the difference of temperature between Switzerland (in 47 degrees N. Lat., and calculated at the level of the sea) and Spitzbergen (in 78 N. Lat.) is 20.6 cent. (37.08 Fahr.), which gives a difference per degree of 0.66 cent. (1.188 Fahr). In the Miocene times, therefore, the warmth was more equally distributed, and the diminution of heat in advancing to the north was much more gradual, so that consequently the isothermal of zero (cent., 32 Fahr.) fell under the pole, while at the present day it comes down to 58 degrees N. Lat.

Lastly, the lecturer controverted the opinion that these plants had

[1] This is fully shown in the "Fossilen Flora der Polarländer," by Prof. Heer, p. 72.

been floated, or brought by water, from a great distance to the arctic zone. This cannot possibly have been the case, for the leaves are in beautiful preservation, and lie together in great masses: they are found in connection with great beds of coal; and amongst the specimens there are flowers, fruits, and seeds (nay, even berries themselves), and young, tender, and even unfolded beech leaves; and moreover, insects are found with them. Any one who, with a sound, unprejudiced mind, looks over the great variety of specimens of plants so beautifully preserved as those which fill the rocks of Atanekerdluk, in Northern Greenland, must come to the conclusion that they came from the immediate neighbourhood: in addition to which, the fact that the Spitzbergen plants are found in a freshwater formation is a decisive proof that they were not the waifs of the sea.

II.

Professor Heer having been asked how he could explain the great change of climate indicated by the Miocene flora, gave a second lecture on this particular subject. In the first place, he discussed the conditions of the globe itself, which here come into consideration. A change of the pole, in the way which has lately been brought forward by Mr. Evans, is opposed by the fact that both in the Arctic zone and in the more southern latitudes, the same phenomena are observable all round the globe. We nowhere find indications of the pole having been displaced; and we cannot, therefore, ascribe the change of climate to any such cause. Much greater weight seems due to the idea that the climatic changes have arisen from a new distribution of land and water on the earth's surface. At the present time the proportion of land to water is about as 1 to 2½. The greater part of the land is in the northern hemisphere, more especially in that part of it which is beyond the tropics. The earth, therefore, at the present moment is in an abnormal condition: what we should consider as the normal condition being a proportionate distribution of land and water over every zone of the earth, by which the temperate and cold zones would enjoy a warmer climate than they do at present. But even if we could imagine such a favourable apportionment of land and water, we should still not find such conditions as would enable us to extend the flora before mentioned from 70 to 79 degrees N. Lat. If we were to place all the main land under the tropics, and only a few islands in the north, the latter would, indeed, have the highest possible medium annual temperature, and the winters would relatively be very mild, but the summer heat between 70 and 80 degrees N. Lat. never could rise so high as to produce so rich a forest flora. Besides this, there was apparently in the Miocene age a great quantity of main land in the temperate zone of the northern hemisphere, and it must also have extended a considerable distance into the polar regions, as may be proved by the spread of the Miocene plants; for many kinds of trees and shrubs may be traced from the Mackenzie through Greenland up to Spitzbergen. Had there been only some scattered islands in the arctic zone at that time, these plants would never have spread so far.

Great stress was some time since laid on the internal heat of the globe, and it was thought that this might account for the higher temperature of the early ages of the world. But even if this may with some probability be thought to apply to the oldest periods, it cannot do so to the Miocene times, for they come so near to our own age, that we cannot venture to attribute to such a cause so great a difference of temperature. It is, therefore, not possible to explain this great change of climate from the conditions of our globe, at any rate from those which are at present known to us.

We must, therefore, turn to cosmical conditions, and see whether we can find in them the solution of the enigma. We may take into consideration the changes in the position of the earth relative to the sun—in the intensity of the sun's rays, and in the temperature of the universe.

With respect to the first, great stress has lately been laid on the periodical changes in the eccentricity of the earth's orbit. It is well known that this is not a circle, but that it forms an ellipse, in consequence of the influence of the larger planets. The form of this ellipse changes within certain limits in the course of thousands of years. At the present moment the earth's orbit is gradually approaching the form of a circle, and in 23,900 years the eccentricity will have reached its minimum, and become most like a circle, but from that time it will gradually become more eccentric. The mean distance of the earth from the sun is 91,400,000 English miles; the greatest eccentricity of the orbit is about 1–13th of this distance, while the smallest is 1–360th. At the time of its greatest eccentricity the earth would be about 14½ millions of miles further from the sun than when its orbit most nearly approaches a circle. At the present time the difference amounts to 3 millions of miles. We must further bear in mind, that at the present time the earth in the winter of the northern hemisphere is nearest the sun (in perihelion), and in summer it is furthest from it (in aphelion). But even this condition is subject to a periodical change, which runs its course in 21,000 years. In about 10,000 years hence the summer of the northern hemisphere will coincide with the time when the earth is nearest the sun, and the winter with the time when it is furthest from it; while, of course, these conditions will be reversed in the other hemisphere. It has therefore, been assumed that at those periods when the earth has reached its maximum eccentricity, and when it also is nearest to the sun in winter (or in perihelion), this hemisphere has had a shorter and warmer winter, but on the other hand a longer and cooler summer; while the southern hemisphere must at this period have had exactly the reverse, that is a longer and colder winter, and a warmer and shorter summer, because the greatest distance from the sun must coincide with the winter of this hemisphere. Mr. Croll supposes that during this longer and colder winter so much ice must have formed, that the short summer, though certainly warm, would not have been able to melt it, and that the glacial period was a consequence of these conditions. During this period a perpetual spring would have prevailed in the other hemisphere, for the long summer was cooler, and the short winter on the other hand was warmer. The astronomer, Mr. Stones, has calculated that 850,000 years ago the eccentricity of the earth's orbit was at its maximum, and the northern hemisphere had the winter in aphelion. At that time the length of the winter was increased by thirty-six days. Very much ice and snow must have accumulated in this period, and consequently Lyell is inclined to consider this as the Glacial age. On the other hand, 900,000 years ago the eccentricity was at its minimum, and consequently other data must be given for the conditions of climate.

But with respect to all these speculations, we must bear in mind the insufficiency of our knowledge as to the effect which the distance travelled by the sun's rays from the sun to the earth has on their intensity. Lyell has very justly drawn attention to the fact, that, according to the calculations of Dove, the earth is warmer in July, when it is actually further from the sun, than in December, when it is nearest to it. This arises from the different distribution of land and water in the southern and northern hemispheres, so that the latter has a warmer summer than the former, although in the summer the sun is nearer to the south than the north. But even this shows, that the distribution of land and sea on the earth is of much greater importance, in a question of climate, than the greater or smaller eccentricity of the earth's orbit, which ought not therefore to have such an excessive influence ascribed to it. Still, it is an item by no means to be neglected, and one which, combined with varied distributions of land and sea, must exercise a great influence. Sir Chas. Lyell has demonstrated this in a most masterly manner.

A second cosmical agent for changes of climate may be looked for in the sun itself. With respect to the spots on the sun's disc, we know that perpetual changes are going on upon the surface of the sun, so that there is at least a possibility that the action of the sun's rays may not always have been the same.

But, besides the sun, there are also in the universe millions of heavenly bodies, pouring out their lightening and warming rays into the firmament. It is, therefore, possible, that different places in this infinite universe may possess a different temperature, as has been pointed out by the mathematician Poisson, who reminds us that the number of stars is so great that they form, as it were, a continuous covering over us.

Now, we know that the sun, together with its planets, is continually changing its place in the universe; and, probably, together with them, is circling round some one great fixed star at an immeasurable distance. If we consequently venture to suppose that the universe has not everywhere the same temperature, we should have the most simple explanation of the phenomena we have described. If the sun, with its planets, was, in the Miocene times, in a part of the universe possessing a higher temperature than that in which it now moves, this warmth would have been proportionably shared by every part of the earth, and would more especially have had an influence on the temperate and polar zones, and have caused a proportionate increase of temperature. Then, again, in this year of our sun (if it may be so expressed), there would be an alternation of colder with warmer seasons; and the Miocene age may be compared with its summer, the Glacial age with its winter, and our present age with its spring. This orbit of our sun is, indeed, one of immeasurable length, and we cannot yet fully comprehend it. But there is a time coming when its extent will be calculated; and races yet unborn will teach in their hand-books the course of the sun, just as we now do the courses of the planets. If we, as it were, become dizzy with surveying the vast period of ages here spread before us, we ought to consider how small is the measure we are accustomed to apply to it. A glance will show us this. There are many living things whose life is but a day long. Let us imagine for a moment that one of these beings were endowed with consciousness;—or that the life of man lasted but for a day: now, an individual, born in winter, could only learn by tradition that the climate was once warmer, and that at some future time, after a long series of generations, a warmer period would again occur: and another individual, born in summer, could only learn by means of races long since passed away, that this warm weather would be followed by a long cold season, and that afterwards the warmth would again return. One of our years must to these beings of a day have seemed immeasurably long, as it would have included 365 generations.

But the present age of the world is not even a day,—it is hardly a minute of the great orbit, or year of our sun; and no mortal will be able to note its phases. We certainly cannot examine them with our bodily eyes; but we can do so with our mental vision; for, in spirit, we can look back into far gone ages, and recognise the connection of phenomena which have occurred in the course of thousands of years. The mental eye glances into the very earliest periods of time, and scans even the furthest regions of the universe.

But however small man may be corporeally, when compared with the immensity of nature—however short may be his life on the shoreless sea of time; yet, as to his mind, he is great; for it is this which raises him above the vicissitudes of ages, and gives him a consciousness that, under his perishable body, he hides the germ of an endless life.

II.—On the Denudation of the Cotteswolds.

By E. Witchell, F.G.S.

(Proceedings of the Cotteswold Naturalists' Field-club. 1867.)

This paper is a valuable contribution to the advancement of that theory of denudation which seems to be steadily gaining ground, and which explains the formation of present irregularities of surface by the action of subaërial forces. The following are the chief points insisted on:—

There is no evidence that the valleys of the Cotteswolds were cut out by the sea or by tidal rivers: the sea would tend rather to wear *away inequalities. There is abundant evidence of denudation, but it is of subaërial denudation, helped by landslips.*

It has been held that tides acting along lines of fracture are essential to the formation of the Cotteswold valleys, and it is a fact that there are fractures in many of the valleys; but this is not enough, the existence of the conditions needful for the action of tides along lines of fracture must be shown;—the land must have been low enough for the tides to reach it, and the fractures must have been opened into fissures wide enough to admit large volumes of water, and long enough to account for the formation of the long valleys as they now exist. There is no evidence of these things.

A close connection exists between combes and springs; there are no combes without a spring, and when a combe forks there is a spring in each branch. It may be said that the excavation of combes by the sea would cause springs; but in this case surely some of the combes should be without springs, as one can hardly suppose that the sea would make combes only where subterranean springs abounded. This connection of combes and springs makes it hard to account for the formation of the former except by means of the latter.

The widening of the valleys is owing in great part to slips; but this process is now somewhat checked by the streams having been made more or less artificial, and therefore hindered from carrying away fallen matter. The slips from the Fuller's Earth are very many; there is hardly a combe cut into that formation and the overlying Great Oolite without a slip, sometimes stationary at present, sometimes moving slowly; indeed where Fuller's Earth occurs on an escarpment a great part of the slope is moving. The Inferior Oolite has so tumbled that it is not uncommon to find quarries of the Freestone on the sands below, or on the Upper Lias.

The slopes facing south or south-west are more denuded and less steep than others, because more exposed to rain.

A very large amount of earth is carried away by springs and storm-waters; frost too has a great effect on soft Oolitic rocks.

In going up a valley one finds that the volume of the stream gets less, and so also does the amount of denudation, until the valley is a mere hollow, and at last vanishes. Then, within a few yards, the ground begins to slope in the opposite direction, and gradually takes the form of a valley like the former, but falling the other way.

Sub-angular gravels, which cannot be looked on as marine, but only as subaërial and fluviatile, are found in the valleys at heights ranging from 200 to 700 feet: it is clear therefore that like conditions held during the whole period of the formation of the valleys, and that no such deposits could have taken place in valleys washed by tidal waters.—W. W.

III.—Preliminary Notice of a New Crystalline Form of Silica.—By Professor G. von Rath.

[Poggendorff's Annalen Band CXXXIII.]

THE two great groups of Silica, the crystalline (Quartz) and the amorphous (Opal), with the respective densities of 2·65 and 2·2—2·3, appear likely to have a third and intermediate species added, which, crystallising in forms belonging to the rhombohedral system, yet possesses the low specific gravity of 2·2—2·3; thus by its crystalline character being related to the species Quartz, and by its low density to the species Opal. The crystals, though belonging to the rhombohedral system, the author states, stand in no relation to any of the hitherto observed forms of Quartz. They are in hexagonal tables, never simple, but always in twins, mostly of three individuals (Drillingen), from which character the author proposes the name Tridymite, and under this name the mineral will be fully described by him in the next part of his "Mineralogische Mittheilungen." The crystals are not pseudomorphous, as has been suggested, as by polarised light they behave as doubly refracting optically uniaxial bodies. The Tridymite is found in small but sharply defined crystals in cavities in a volcanic porphyry, accompanied with iron-glance and acicular crystals of hornblende from the Cerro S. Cristobal, near Pachuca, Mexico. Should the further description tend to substantiate the correctness of Professor von Rath's observations, it is evident that some of the arguments put forward both by the supporters and opponents of the igneous theory of the origin of Quartz in modern volcanic lavas and granite, based on its density, will be materially affected. The fuller particulars will be anxiously looked for. T. D.

REVIEWS.

Reliquiæ Aquitanicæ; being Contributions to the Archæology and Palæontology of Périgord and the adjoining Provinces of Southern France. By Edouard Lartet and Henry Christy. Edited by Prof. T. Rupert Jones, F.G.S. Part V. London: H. Baillière. 4to. Part V. April, 1868.

In this part the description of the Geology of the Vezère is completed by a short account of the ossiferous caves and recesses. These "(whether or not, in some cases, enlarged artificially) have been hollowed out by atmospheric agency, where the softer alternate with the harder bands of limestones, the latter often still forming more or less continuous ledges around the interior."

With regard to the in-filling of the cavern of Le Moustier with red, sandy, micaceous alluvium, very similar to the brick-earth of the valley below, "it is not necessary to suppose that the cave was on a level with the flood-waters of the valley since Man inhabited it; for, as Mr. John Evans has suggested (Geol. Soc. Lond. June 22, 1864), the sand may either have been blown in by the winds, or, possibly, it may have reached the cave from the top of the hill during the formation of a talus, removed for the most part, since that time, by the river having swept the foot of the cliff, from which it has now receded."

Some such explanation as the above is absolutely requisite in cases where the valley is of very considerable width, and the filling in of some of the caves on the east side of Gibraltar, partly by wind-blown sand from Catalan Bay, and in part by a talus formed of dis-