

2. *On the GEOLOGY of the UPPER PART of the VALLEY of the TEIGN, DEVONSHIRE.* By G. WAREING ORMEROD, Esq., M.A., F.G.S.

[The publication of this paper is unavoidably deferred.]

(Abstract.)

THE district noticed in this paper lies to the north of Bovey Tracey. The author describes the courses of the Teign and its feeders, and the strata traversed by those streams, namely, Granite and Carboniferous Limestone. Gravels are occasionally found, which the author regards as having been deposited before the reexcavation of the valley; and he shows that these had been transported by a current from north-west to south-east. From the absence of these gravels in the gorge of the Carboniferous rocks between Hunts Tor, near Chagford, and Clifford Bridge, he considers that that valley has been opened since the time when the boulders and gravels were deposited; and he then shows that the stream from the valley of the Teign, prior to the opening of that valley, passed by Moreton Hampstead to Bovey Tracey. The paper contains notices of the minerals found in the district, and of the Granite veins in the Carboniferous rocks.

3. *Notes on the GEOLOGICAL FEATURES of MAURITIUS.*
By GEORGE CLARK, Esq.

[Communicated by the Assistant-Secretary.]

(Abridged.)

MAURITIUS is well known to be of volcanic origin, as is also the neighbouring island of Réunion, where there exists a volcano in constant activity. There is this great difference between the two islands: Mauritius is surrounded by coral-reefs, which protect nearly the whole of its coast, and by their shelter form excellent harbours, while the coast of Réunion is exposed to the full force of the ocean. The action of the waves is so strong on its shores that not a particle of the basaltic sand which strews them presents an angle. Its beach exhibits nothing but a mass of pebbles, varying in size from a foot or more in diameter to particles almost imperceptible to the naked eye.

The reefs of Mauritius support various islets, which have been generally regarded as forming an integral part of them, though rising to as much as thirty feet above the sea-level.

Gabriel Islet, is partly basaltic and partly calcareous; and it is on the latter that the late Dr. P. Ayres discovered the fossilized remains of a forest, of which he gave an account at the Meeting of the Royal Society of Arts and Sciences of Mauritius, in 1860.

Egret Island stands on a calcareous bottom surrounded by sand between the reef and the shore, about a mile from the former and

half that from the latter, with a depth of water varying from half a fathom to a fathom. This island, which rises to a height of about thirty feet, is formed of calcareous stone, having a western dip of about 30° and covered in many parts by coarse sandstone. This is very uneven and is traversed in various directions by veins of much harder texture, which rise above the surrounding surface, forming sharp ridges intersecting each other at various angles.

This island is nearly circular, and the outer part of its circumference is hollowed by the action of the waves and currents, leaving a projecting ledge, forming a kind of penthouse, varying in width from six to fifteen feet, and generally thinnest on its outer part. On many spots this has broken off, and the fragments have fallen on the shore, where they remain. These fractures have mostly been caused by cylindrical holes which perforate the thickness of the ledge. The substance which caused these holes sometimes remains adherent either in the persistent or the detached portion; and in other spots the ledge remains entire, with the foreign body projecting both above and below its surfaces. In the latter position, it is generally tapering at the lower end; and a portion of the same substance, of corresponding size, may be perceived at the bottom of the sea: this portion is sometimes worn to a level with the surrounding surface by the action of the waves.

The landward side of the island is destitute of the projecting ledge which marks the seaward border, and is rent into deep fissures in various spots. Adhering to the sides of these may be perceived considerable masses of the same material as that found in the holes mentioned, which seem to have formed portions of trees, of much larger dimensions than those which are found in the holes mentioned.

The surface of the island is very unequal; and in many parts cylindrical holes are perceived which extend to the sea-level. The regularity of their form is very remarkable. Their diameter varies from 1 to 2 feet.

On the surface, in the sandstone which covers the calcareous rock, are many fissures radiating from a hollow which appears to have been caused by the base of a tree, as the fissures have been by its roots. On other spots, numerous stumps are seen, some of which are as much as three feet long, corresponding in diameter with those found on the ledge; and a much greater number of smaller size and height are scattered among them. The former have the appearance of exogenous trees; and their form and colour, when viewed from a distance of from twenty to thirty yards, might easily cause them to be mistaken for wood. The outer part is in most cases of the ashy grey seen on old dead bark. The interior is more or less hollowed, leaving an uneven border; and the inside is exactly of the colour of rotten wood, and is in every case perforated with numerous holes, bearing a resemblance to those produced by white ants, but of larger calibre. The same colour and riddled appearance is often seen on the outside of the stump, and always on the inside. The smaller stumps appear to have belonged to endogens of the Palm tribe; and in many individuals the medullary substance has entirely disappeared,

leaving only the hard envelope, to which thin portions of the inside, bearing the same appearance as that of the wood of the supposed exogens, is seen adherent. These stumps are very near together in many places; and numerous examples of the adherence of two stems are seen, as may often be witnessed in living trees in this island. Everything seems to indicate that a very thick forest, of trees of various sizes and kinds, once occupied this spot. Those trees which have disappeared, leaving only the cavities they occupied, may have been of species less favourable to the process of fossilization than those which remain. In every case, the vegetable substance, how different soever in size and colour it may have been, has been replaced by carbonate of lime.

Pass Island, about two miles from Egret Island, is composed of the same calcareous rock as the latter, but is not covered by so thick a stratum of sandstone. No stumps remain on it; but some cavities show where trees have been; and a large prostrate trunk seems to indicate that one had been blown down and fossilized there; this presents the same appearance as those of the other islands. Vast numbers of fossilized roots cover the surface of this island, being particularly numerous and apparent on the face of a cliff on the seaward side. No roots are found in Egret Island; and those found in the other islands are free from the perforations which pierce the trunks. Some of them appear to have rotted in great measure before becoming fossilized, the bark alone remaining to indicate their size and shape.

Vakois Island stands a few rods from Pass Island, with which it is connected by the reef. Its structure is the same as that of the others; but there is less sandstone upon it, and the calcareous rock is crossed by more numerous veins of carbonate of lime. There are two small caverns in it, formed by the unequal inclination of masses of stone, showing the same formation within as without. At the opening of one of these caverns is a large fossil stump, apparently of some tree of the fig family, and a great number of roots of the same, all of which appear sound.

Booby Island, similarly situated with the last two, on the edge of the reef, is about six acres in area, and differs much from the others in having a considerable depression across the middle. It once contained many fossil stumps, imbedded in loose sea-sand, which covers the south end of it to a depth of from 10 to 15 feet. Most of those which remain appear to belong to some species of fig, to which their roots, which are very numerous, bear a striking resemblance.

Fossil corals, of species now existing around it, imbedded in sandstone, in which are included fragments of shells, are also found here; and under a mass of calcareous rock is a vein of carbonate of magnesia (?) in a moist state. There are several other small islands within a short distance of those mentioned, of similar formation and offering the same phenomena. One of these is called "l'Île aux Fous," and is situated on a projecting point of the reef, which exposes it more than any of the others to the action of the surf. It is only about three rods square, and was once covered with a deeper

stratum of sandstone than any of the others. This has been hollowed by the waves in a remarkable manner, leaving channels and ridges so sharp as to render walking over it a task of some difficulty. In hollows sheltered by these ridges are some stumps of exogens, the tops of which are quite level, and their substance much more solid than that of those found elsewhere. Palms of large size appear to have stood very thickly here; but not a single stump projects above the surface, the force of the waves having washed them away, while the more solid stems of the exogens resisted its action. This island has no projecting border, nor have the others on the outer side.

On the shore, immediately opposite two small islands of calcareous rock, called Monkey Island and Rat Island, is a mass of the same calcareous rock, about 400 yards in length, 50 in breadth, and 10 in height, lying on a bed of clay. Separated from this by a little shallow bay about 50 yards wide, is another mass of the same rock, about 100 yards long, and of the same width as the other. The line of separation between the limestone and the clay is clearly defined. It appears that formerly (but not at all within the remembrance of the oldest inhabitant) the projection of the limestone over the clay, seaward, was much greater than at present; and many large masses, having lost their support, have fallen off, and are lying on the shore beneath, exhibiting a perfect correspondence in surface at the point of fracture. The whole of this mass is free from the sandstone covering, and exhibits no clear traces of having borne trees. Its substance is permeated in every direction by crystals of carbonate of lime, which, on the sea side, are covered with a pink incrustation consisting of oxide of iron. At the base of the superincumbent mass is a bed of crystals of carbonate of lime, six or eight inches in thickness; and stalactites of curious forms depend from its overhanging parts on the land side, where this mass abuts on a small plain of ferruginous clay, in which are elliptical boulders of basalt, which serve as nuclei to concentric layers of sand, hardened into stone by a large portion of oxide of iron. This spot is overflowed at high water; and these nuclei project above the surrounding surface, showing a clear section of their several enclosures.

On various parts of the coast of Mauritius, masses of calcareous stone, such as are here mentioned, are seen lying on the sand, but always, I believe, in close proximity to the sea. Two such masses exist at "Anse Bambou," in Grand Port, and one at Turtle Bay, on the north-western side of the island; and an islet at the entrance of the Grand Port, called "l'Île des Roches," is of the same formation. This last is exposed to the action of powerful currents on both sides, and has been considerably diminished in size within fifty years.

Great masses of coral, some of forty or fifty tons' weight, are seen on various spots on the shores of Grand Port, at a distance of a quarter of a mile from the sea, and at least fifty feet above its level. These are of a species not now found here in a living state.

Near the Chamarel Falls, at Blackriver, at about 900 feet above the sea, is a large quantity of old coral, of species still existing here;

and not far from this spot is a mountain consisting in great part of a soft aluminous stone, of a greyish colour. A road cut along the side of this mountain exhibits in this stone a number of concentric rings from one to twenty feet in diameter, coloured with oxide of iron.

The most extraordinary feature, perhaps, in the Geology of Mauritius is a double-headed mountain adjoining the range which separates the districts of Grand Port and Flacq. This is about a thousand feet high, and the heads are rounded in a very remarkable manner. It consists entirely of hexagonal prisms, from one to five feet in diameter, composed of aluminous rock, of a light greenish grey, with minute black spots. It is so soft as to be easily cut with a chisel or saw.

The facility with which this stone is wrought induced some persons to employ it for a time; but it is not suited for building-purposes, as it crumbles away very rapidly under the action of the atmosphere.

In various parts on the coast of Grand Port may be seen masses of columnar basalt, the prisms of which vary in diameter from six to fifteen inches; these have evidently been detached from the "Lion" Mountain, at the foot of which they lie. One such mass, of sixty or eighty tons' weight, is to be seen on the side of a mountain at least two miles from any similar formation.

In many places a mass of molten stone has been poured down on a bed of clay, itself overlying a stratum of stone.

In the north-eastern part of the island is a spot comprising an area of ten or twelve square miles, called "la Plaine des Roches." This is covered almost entirely by a band of rock, generally becoming thinner towards the sea, where it is from six to ten inches in thickness. This stratum lies on a bed of loam of about equal thickness with itself. Its surface bears the appearance of water rippled by the wind. In many spots there occur spaces of some hundreds of square feet without a fissure, forming what are locally and aptly called "pavés." In other spots conical mounds are observed, varying in size and height, which have evidently been formed by some upheaving force exerted in the centre, whence radiate cracks extending to the circumference. Such mounds are often seen in other parts of the country, but are nowhere so frequent as on this spot. They offer most convenient stones for building, the upper and lower surfaces being parallel, and a little breaking at the edges being all that is required to prepare them to form symmetrical walls. They are largely employed in the wall skirting the railway.

The fertile soil beneath this great extent of rock enables trees and grass to flourish wherever a fissure admits their seeds: and in some places cane-holes are broken through the overlying stone; and the plantations made there thrive well in wet seasons. This part of the country offers numerous other proofs of the disturbance of the upper strata by subterranean forces.

Oxide of iron in pisiform nodules occurs in many spots, and was thought of sufficient importance to cause the establishment of foundries by Governor Labourdonnais. These supplied a great portion

of the iron employed by him in ship-building; but the rapid destruction of wood necessary to keep up these works caused their speedy abandonment. A large quantity of scoræ from these furnaces was found during the construction of the railway, and even some pigs of iron. Thin veins of hepatic iron-ore occur in many places. It is usually coloured scarlet on its under surface, and has been found by experiment to contain more than 70 per cent. of pure metal.

In the northern part of the island, at a spot called "Mapou," and in one or two other places, is found a white soft earth locally termed "boue blanche," which supplies the cottars with both plaster and whitewash. It appears to be formed of a mass of decomposed madrepores, but possesses more consistence than would be expected from such a material.

I now venture to put forth a conjecture as to the probable cause of the existence of the fossil-bearing islands, and the masses of calcareous rock similar to that which forms them on the shores.

As fossilization could not have taken place in the air, there must have been a subsidence of the land-bearing forests, carrying them below the water-line; and during the period of their submersion a deposition of sand, which has since formed sandstone, took place. This, probably, only reached to a portion of the height of the trees, and that part which remained exposed to the air rotted away. Whether the perforations are the work of lithophagous or xylophagous mollusks I cannot pretend to say; but I think it probable that the latter were the agents, as I have seen wood in the sea hollowed in a manner much resembling that in which they are riddled. Petrification having taken place, upheaval followed. As the calcareous formation is of considerable antiquity, and is found at the extremities of the island and beyond its proper limits, it may have constituted part of an island larger than Mauritius itself, and of greater antiquity. I have ascertained by careful observation and examination, that the present extent and elevation of Mauritius have undergone no perceptible change since the first regular surveys, made upwards of a hundred years ago.

In conclusion, I may observe that, on most parts of the coast, the land rises, immediately before reaching the sea, to a height of from 6 to 20 feet. In the lower parts this rise is occasioned by sand dunes overlying basalt, and in others by basalt overlying sand. This appears to me to indicate that after a considerable deposit of volcanic matter, at a period long anterior to the formation of Mauritius as it now is, a second outpouring took place, over the spots where the basalt is on the surface, and the fluid mass was partially arrested in its downward course by the sand-hills on the shore. The looseness of the heaps of scoræ, which form the elevations mentioned, appears to favour this hypothesis.