ON THE FORMATION AND GROWTH OF CORAL REEFS AND ISLANDS.

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In attempting to embody in a popular form, the following brief outline of the history of coral reefs and islands, it will be necessary to premise the subject by stating, that the greater portion of the matter will be found to assimilate very closely to that of various published authorities, but corroborated by personal observations made among the Islands of the South Pacific, particularly those denoted on the charts by the name of the Dangerous Archipelago, and situated between the latitudes 12 and 27 degrees south, longitude 130 and 155 west, forming a part of that division of the world entitled Eastern Oceanica, or Polynesia.

The particular groupe of islands to which we shall call attention, is named by the natives *Paumotus,* literally signifying low islands, *Pau* in the Tahitian language meaning low, and *Motu* an island.

In speaking of the material of coral, to which it will be necessary continually to allude, we mean that hard cretaceous substance, formed by myriads of minute marine animals, called saxigenous (or rock making) polypiers, of which there exist an amazing variety.

Note.—Our motive in appending the following abstracts from the published account of the voyage of Captain Flinders, in the form of a note, is, that although it has already been often quoted, and although we differ from it in very many particulars, yet we still think it highly deserving of being perpetuated and brought forward, as a beautiful and popular view of these highly interesting formations.

Captain Flinders, when upon the coast of New Holland, made the following observations on the formation of coral islands; speaking of those in Torres straits, he says, "These islands, or banks, are in different stages of progress; some have become islands, but not yet habitable; some are above high water mark, but destitute of vegetation; whilst others are overflowed with every returning tide." He goes on to say:—

"It seems to me, that when the animalcules which form the corals at the bottom of the ocean, cease to live, their structures adhere to each other, by virtue either of the glutinous remains within, or of some property in salt water; and the interstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is formed. Future races of these animals erect their habitations upon the rising bank, and die in their turn to increase, but principally to elevate, this monument of their wonderful labours. The care taken to work perpendicularly in their early stages, would mark a surprising instinct in these diminutive creatures. Their wall of coral, for the most part in situations where the winds are constant, being arrived at their surface, affords a shelter, to leeward of which their infant colonies may be safely sent forth; and to their instinctive foresight it seems to be owing, that the windward side of a reef, exposed to the open sea, is generally, if not always, the highest part, and rises almost perpendicular, sometimes from the depth of two hundred and perhaps more fathoms. To be constantly covered

The corals principally instrumental in the formation of reefs, belong to Lamarck's third order of polypes, the polypi vaginati, and the fifth division, which he distinguishes as his polypiers lamellifères, containing the following recent genera:—caryophillia, fungia, pavonia, agaricia, meandrina, monticularia, echinopora, explanaria, astrea, porites, pocillopora, madrepora, seriatopora, and oculina; in fact, the whole of the Linnean genus madrepora. Of these, caryophillia, meandrina, astrea, porites, and madrepora, form the main portion of the reef; while the ornamental parts are made up by a diffusion of the other genera, together with gorgonia, isis, corallium, melitea, corallina, spongia, alcyonium, actinia, &c. &c. independent of the locomotive beauties, in the form of astrea, echini, and testacea.

For conciseness, it will be well to divide and treat of these islands, under the different forms that they assume, which are as follows, *first*, the circular; *secondly*, the flat; *thirdly*, the long narrow; and *fourthly*, those which encircle high lands.

The whole of the islands, exceeding fifty in number, which (with two or three exceptions) form the groupe called the Paumotus, are of the first kind, and consist of narrow strips or belts of coral, of an annulate or circular form, each containing or enclosing a lagoon. These strips of coral have never been observed to exceed one mile, but are much more generally of about four or five hundred yards in width; seldom raised above the water more than four or five feet, and presenting an abrupt line towards the ocean. On these the waves break with much violence, and at a short distance from them the depth is usually so great, as to be denoted by navigators as unfathomable; this however is a vague mode of expressing themselves, as it is now known that soundings may be had at more than one thousand fathoms; and we have repeatedly obtained soundings about a mile from the shore, at between two and three hundred, (mariners in ordinary cases seldom using a line of more than one hundred and twenty fathoms deep, which is by them termed the deep sea line; and in fact it requires great care, time, and labour, to get soundings at much greater depths;) while the interior of the lagoon is comparatively shallow, varying from an inclined beach to a depth of one hundred fathoms or more.

These islands vary from two and three miles in circumference to one hundred or one hundred and fifty; and in many instances a fissure, or

with salt water seems necessary to the existence of the animalcules, for they do not work, except in holes upon the reef, beyond low water mark; but the coral sand and other broken remnants, being rarely covered, their adhesive property, and remaining in a loose state, form what is usually called a key, upon the top of a reef.

The new bank is not long in being visited by sea birds; salt plants take root upon it, and a soil begins to be formed; a cocoa nut, or the drupe of a pandanus is thrown ashore; land birds visit, and deposit seeds of shrubs and trees; every high tide, and still more every gale, adds something to the bank; the form of an island is gradually assumed; and last of all comes man to take possession."

break, in the ring of coral occurs, forming an entrance into the lagoon, and thus enabling ships to enter, in which cases they form commodious and safe harbours.

The reefs and banks of coral not yet above the level of the water, are exceedingly numerous; we have seen lists of more than a hundred, not to be found in any published chart; these lists are handed on from one captain to another, whose business carries them to the seas of the Pacific.

The height above the level of the ocean seldom exceeding four or five feet, it often happens that the sea breaks over with great violence at the windward side of the island.

It is not unusual to see, during a strong easterly wind, the waves of the ocean forced against the abrupt barrier of coral; where the surf, towering in one vast sheet of water to an immense height, would fall within the lagoon in form of a shower, exhibiting all the iris colours of the rainbow; and thus, by the continued overflow at the windward side, and by the rush of water upon the ebb tide, through the leeward opening, in this way preventing the growth of the corals, is the entrance kept open. But there can be little doubt, that in a series of years the increase on the weather side, will form a perfect breakwater; and then, from the quiescent state of the water within the lagoon, the leeward opening will be choked by the growth of coral, and the fresh supply of water by the flood tides cut off. Evaporation going on, salt would be deposited, the zoophytes of the lagoon would lose their vitality; and at this period a perfectly new order of things would commence, the subsequent formations being deposited horizontally and filling up the vast basin which would then bear some slight analogy to the coal basins of this district, or the more recent basins of London and Paris.

That many of these islands have actually arrived at this state, is known to navigators; in these the lagoon is perfect, the ring of reef having no visible opening; the water, which is accumulated within the lagoon by the spray dashing over the windward edge, finds the level of the surrounding ocean, by percolation through the sides of the basin.

Confining the assertion to the corals before mentioned, because we are aware, that a few genera of Lamarck's second and fourth orders have been found to inhabit great depths, we believe it will not be found that corals commence their growth or origin, at a greater depth than fifteen or twenty fathoms. Quoy and Gaimard, who accompanied Capt. Freycinet, say indeed twenty or thirty feet.

This assertion is in opposition to a statement of Lamoroux's, a naturalist, whose name stands most deservedly pre-eminent, from the value of his investigations with regard to the particular subject before us.

He says, in a prefatory address appended to his Corallina, speaking of the madreporous islands of the southern pacific: "Their base is fixed on the

foundation of the sea, at a depth that cannot be measured, whilst their extremities are lost in the regions of the clouds."*

In proof of the views we are adverting to, with regard to the depth at which they actually commence their growth, we have only to mention that it is in some degree corroborated by the following facts:—Within the lagoons, upon a calm clear day, the smallest objects may be seen at a depth of one hundred feet or more;† and at these times, the bottom may be observed strewed with dead shells and broken fragments of coral; whereas, if the animals could exist at such depths, the centre of the lagoons would be seen paved with these productions, and exhibiting, even in a more beautiful form, the living analogues of the surrounding reefs; yet here and there, in somewhat shallower depths, we find a solitary specimen, which by accident has been broken off from the reefs above, growing and extending itself upwards, like a plant partially deprived of light and air.

In this manner many of the differences, which are supposed to distinguish species, may be explained; thus, if we suppose a flattened wide-spreading fragment of madrepora prolifera, to be broken off from the upper part of the reef, this fragment, if its vitality was not destroyed by its descending into too great a depth, would then commence a lengthened growth, with its branches ramifying like stags' horns, and forming the species called cervicornis.

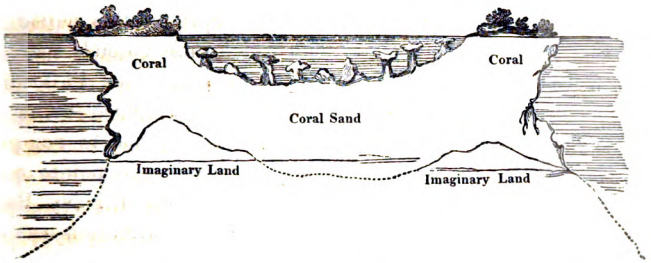
We ought to mention that the lagoons are studded with smaller reefs in all the various stages of their growth; and in these we have the best evidence of the depths at which the polypiers commence their work, as in most cases their nucleus, or rather the foundation of their structure, is a portion of the surrounding reef dismembered from its original situation, and washed into deeper water; upon this the polypes build their habitations, each appearing to act independently in the creation of its own cell; while the whole seem actuated by a common instinctive principle, which induces them to extend the colony upwards towards the surface of the water, in the form of sugar loaves; when the apex of the cone has reached to within a few inches of the low-water level, the innate principle before mentioned directs their operations laterally, when, after a time, they assume the form of a mushroom upon its pedicle.

These clumps do not arise from a greater depth than sixteen or seven-

* Lamoroux's views were probably derived from the accounts given by various voyagers; Flinders, for instance, who speaks of their being based at a depth of two hundred fathoms or more. This idea must have arisen from the observer having sounded and obtained those depths, along-side coral formations, and not taking into consideration the fact of the coral being formed upon the summits of sub-marine hills.

† In rough weather, the bottom may be observed exceeding well, by looking through a tube, with one end inserted just beneath the surface, or by dropping a small quantity of oil on the water.

teen fathoms, while in deeper water, the broken masses of rock may be seen without any living portion attached; and the mass, like the smaller conical clumps, remains loose among the sand, being frequently overturned by the straining of the ships cables, which, during calm weather, had got entangled among them.



When two or three of these smaller reefs approximate by their lateral increase, they would unite together at their circumference, light would be shut out, the animals would cease to exist in the dark interior, and thus chambers or caves would be formed.

We perhaps may be allowed to digress a little from our subject, in endeavouring to depict the beauty, the exquisite beauty of these living submarine gardens. Those who have had the pleasure of visiting these scenes, will never forget the delight they must have experienced on a calm day, when the meridian sun directed his powerful rays into the recesses of these natural grottoes.

In imagining the similarity to a garden, it is not difficult to picture the various coloured actinias as beautiful anemonies; the muricated branching madrepores, as shrubs; with a delicacy of tinting, unequalled by terrestrial plants, the caryophilliæ and agariciæ would not unaptly suggest the familiar idea of cauliflowers, endive, and lettuces; and among them, to make the resemblance more complete, there are not wanting crabs for spiders, variously coloured eels for snakes, nor even snails, slugs, and dew worms, all of which would readily find their representatives upon the land, but to attempt to paint or give the slightest conception of such a scene, would require the pen of a poet, rather than the simple matter of fact natural historian.

Comparatively with other accreting formations, the growth of coral may be esteemed as rapid and estimable within the period of man's life.

At the island called Taapoto, there may be seen in smooth weather, a ship's anchor lying in about seven fathoms water, now entirely encrusted by coral, but still preserving its original form; this anchor belonged to a large ship, which was wrecked upon the island during the childhood of some of the natives now living, and the probability is that the time does not exceed half a century. Shells, or any extraneous substances, are

often encrusted by coral. In various collections, are examples of bottles, upon which very dense corals have colonised themselves; and there is in the museum of the Bristol Institution, a bottle which was picked up by a diver in Port Royal, Jamaica, to which a dense species of astrea, weighing 1*lb*. 8*oz*. is adherent. Another specimen of agaricia, weighing 2*lb*. 9*oz*. surrounds a species of oyster, whose age could not be more than two years, and yet it is completely enveloped by this dense coral. And in further proof of the rapidity with which these animals secrete the calcareous matter, we have only to refer to a paper in the Philosophical Transactions, by Capt. Lloyd, who was engaged by Bolivar to ascertain the relative levels of the Pacific and Atlantic oceans, and to complete a survey of the intervening isthmus of Darien; wherein he points out the possibility of forming a breakwater across the mouth of Navy Bay, by throwing in coral broken from the adjacent reefs: his attention was called to this by having collected specimens as curiosities, and not being able to carry them away at the time, he returned a short period after, and to his surprise found them permanently soldered to the place whereon he had placed them by their own calcareous deposit.

We at the same time caution projectors of this kind to take into their mature consideration, whether the foundation might not, by this means, be laid for entirely filling up the harbour, and thus depriving the navy of a port, which it had only intended to make more secure. In fact, the natives of the Polynesian isles have long employed this method for building their jettys, piers, wharfs, fish preserves, &c. At the island of Barabora, a very beautiful pier has thus been formed by the natives, along-side of which a large vessel may lie and discharge, or take in cargo. For a view of this, and much interesting matter respecting these islands, the reader may consult Bennet and Tyerman's Mission to the South Sea Islands.

In a similar manner are vast quantities of shells, &c., encased, fixed, and preserved, either by the hardening of sand, secretion of the calcareous matter before mentioned, or as follows.

It would appear, that as during the formation of a reef, portions of it become compact, and as dense as any limestone rock; the presumption arises, that when the coral animals die, the animal matter decomposes, and the carbonate of lime, of which the coral is composed, will be held in solution, and again, (probably under peculiar circumstances) precipitated of the consistence of paste, entombing shells, corals, fish, &c., which have sufficient animal matter to protect them, by which means they retain their organic form; in this manner closely resembling the limestones, in which the fossil remains of corals, shells, &c., are so often found; and, as we believe, cemented by a paste composed of the lime derived from their congeners.

Among these islands it is not uncommon to see extensive beds, or strata, of particular species of shells, deposited along the shores in the

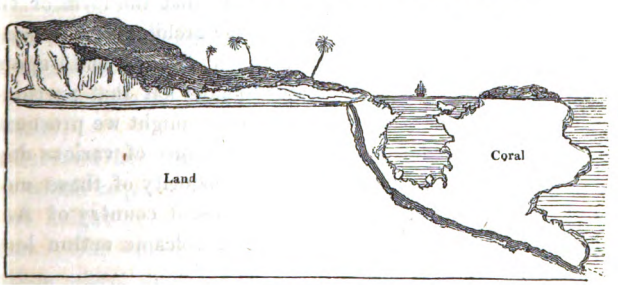
most regular order, with comparatively little or no admixture of other substances, which may be accounted for by considering their separation to have taken place by the mechanical action of the waves, according to their different degrees of gravity.*

Islands often occur of a flat or tabular form, generally oval or irregularly circular at their circumference: of this form may be mentioned the groupe, named by Cook the Friendly Isles, consisting of numerous islands, the majority of which are of the tabular form.

There are also many crescent shaped reefs, with the most convex portion of their arc the highest, often denoting themselves to the mariner only by the breaking of the waves, and here and there a rock above the level of the ocean, while the horns of the crescent are depressed, and gradually lost in the greater depths; in a few instances, as at the groupe called Gambier's Islands, they are sufficiently raised to have become verdant and inhabited.

We may next refer to those which form long narrow slips of land; for example, Tethuroa,† or the great reef which takes the course of the north-eastern shore of New Holland, which Captain Flinders describes as being more than one thousand miles in extent; in the course of which, there is a continued portion, exceeding three hundred and fifty miles, with scarcely a break or passage through it.

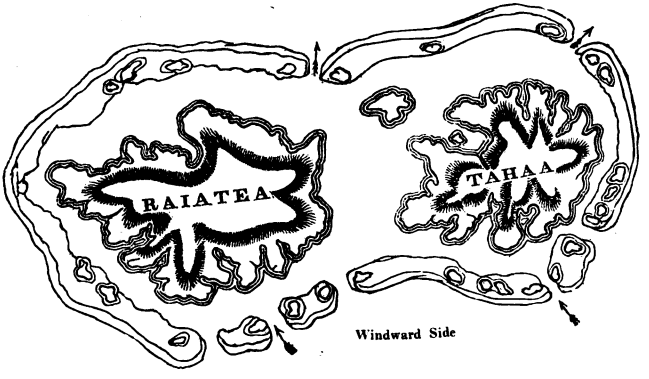
Among these groupes are many high mountainous mineral-formed islands, which are surrounded by coral; of these it will only be necessary to refer to the Society Isles, which include Tahiti, and other islands familiar to us, from the beautiful descriptions we have been favoured with, by our intrepid circumnavigators, Wallis, Cook, and others. Of these islands, at the present, we need only state, that they are surrounded by coral reefs, generally situate four or five hundred yards off shore, with a deep channel between, having numerous openings, through which ships can enter, and lie at anchor in perfect safety. These breaks in the coral barrier, are in most instances opposite the mouths of fresh water rivulets.



* At Bow Island may be observed beds of cardium fragum, from six to eight feet thick, and more than two miles in extent, without even the broken portion of any other shells being deposited in the same stratum.

† Tethuroa is a coral island, situate a few leagues from Tahiti, and uninhabited,

The islands Raiatea and Tahaa, *Ullietea* and *Otaha* of Cook, are divided by a strait, by which ships can enter at the windward side of the island, and get to sea again through the leeward channels. These two islands are entirely surrounded by one coral reef, extending throughout the circumference of both; the openings through the reef are in most cases denoted by the points being rather higher and often verdant, having trees, principally cocoa nut trees, planted by the natives upon them. The passage is seldom more than a hundred yards in breadth, with the depth varying from three to fifteen fathoms.



The form of all coral islands must very materially depend upon that of the base on which they happen to be built, therefore we must assume a form of substructure corresponding with the peculiarity of the formation we are investigating. We have thus enumerated several formations differing essentially from each other.

Although, in common with all animated creatures, the polypes possess certain instinctive powers, yet so constant are their results, that under whatever circumstances they may be placed, their actions and mode of growth are the same; therefore it is evident, that the form of the reefs produced are not so much dependant upon the architectural design of the builders, as upon the form of the basis they may have to build upon.

Let us for a moment imagine the water to have left that portion of the ocean in which these islands abound, and what might we presume would be their appearance? should we not have mountains of various degrees of elevation? And is it not as likely that the majority of these mountains should be of volcanic origin, as that the present country of Auvergne, Italy, or Mexico, should exhibit evidences of volcanic action long since

except at particular seasons, when it is visited by the Tahitian nobility and invalids, as a place of recreation and fashion, similar to our watering places; and it is here that the ladies sojourn during the fattening season, just previous to their national annual meetings; for in this part of the world, height and weight are essential to enable them to carry off the palm of beauty.

expired ?—so long since, that we have no historical record of their existence, and yet we have ample ocular proof of such having been the case, strengthened by the fact of a few remaining in actual operation. Also taking into consideration the positive evidence of the greater portion of our present dry land having been submerged, and whether at that time Europe must not have been similarly situated with that portion of the Pacific to which we have now been directing your attention. Comparing the Apeninnes or Jura chain of mountains, or if you please, the colossal Andes, with the coral chain or reef of New Holland, the western isles of Scotland, with the islands of Tahiti, &c.; the extinct volcanoes of Auvergne, with the circular coral lagoon isles of the Paumotus; and there can be little doubt that the analogy of circumstances will appear much closer than it is necessary now to insist upon. As a further proof that the lagoon islands are formed upon the edges of extinct volcanic craters, Captain Beechey found lava or pumice within one of the lagoons, among the Gambier isles; and that the islands are being repeatedly raised or sunken by submarine movements, is evidenced in many instances; it will be sufficient to show that land is raised; proof of its depression would from the very circumstance of its being submerged, be more difficult, except from analogy or actual observation; still proofs of the latter are not wanting; for one, take the following case, which was the topic of conversation among the islanders, when the author of this memoir was among them, in 1826.

Towards the close of the year 1825, the island of Ana, or Chain Island, was devastated by a violent *toerou*, or westerly wind, which lasted many hours; and coming from an unusual quarter, the sea broke with infuriated violence on the western portion of the reef, carrying with it trees, huts, and natives; a few only who were fortunate enough to secure their canoes, being saved, by their being drifted across the lagoon to the opposite shore. In this instance it was evident, even to the natives, that the hurricane alone was not sufficient to account for the violent agitation of the ocean. When the sea had returned to a smooth state, it was found that a great portion of the western side of the island had disappeared, and it was computed that not less than three hundred lives were lost upon the occasion, and great numbers of individuals were obliged to emigrate to the neighbouring isles.

Whether and how these islands are raised after their formation, is a question which requires deliberate investigation, on account of the slight degree of height at which the majority of them stand above the level of the ocean. Our opinion is, that a gradual upraising has in some way or other taken place, and that they do not owe their present height to the accidental increase upon their surface, by the debris of the outer portion of the reef being washed up.

With regard to the flat, tabular islands, they may have been formed either upon the tops of sub-marine mountains, or by the filling up of the

before mentioned lagoons. Tongataboo, Vavaa, and others of the Tonga and Hapai isles, are standing from ten to thirty feet above the surface of the water.

The crescent-shaped reefs appear to have been formed under similar circumstances to the lagoons; but at the time of their elevation, their projectile force was unequally exerted, thus depressing one portion of the circle, while the other was in a slight degree elevated.

Of the long slips of coral, or coral banks, such as Tethuroa, and the great barrier of New Holland, the most probable solution will be, to consider them as built upon elevated ridges, or the tops of a vast chain of mountains, the corals having formed upon the apices, until arrived at the water's surface, when they enlarged themselves laterally, until one continued wall of coral presented itself, with occasional openings, which may have happened by the chain of mountains being broken by champaign country. Captain King states, that the continuity of the great barrier, taking seven hundred and fifty miles of its course, is broken by the intervention of gaps, at about thirty or forty miles distance from each other; this would answer very well for the distance from one cone to the other of any chain of mountains, supposing them to be submerged.

Lastly, we arrive at the high basaltic islands, the Society Isles, for instance, of which we will take Tahiti. The highest point of this island is computed to be 12,000 feet above the level of the ocean; the whole of the island is formed of basalt, with scarcely any other substance, except the common minerals which occur in such rocks, some portions being very compact, and of which the natives form their tools, while other parts are vesicular, or scoriated, bearing decided evidences of volcanic origin.

Here a reef surrounds the shores, sometimes forming a connected flat coral platform; but in most instances it appears to have raised itself abruptly from the sides of the land, leaving a space, as we have before stated, between the reef and the shore.

This island may be considered as a favourable example for explaining, or rather corroborating, the views before taken; for upon the apex of one of the highest mountains, there is a distinct and regular stratum of semi-fossil coral; while at the summit of an adjacent mountain, at a much lower elevation, there is a basin considered by most who have visited it to be an extinct volcanic crater, now filled with rain water and forming a fresh water lake: this basin or crater has its outer edge broken by two notches or gorges.*

We are thus furnished with the best possible proof of the state in which this and the other high lands of the group once stood; it has been stated

* The lake is named by the natives Vai-hiria, from *vai*, water, and *hiria*, to swim, in consequence of the only mode of getting from the one side to the other being by swimming across by the two gorges; the edges of the basin being in other parts exceedingly perpendicular. Its diameter in the rainy season is about one mile.

that it is twelve thousand feet high, and that on the top of its highest mountain there is coral, while at a short distance there is a volcanic crater with two gorges. Now imagine this island to have been wholly submerged, is it not apparent that the most elevated point was within reach of the coral animals, to found their colonies upon?—whilst the crater at the same elevation would have formed the basis for a lagoon island, with two openings; when, from its being so much below the surface, it remained uncoated by coral matter; but, being elevated together with the adjacent isles, and filling with rain water, it now forms the fresh water lake.

Therefore it is a natural presumption, that the island was projected twelve thousand feet at one movement: (for had it been gradual, the whole island would have been flanked by limestone, or if its uprising had been intermittent, the limestone would present itself in the form of zones or terraces;) and, in consequence of the time which has elapsed since this took place, the coral animals have had time to form the vast bulk of calcareous matter, which now surrounds these islands: and should any after elevations take place, sufficient to raise the whole of this portion of Polynesia a few thousand feet, it will be equally evident that a continent in regard to extent of country as large as Europe will be produced, and in many respects bearing a strong analogy to it.

Tahiti is not singular with regard to these proofs of comparatively modern elevations; if further examples were necessary, it would be only to mention as familiar instances, the Isle of France, where a bed of coral ten feet thick may be observed between two beds of lava; Bermuda, Guadaloupe, Barbadoes, and other islands, independent of the proofs which the continent of Europe gives us of similar occurrences in antecedent times; for how else is it that our own island presents such numerous facts relative to its having once formed the bottom of the ocean? Again, how can we account for the marine productions which are situated upon the Pyrenees, at the height of 10,500 feet; or in America, upon the Andes, at 13,000?

Italy offers a peculiarly favourable spot to be put in opposition to the formations here treated of. Italy in general is covered by strata containing marine remains, extending to an altitude of 1200 feet above the sea level, while the extreme height of the Appenines is 9000 feet; the whole of the chain from this height down to that of 1200, must be supposed to have formed a ridge rising above the sea.

It is therefore evident, that at the period at which Italy became dry land, the whole must have experienced an elevation of 1200 feet; and that the cementing paste was precipitated suddenly, is proved by the perfection and peculiar situation in which many of the marine fossils are found; among such may be mentioned a specimen from Monte Bolca, now in the collection at Paris, wherein one fish appears to have been arrested in the act of swallowing another.

So closely do some naturalists draw these analogies, that the Abbé Fortis, in the Journ. de Physique for 1786, says that he has identified some of the fossil fishes from the above locality, with living specimens from Otaheitè. Certain it is, that the identification of genera has been made out in several instances of late years, by the discovery of recent animals in the southern pacific, whose analogues were before only known in a fossil state. Nor are we without direct evidence of such forces now actually operating; numerous instances might be quoted, such as the appearance of several islands in the Grecian Archipelago, recorded by Pliny as occurring in his own time, particularly in the bay of Santorin; since which, others have occurred among the Azores, where, in 1638, a submarine volcano arose close to the island of St. Michael, occupying a space of nine miles in length, by three in breadth, and remained above the water three weeks, when it disappeared. In November, 1720, it again appeared, and remained until November, 1723, when it sunk and gave eighty fathoms soundings; and it will be recollected, that in 1811, it once more shewed itself, was taken possession of by the British, and received the name Sabrina, thus giving a periodic distance of time, of about ninety years, though probably this ought only to be noticed as a remarkable coincidence; and lately, we have had the evidence of Graham's Island. It in fact is only necessary to read the various geological works, to satisfy the reader, of the very numerous cases of alteration which have taken place on the face of the earth, by volcanic agency and earthquakes.

That the New Zealanders have a knowledge of such events as the rising of land from the depths of the ocean, is certified by their having a deity, who makes land under the waters when he fastens a hook to it, which it is another god's duty to haul up: *Mowheemoha* is the name of the god who makes the land; *Mowheebotakee*, of the god who hauls it up, and is the giver of life.

NOTICE
OF
PROFESSOR FARADAY'S RECENT DISCOVERIES,
With regard to the Laws of Electro-Chemical Decomposition.

At the period when the first number of this Journal is about to make its appearance, the most important novelty in chemical science appears to be undoubtedly the recent discoveries in Electro-Chemistry, by the individual to whom both the important branches of physics which have given rise to this compound appellation, have been previously so much indebted. Mr. Faraday has now investigated the general laws of electro-chemical decomposition; he has reduced those with which we were before acquainted, to a degree of precision far beyond that attained by former discoveries, and he has suggested many which are perfectly new—and one of them of transcendant importance—namely, that electro-chemical action follows the law of definite proportions; so that if we take the quantity of water