JOURNAL

OF THE

BOMBAY BRANCH

OF THE

ROYAL ASIATIC SOCIETY.

JULY, 1845.

I.—*Some Observations on the Geology of the Egyptian Desert*; by A. B. Orlebar, M. A.

Immediately south of the town of Cairo, the Mukattim hills present a section which represents the structure of the whole desert as far as I examined it; and here the total absence of vegetation enables one, at a single glance, fully to observe the arrangement of the various beds of which the Egyptian Desert is composed. The lowest beds consist of a dazzling white limestone, which is capped by a yellow variety; and superposed on the yellow limestone, on the east side of the landscape, rises a red hill which is formed of various sands and sandstones, in which some red beds give a colour to the whole. In general, the beds may be said to be horizontal; but their stratification is undulatory, in bold sweeps, which the nakedness of the land enables the geologist to see in frequent sections. The red hill, above referred to, rises to a considerable height, but in general, the sandstones are imperfectly developed. They seem, however, to have furnished the fine quartzoze sand, which overlies the limestones, sometimes to the depth of a foot or more, and which, driven about by the wind, is so annoying to the traveller.

No district can present greater facilities for geological research than the

Desert, and we need not here conjecture any law of superposition, as the mind has little to do; for if the eye be active, every observation must be a theory and every theory a fact. Those who have labored to trace out the strata in cultivated or jungle countries will appreciate these remarks, if they but turn their attention to Egypt.

I shall now describe, *seriatim*, the three formations, viz. white *limestone*, *yellow limestone*, and *sandstone*.

WHITE LIMESTONE.

The appearance of this rock is very much that of the chalk but it does not soil. It is sufficiently hard to be made use of for building, but is very soft and easily broken, being composed of minute uncrystallized particles of lime.

The most marked characteristic of the rock is the abundance of nummulites, which seemed to me to be larger in the lower beds than in the upper. The *neritina grandis* is also very common, as is the *clypeaster varians*, and fossil crabs of the genus *carpilius*. The rock in many parts is wormed through and through by cylindrical bodies, which I take to be branching coral. The fossils in this formation are very numerous and well preserved, the shells having only lost their colour. I found no bones, but a piece of dicotyledonus wood, with central pith and seven concentric rings.

Its thickness must be very great; for beyond the spot where travellers are usually taken to visit the fossil forest, the Pasha (March 1844) was sinking a shaft in search of coal, and they had then sank 328 feet through the formation.

The beds of white limestone are parted by beds or seams of black clay. In the Pasha's shaft there were three such beds, the uppermost twenty feet thick, the next eighteen, and the lowest ten feet. In one of these clay-seams, in the Mukattim hills, there were many arborescent iron markings between the dry laminated strata.

The Pasha was induced to sink this shaft after the discovery of a black mineral, which his Officers, (but not his professed mineralogist, who unsuccessfully endeavoured to undeceive the Officer who conducted this vain speculation,) have supposed to be coal. It is mineral pitch, and coats the fossils in a very curious manner, making a black and white rock. I found some crystals of carbonate of lime at the mouth of the same shaft;

and also some of the lower rock, which contains sulphur, and blackens on exposure to the atmosphere. I found no where in this rock any other mineral, or pebble, or imbedded fragment.

It is extensively quarried for building. The pyramids are built on and of it, except the casings of the principal chambers.

Yellow Limestone.

This is a thin formation, not exceeding 60 feet at the most in thickness. It is much more rich in fossils than the white beds, but they are by no means so well preserved. Casts only remain in most cases, particularly in the harder beds. In the softer beds, they are much better preserved; and in the lower part of this series there are partings of black and of yellow clay, and in the upper part the lime is intermixed with quartzoze particles.

The yellow limestone also contains nummulites, but they are smaller in its lower beds than in the white limestone, and disappear altogether in the upper beds.

The series of beds are very strongly marked off by characteristic fossils, which are much better grouped than in the white beds. One of the lowest beds contains a vast quantity of coral, belonging to the genus *eschara*, with fragments and spines of *echinidæ*. Another a little above it has *anomia placunoides* in situ, with bone of a *mammalia!* Higher up is an oyster bed. *Turitella egyptiaca* is quite characteristic of another, and *Cerithi* a characterize a higher one. The highest fossiliferous bed in the Mukattim hills abounded with very large *solens* like the common razor shell. The highest fossiliferous bed, a few miles N. E. of the middle station, is formed of oysters, *pectens*, *anomias* and *scutellas*, upon which barnacles are fixed, all heaped confusedly together in vast numbers. The same bed may easily be studied just behind the third station.

The fossils in the softer beds, particularly the corals, are sometimes coated with rust.

The uppermost bed, are *unfossiliferous* and abound in common salt and gypsum. The gypsum is fibrous, and in thin seams. The salt frequently reddens the soil, and being washed down the tali of little hills by the rains, gives the whole of them a red tint, which is not unpleasing in the general yellow hue of the desert landscape, but deceives the geologist, at first sight, with the expectation of finding a distinct formation.

SANDSTONE.

The structure of this rock is very various, although its sole mineral constituent is quartz. It forms the whole of the red hill near Cairo, where it may be studied with great advantage. In some parts it is a light yellow sand, in others a hard black rock, in others a conglomerate, in another a compact white quartz rock; and frequently it has a red tinge. The brown Egyptian pebbles belong to one of its conglomerate forms.

The well known fossil trees lie in this sandstone, which is found overlying the yellow limestone throughout the desert.

The stratification of the red hill at Cairo is horizontal, but in the centre of it there is a white quartz rock, which is extensively quarried. At first sight this quartz rock appears an immense eruptive mass; but, on nearer approach, it is found to contain rolled pebbles; the lines of which are continued into softer sandstones, which lie against the quartz rock as a mound of earth thrown up against a wall. There can then be no doubt but that the whole extent of each of these lines of pebbles has been deposited at the same time; consequently the softer portions are the deposition in its original state, and the original sand has then undergone some action, in a vertical direction, which has metamorphosed vertical portions into a compact quartz rock.

No shells or fossils of any kind, but silicified wood, could be discovered in any locality of this sandstone, which I examined carefully for some distance south-wards of Cairo, as well as along and about the road from Cairo to Suez.

The superposition of this sandstone upon the yellow limestone is very easily seen, on the angle of the hill towards Cairo, by clearing away the rubbish a little. A little spur from the main hill is capped by the black sandstone; under this is the salt and gypsum deposit; and then come the upper beds of the limestone in their descending order. The same may be traced, although not with equal facility, all around the western base of the hill.

The superposition may be also easily seen, under the hills which appear to the northeast of the middle station, at the locality where I found so rich a bed of *pectens* and *scutellæ*.

Along the usual road to the fossil forest, this sandstone lies in such a manner, at the base of the hills, as to have the appearance of a dyke burst

through the limestones. Its structure however, the geological character of the red hill, and every positive evidence which can be alledged as to its nature, prove that it cannot be of volcanic origin as has been supposed by travellers.

The red hill contains no fossils of any kind, but the sandstone of the same character, near the middle station, contains fragments of trees; and all the trees of the fossil forest lie in a sand of the same description.

It is necessary to recollect that the stratification of the limestone is undulatory, and the surface of the whole country is therefore naturally diversified with alternate elevations and depressions, which may be easily traced by the eye, in this barren land, however much the sides of the elevations may be worn into cliffs by the torrents. At the extreme height of these elevations, fragments of the hard black sandstone and of fossil wood are almost always to be found. The lowest depressions are filled to some depth with sand, in which lie the trees which are so generally visited. This sand differs in nothing from the sand of the red hill. It frequently abounds with brown pebbles, which are often carried away and are well known as Egyptian pebbles. Around the trees, the sand is frequently of a red colour; and, a few inches below the surface, was quite moist in March, after rains had fallen about a month previously.

The trees are silicified, and have entirely lost all structure except the external shape of the tree, and some appearance of concentric rings. The trunks are of great length; and the measurements of those taken were 52, 57, 65, and 68 feet. Their girth is hardly proportionate; as trees of 52 and those of 68 feet were each only eighteen inches diameter. Knots are rare upon the trunks, and still less frequently are branches to be found. Those however, which do occur, are quite sufficient to prove that these trees belong neither to the *Palmæ* nor to the *Coniferæ*.

The trunks are divided transversely into segments; so, that it would be impossible to stir one from its position except in fragments.

The trees are all prostrate, and lie in every direction of the compass. I am imformed that some are to be found upright, but I doubt this. I was taken to one said to be upright, and having with me labourers to remove the sand, in order to ascertain in what soil the trees grew and the character of their roots, I had all the sand removed and the specimen sufficiently exposed. I thus discovered that it was the lower part of a trunk with the roots; but broken off about an equal distance from the

centre of the trunk, and forming in fact a circular base of about four feet radius to the trunk, just such a mass as an elm torn up in a high wind. This however proved that the tree is not a palm; for the roots of palms are mere clusters of long thin fibres, little better than the base of a mushroom; and the Egyptian fossil had the fine spreading thick roots of a modern forest tree. Further it was evident that the tree had not grown in the sand in which it was standing, for if it had, the roots would not, as they were, have been broken. The conclusion unavoidably made was that it had been torn up by wind in some distant locality; and being carried thence by a stream was left astrand in the place where it is now to be seen.

I could discover no trace in the trees, of boring animals, as *solens*, &c. nor could I find any mark of barnacles upon them.

The trees are to be found in every undenuded spot between Cairo and Suez, and also may be traced I understand as far as Thebes: so that there is every reason to believe this sandstone formation has covered the yellow limestone in the vast rectangular space comprised between the Delta, the Nile, the parallel of Thebes and the Red Sea.

GENERAL CONSIDERATIONS.

The three formations above described constitute but one system, for although they are very distinct from each other yet they also pass easily one into the other. The white limestone is parted by beds of bituminous marle, which also parts the lower beds of the yellow limestone; and losing its bitumen and blackness, the marle becomes yellow and more aluminous, till the marles giving place to limestone, in which quartzoze particles become more abundant, the limestone altogether disappears and gives place to sand entirely. In like manner there is a connection in organic remains. Dicotyledonus wood is found in the white limestone as well as in the sandstone. The nummulites gradually decrease in size from the lower beds of the white to the upper of the yellow limestone. The remains indeed of the white limestone are in general of larger proportions than those of the upper formation. For instance the *neritina grandis* is of immense dimensions for a *neritina*; and so also the crab large in proportion to its congenera. The *cardita intermedia* also seems to be larger in the lower than in the upper formations; yet the remains are all marine (except the bones and the wood), and the great proportion of shells are common

to both; so that the same animals appear to have existed throughout, but in a decreasing temperature as the deposits were successively made; if it be admitted that the same form of animal life inhabits larger bodies under higher temperature.

The animals are none of them inhabitants of deep sea. The crab belongs to a genus (*carpilius*) which frequents the sea shore, and so also does the *neritina*. But if any of the deposits were made in a deep sea we should suppose the deep white limestone was *that* one; and certainly not the beds of the yellow limestone, which gradually and almost imperceptibly seem to have changed into sandy *dunes* where the tide or flood deposited the great trunks of trees on dry land uninhabited by any shell fish.

But I am inclined to believe that the ancient owners of the white limestone fossil did not dwell in the localities where we now find them. The white limestone is, in many localities, full of long tubes branching in all directions, which one can refer to nothing but the branching coral which is only found where the tide never exposes it to the atmosphere. The white limestone was therefore probably formed in deepish water; but neither the *neritina* nor the crab could have lived in deep water, nor in a tanglement of coral. The *neritina* more probably lived on the surface of rocks ,and the crab used to lie in wait for his prey in their fissures, where he spread out his *great greedy pincers*, resting himself comfortably against the uneven sides of the rock clefts by help of the protuberances at the back of his test. But no such rocks could have existed here at a time when there was nothing but a loose floor of lime particles continually depositing. This was not the place then for them to have originally inhabited; and in fact it seems to have been only their grave yard: for if they were not produced here, they must evidently have been buried.

The crabs are always uninjured in the quarries, every member remaining perfect. Now if a live crab is suddenly immersed in any thing which he does not like, he throws away some of his limbs: these crabs therefore must have died in a natural and easy manner. This may also be inferred from the natural manner in which they have folded up their pincers, and spread out their legs, and shut down their eyes in the sockets. As soon as a crab is dead, he is generally pounced upon and made a meal of by some wading bird or some other genus of the crab class; a hole being thus picked in him and the specimen mutilated. Now that waders did

exist long before such a crab as this in the world is admitted, and therefore it is extremely improbable that such numbers as those in the Cairo quarries could have escaped a wader, even supposing that there was no species of carniverous *bracyoura* or *macroura* in the neighbourhood, or that our crab was not of a cannibal disposition, both which suppositions are rather impossible. He must therefore have been quickly carried away from the place of death to his present locality. The agent which carried the crabs to the Cairo quarry, did not treat them with great gentleness, for all the specimens are much broken in the weaker parts, as the lower portions of the *carapace;* and this is to be observed in the shells of the *neritina* also. Lastly they must soon have been buried, for if not they would most probably have soon fallen to pieces, and certainly would have been knocked against one another and coral, and been much more seriously injured than they have been. The evidence appears therefore to be conclusive that the *neritina* and the crab inhabited rocky spots at a distance from Cairo, where they were carried by a current, and lime rapidly deposited around. This rapid deposition of lime may have been connected with a flow of bitumen at the bottom of the sea.

Every sea-shore is naturally divided into zoological districts according to the distribution of mud, sand, and rock, and according to depth of water. Wanderers are occasionlly found straying out of their proper limits, but in general each species is restricted within very narrow bounds. The arrangement on a shore is sand, and then mud or clay. The sand is frequently composed almost entirely of shells. Now such is the order of the yellow limestone; for clay abounds at the bottom, sand at the top, and throughout the debri of shells has formed a limestone. Not that the shells are the exclusive source of all the limestone; for by some process or other, lime seems to have been disengaged from the waters of the sea, which added their quota to the deposits of limestone beds, and this deposition seems to have been the principal source of the whole beds. The series therefore indicates a gradual shallowing of the water, and consequently the vertical section, which the geologist now examines, tells him how the superficial surface of the ancient shore must have been mapped out, when the formative causes of the Egyptian limestone were narrowing the limits of the ancient sea. Beyond the limits where the large branching corals were rising in deep water above the lime, which precipitated around them, and was entombing the remains of *crabs*, *neritina*, and *various mollusca*, which a stray current drifted

among them, grew one of a genus of coral (*eschara*), whose modern types grow on rocks even under water, but generally exposed to strong currents. Beyond this was a bed of oysters. Next a bed of large turritted shells, much of the same character as the large *Proto* of our own coasts. Then crowds of *pleurotomæ*, associated with *cerithia*, apparently occupying much the position of the *cerithia* which abound both on our rocks, and in our mud, at such a low depth that they may often be exposed to the fresh air by the retiring tide. Lastly *pectens, scutellæ*, and *anomias* were washed on a shell beach from deeper positions. These are all shells of deepish water, and any one who has studied a modern beach, knows how constantly these large flat shells are washed on shore. We have already noticed that the *anomia* appears to have two localities; one is its beach or burying place, the other is its living locality; and we do not doubt but that more careful search will find deep sea localities for the *pectens* and *scutellæ*. Consequently we now see the following order of superposition: the upper strata of the yellow limestone is a shell beach, formed by the spring tides only, washing thereon more particularly the large flat *bivalves*; next, the strata of the beach left dry at ordinary tides, inhabited by *pleurotomæ* and *cerithia*. The next strata are parts of the coast left dry but for a short time, and inhabited by large *turritellæ*. Next an oyster bed, and next a bed of *anomias*, in deep water. Then a growth of coral, left uncovered only at spring tides, and then we come to deep water, where the tides washed many of the inhabitants of the coast regions.

I consider therefore the yellow limestone to have been the *habitat* of the primæval inhabitants of Egypt; and that the locality where the *neritina* and crab lived, will be probably found on the primitive rocks near Thebes, upon which the nummulitic limestone probably abuts.

The sea was continually retreating northwards from the neighbourhood of Thebes; and, as it shallowed, formed great salt pans, in which it deposited its salt, viz. common salt and sulphate of lime. Hence the upper beds of the formation abound in these minerals.

The origin of the sand and brown Egyptian pebbles, is probably to be sought in the mountains of upper Egypt or of Abyssinia: for following up the ideas ventured above, I should conclude that the *dunes* of sands have advanced from the south, following upon and filling up the salt marshes which the shallowing sea left.

The hard quartz rock, in the heart of the mound of sand now called the

Red Hill, may be the agglutination of the quartzoze particles, by a silicious spring of warm water; and a similar spring may have formed the appearance of a dyke along the fossil forest road. Such springs moreover may have poured out hot water over the whole surface of the country and silicified the trunks of trees.

The existence of a potent subterraneous heat at that time is rendered probable by the large size of many of the fossils before noticed: for it does not seem possible to account for a heat in the sea, sufficient to silicify them except it were fed by hot springs. The dissemination of bitumen in the lower beds of the white limestone may be connected with this unusual heat.

Although we have then a sufficient agent to silicify the trees, we have a difficulty in bringing them to their locality. That they were silicified in their present positions appears from the fact, that of the silicifying *agent* having divided them transversely, and as they certainly did not grow there, they must then have been transferred by water. They could never have been submerged in a sea, where *solens* abounded, without having been penetrated by them, and they could not have remained on a sea beach for any length of time, where *balani*, and *flustra* attached themselves to *pectens* and other marine bodies, without being also incrusted more or less by the same animal. Yet it must have been a powerful current which transported such large trunks, and that current was not the current of a river: for we cannot imagine ever to have been on earth a river stream whose breadth is a measure from the Red Sea to the Nile at least. Moreover, there is no trace of a river action on the nummulitic limestone. The trunks must then have been swept from their place of growth by the ocean, and by a rapid flood which swiftly drove the *dunes* of sand, and debris of the ancient forests, over the salt pans and dry beaches of the retreating sea.

The sea must have been gradually retreating owing to the greater depths quickly filling up by a deposit of lime. Perhaps in twenty years it might have filled up from the parallel of Thebes to that of Cairo, while a mighty flood overthrew the forests of the ancient African continent, broke in pieces its eternal rocks, and drove the debris of all down into the vast extent of low salt marshes which the sea had left.

The circumstances of the crab prove an unusually rapid deposition of lime, and consequently an unusually rapid filling up of sea, and advance of the usual coast, in the usual manner, on the sea, until all was filled up,

and nothing left but salt marshes. The circumstances of the fossil wood prove a subsequent unusual sea flood, in short, a deluge.

Egypt was inhabited and a kingdom three hundred years after the deluge of Noah. A shorter time than this would have been sufficient to drain off the waters of the deluge, and by that drainage to have hollowed the valley of the Nile and formed its fertile plain. Our geological facts then perfectly agree with the Bible history; for it is certain that a great flood was the last geological event in Egypt, and this affords additional evidence to the truth of the Bible record.

The nummulitic limestone, therefore, was in progress of formation a little before the flood, and might have commenced but a few years before. As it is clear that there was nothing miraculous or unusual in its formation, the length of time will entirely depend upon the amount of lime precipitated and the time requisite for this, and the time necessary for the multiplication of nummulites, of which creature the great mass of the stone is composed.

Relation of the Egyptian to other formations.

If then Egypt has really afforded us the means of connecting history with geology, we have a fixed point to which we may endeavour to connect other formations, and thus perhaps, step by step, to trace back the history of our earth.

First. With regard to the nummulitic limestone. It is found in Cutch and Siudh, in Lombardy, and in the Grecian islands, and I believe also in Spain. In all these localities it has been referred either to the upper members of the chalk, to the tertiary, or to some intermediate formation between the secondary and tertiary series. Now, with regard to the chalk, it does seem, in its general character, to be a deposition of much the same character as we have found the lower nummulitic limestone, namely, a rapid deposition in a deep sea. And with regard to the marine tertiary strata, they seem to indicate the same changes as the upper nummulitic limestone of Egypt; viz. the gradual recession of the sea from its shores. There are no doubt strong objections against the identification of the chalk with the lower nummulitic limestone and of the whole range of *eocene, meiocene,* and and *pleiocene* formations with the upper beds; and I merely wish to suggest the possibility of this view being correct.

With regard to the identification of the nummulitic limestone of India

with that of Egypt I have no doubt. In the description of fossils, several instances of the same being found both in Cutch and Sindh are specified. But I think that it would be premature to do more than to urge exertion in procuring more specimens from both Egypt and India for our Museum, and in collecting further facts; as we are in an admirable position between the two countries to establish the negative or affirmative of the assertion.

Having examined the nummulitic limestone about Verona, I feel no hesitation on the identification of the Lombardy with the Egyptian formation; but I am not able to refer to the work of the Italian Geologist who has described these formations. The nummulitic limestone of the Grecian Islands has been recently investigated by an English Geologist.

From the specimens brought from the great Sahara, by Captain Lyon, Dr. Buckland concluded that the greater part of the desert was an equivalent of the new red sandstone supporting patches of tertiary beds; and on the same grounds it has been generally imagined that the whole of that great salt bed, stretching from the Atlantic to the Himalaya, including the deserts of Africa, of Arabia, and of Persia, is new red sandstone. The accounts of travellers seem to establish the idea that they are all of the same character; and their geographical relations warrant the supposition, that this chain of salt desert has originated in the same geological events. The account above given of the salt and gypsum deposits shews, why Dr. Buckland erred in assigning so early an age as the new red sandstone to the desert formations; and Captain Lyon's specimens of tertiary shells were doubtless from the same nummulitic formation as the salt and gypsum. This extends the nummulitic limestone and the shallowing ante-diluvial sea to the Atlantic; and, again to the eastward of our researches, into Arabia and Persia, and thus connects the Egyptian directly with the Cutch *beds*, and with those of the Indus.

This great sea had then a southern boundary probably in the central mountains of Africa, or about the line of the Niger. Its northern boundary was the line of the Pyrenees, the Alps, the Balkan, the mountains of Armenia, and the central chain of India. The notices which have appeared of Mr. Murchison's investigations in Russia would, combined with our previous knowledge, seem to say that a great sea prevailed over northern Europe, so that the habitable continent, in ante-diluvial times, consisted of a long ridge from Cape Finisterre through Auvergne, Swit-

zerland, Hungary, on to central Asia. From the reported state of India itself, it would appear that it was then also a peninsula. The lakes and coal beds of the Nerbudda probably belonged to that period, and the fossils of Perim and of the Sevalik hills, prove the existence of large continental animals living in watery places: whilst on the other hand, the marine fossils at Mandoo on the one side, and on our East coast on the other side of the peninsula, prove that its dimensions were then much smaller than they now are.

It seems to me that we have then within the limits of our research, the possibility of mapping out and ascertaining the geography of the old world previous to the flood, and the nature of that great catastrophe. We may do much in India, to carry this into effect; and with the hopes of moving the spirit of research, which has been for years employed in unveiling the physical state of the peninsula, I offer these remarks. My theory may be quite wrong but it is drawn from many facts and is plausible. Let the whole country from the lakes, south of the Nerbudda to the Indus, and the deposits from the Ganges to Cape Comorin, be well examined; and India is likely to afford as valuable a contribution to the history of the whole peopling of the Earth in *præadimate* and *prædiluvial* times, as Egypt or Russia.

The fossils which I collected, together with contributions from Major Twemlow, Dr. Heddle, Mrs. Barr, Dr. Pigou, and Dr. Stevenson, are deposited in our Museum: and, as I can find leisure, I shall publish, lithographs * of these together with those from Sindh and Cutch which have not been already published.

CEPHALOPODA. *Clymene. Pl. iv. fig.* 1.

The genus Clymene is separated by count Munster from the Nautilus, on account of the position of the syphon, which in this genus is ventral, in the Nautilus central, and in the Ammonites and Goniates dorsal.

Count Munster says, that he has not found this genus in any formation of later date than transition limestone. *Annales des Sciences, August,* 1834.

* The Society having kindly permitted me, I shall deposit these lithographs with the librarian at such a price as will cover the expense of publication. The limited means of the Society will not allow it to hazard the expense of the illustrative lithographs.