

R E V I E W

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OF THE

THEORY OF CORAL FORMATIONS,

SET FORTH BY CH. DARWIN IN HIS BOOK ENTITLED: RESEARCHES IN GEOLOGY AND NATURAL HISTORY.

BY

J. C. ROSS (1).

I. (2) »I will now give a sketch of the general results, at which I have arrived, respecting the origin of the various classes of reefs which occur, scattered over such large spaces of the intertropical seas.’’

»The first consideration to attend to is, that every observation leads to the conclusion, that those lamelliform corals, which are the efficient agents in forming a reef, cannot live at any considerable depth. As far as I have personally seen, I judge of this, from carefully examining the impressions on the sounding lead, taken by captain FITZROY at Keeling Island (the Cocos) close outside the breakers, and from some others, which I obtained at the Mauritius, at a depth under ten fathoms. The arming came up as clean, as if it had been dropped on a carpet of thick turf, but, as the depth increased, the particles of sand brought up became more and more numerous, until at last it was evident, the bottom consisted of a smooth layer of calca-

(1) A resident for many years on the Cocos-island. (Red.).

(2) The small characters indicate the extracts from Mr. DARWIN'S work, the large ones the refutations by Mr. Ross. (Red.).

»reous sand, interrupted only at intervals, by shelves composed (probably)
»of dead coral rock. To carry on the analogy, the blades of grass grew
»thinner and thinner, till at last, the soil was so sterile, that nothing
»sprung from it.

All corals are efficient agents in forming a reef, the lamelliform perhaps the least so of any. Mr. DARWIN himself, observed in the cold waters of the seas of Terra del Fuego, that, "even at the depth of forty or fifty fathoms, small strong corallines, were abundant on the sea bottom," and, captain Sir JAMES CLARKE ROSS (who doubtless had seen), seems to have correctly estimated these statements of Mr. DARWIN, as he very quietly observes, respecting a bank in the Pacific, on which he had sounded. "This coral bank is thus growing up, from a depth of over three hundred fathoms." The whereabouts of those soundings taken by captain FITZROY is a desideratum, because the reef on which the chain of islets is situated, slopes down from the breakers on its brim to some distance, the slope from that brim outwards being composed of patches of sand and stools of coral having from forty to fifty fathoms at about a cable's length from the reef. In fact live coral in abundance and in large masses are to be seen in a calm day, in more than fifteen fathoms depth, and pieces of the same have been brought up (on an anchor) from over fifty fathoms in depth. Dead or rotten coral, could not have broken all capt. FITZROY'S "small anchors, hooks, grappling irons and chains, one after another as soon as a strain was hove upon them by, or in his largest boats." Fitzroy, Volume I page 634.

The shelves are therefore most probably of basaltic, if not of live coral rock formation.

II. »As long as no facts beyond those relating to the structure of lagoon islands were known, so as to establish some more comprehensive theory, the belief that corals constructed their habitations, or speaking more correctly, their skeletons on the circular crests of submarine craters, was both ingenious and very plausible. Yet, the sinuous margin of some, as in the Radack Islands of Kotzebue, one of which is fifty two miles long by twenty broad, and the narrowness of others, as in Bow Island, must have startled every one who considered this subject."

Not at all startled or surprised am I, by these formations. In the time or era, wherein the supermarine portions of the earth's crust were broken up and down, and the rendings filled in with liquid molten rock from below (forming the basaltic dykes occurrent in the coal measures &c), no plausible reason can be assigned for assuming, that the submarine portions were not in the same era likewise convulsed and bodies of liquid molten rock consequently bursting upwards through those rendings, the hydrostatic pressure on the sides of which, and the cooling of their exteriors into solid shells, would cause their interiors to rise upwards, in forms corresponding to the forms of the openings, through which they were issuing, whilst the vast pressure of the ocean on its bottom around or along those uprising portions, would force the liquid metal, or rock on its upward progress; these forms of course varying from circular and sinuous, to straight lines or nearly so. When these erupting masses became so much elevated, that the hydrostatic pressure upon their sides and tops failed to counterbalance the outward and upward pressure of their interiors, they would burst open, the openings of the circular forms (or nearly so) becoming submarine craters and the dyke forms, splitting and in part falling outwards into the adjacent depths of the ocean.

III. » The very general surprise of all those who have beheld lagoon » islands, has perhaps been one chief cause, why other reefs of an equally » curious structure, have been almost overlooked. I allude to the encircling » reefs. We will take as an instance, Vanikoro, celebrated by the ship- » wreck of LA PÉROUSE. The reef there runs, at the distance of nearly » two and in some parts three miles from the shore, and is separated from » it by a channel, having a general depth of between thirty and forty fathoms » and in one part no less than fifty or three hundred feet. Externally, » the reef rises from an ocean profoundly deep. Can anything be more sin- » gular than this structure?

» It is analagous to that of a lagoon, but with an island standing in the » middle, like a picture in a frame. A strip of low alluvial land in these » cases generally surrounds the base of the mountains; this, covered by » the most beautiful productions of a tropical land, backed by the abrupt » mountains, and fronted by a lake of smooth water, only separated from » the dark waves of the ocean by a line of breakers, form the elements

» of the beautiful scenery of Tahiti, so well called, » the Queen of Islands.”
» We cannot suppose these encircling reefs are based on an external crater,
» for the central mass sometimes consists of primary rock, or on any accu-
» mulation of sedimentary deposits, for the reefs follow indifferently the
» island itself, or its submarine prolongation. Of this latter case there is
» a grand instance in New Caledonia, where the reefs extend no less than
» 140 miles beyond the island.”

Throughout this palaver, Mr. DARWIN constantly assumes that lagoon reefs and islands may be produced by one and the same cause, his subsidence theory to wit, whilst it is impossible for him, or any one for him, to shew even a probability in support of that assumption. The central islands which are now standing within encircling reefs, were most probably originated as follows. When the submarine volcanic (or as it may be named lavatic) protuberance, had ascended so near to the surface of the ocean that it burst open, as afore said, the sea then tumbling in solidified the central body of the liquid rock, to some depth downwards. The exterior shell of the mass having been previously solidified, by exposure to the refrigerating action of the ocean water, this central body in the process of solidifying shrunk, and thereby became a cone or cylinder, separated from the external shell, after which, the pressure from below being still continued, or at any subsequent time renewed, that central mass would be raised upwards (as a plug is forced out of a jar, by internal pressure), so becoming an island, and probably by successive recurrences of the submarine action elevated high above the ocean level, the exterior shell, remaining all the time at the elevation it had attained when the top burst open; meanwhile the action of wind and rain etc. on the sides of the elevated mass would reduce the surface to mould and sand, at the same time carrying that downwards, partly to form the alluvial belt around the island, and partly into the space between it and the top of the shell, or crater wall, whilst the coral building polypi were fixing themselves on the top of that wall and thereby raising upon it a coralline reef, or as it may be termed a coping of coral.

As for not being able to suppose, that any of these reefs are

not formed on primary rock, the probability now admitted by all respectable geologists, that these rocks are of igneous origin, enables us to make the supposition, without any difficulty whatever; but, were that not so, Mr. DARWIN has not to our knowledge, found a single instance of a reef encircled island, composed altogether of primary rock, but if he had, he should have recognised at the Cape of Good Hope (as hereafter to be farther noticed), that the inclination of the sides of mountains is often very different from that of the strata of which they are composed, and lastly that these reefs follow indifferently the tending of the island itself, or of its submarine prolongation, is precisely what the supposition should lead us to expect. The northern end of New Caledonia slopes gradually into the sea, and nothing is more likely than that the extension, which was not raised above its level, would in process of time, become covered with the works of the coralline polypi.

IV. »The Great Barrier which fronts the N. E. Coast of Australia, forms
»a third class of reef. It is described by FLINDERS as having a length of
»nearly one thousand miles, and as running parallel to the shore at a dis-
»tance of from twenty to thirty miles from it, and in some parts even of
»fifty to seventy. The great arm of the sea thus included, has a usual
»depth of between ten and twenty fathoms, but this increases towards one
»end (towards the S. E. projection of New Guinea) to forty and even sixty.
» This probably is both the grandest and most extraordinary reef, now exist-
»ing in any part of the world.”

This does *not* form a third class of reef. It evidently belongs to the same class as the northern extension of the New Caledonian, and like that, stands on a submarine prolongation of the easternmost ridge of the Australian supermarine elevations, running also parallel to the submarine isthmus, by which Australia is connected to New Guinea (under Torres Straits), which is also mostly covered up by coral formations. The consideration of the extent of that isthmus and of the continual passage over it, during one season, of the superficially heated waters of the Pacific Ocean, and during the other, of those of the still warmer Indonesian seas, both, at all times, bringing abundance of food and of materials for the builders to use and em-

ploy, supercedes the necessity of feeling any wonder at its extent or grandeur.

V. »It must be observed that the reef itself in the three classes agree »in structure, even in the most minute details. The difference entirely »lies in the absence or presence of neighbouring land, and the relative »position which the reef bears to it. In the two last mentioned classes, »there is one difficulty in understanding their origin, which must be pointed out. Since the time of DAMPIER it has been remarked that high »land and deep seas go together. Now when we see a number of mountainous islands, coming abruptly down to the sea shore, we must suppose »the strata of which they are composed are continued with nearly the same »inclination beneath the water, but in such cases where the reef is distant »several miles from the coast, it will be evident upon a little consideration, »that a line drawn perpendicularly down to the solid rock, on which the »reef must be based, very far exceeds that small limit, at which the efficient lamelliform corals exist.”

That high lands and deep seas go together, was observed by the Northmen, some thousand years before DAMPIER was born but Mr. DARWIN, an enlightened modern geologist, should have remarked firstly, that low, as well as high lands, terminate precipitously in the ocean, however gradually sloping down to the coast and thence under the sea to the verge of soundings. The margin there becomes abrupt and precipitous, a fact indicative of the conclusion, which is otherwise corroborated, that the beds of the ocean have formerly broken away from the submarine crust and subsided bodily, towards the centre of the globe. The observation already made, with respect to the efficient agents in forming a coral reef, might suffice for setting aside the difficulty which Mr. DARWIN propounds, but the strong probability of the suppositions made above, respecting the basements of the circular and prolonged reefs being correct, does that very fully. Moreover Mr. DARWIN forgets the fact, that in mountains of the supermarine portions of the earth's crust, the strata or outline formed by their edges, seldom or never, lie in one uniform dip from the tops to the bases, but gradually become more and more horizontal as they near the plain or valley adjoining to the mountains; of course in volcanic formed elevations there is not, nor can be, any regular strata or any,

lying all at one uniform dip. The convulsive motions, accompanying the formation of such elevations, precludes all reasonable expectations of finding in it any such regularity of strata and dip, as Mr. DARWIN here assumes. He himself indeed furnishes a direct contradiction to that assumption, in his notice of the mountain range of the Cape of Good Hope peninsula, the steep eastern side being composed of horizontal strata of sandstone, and we know that the western sides, from the Lion's Rump southward, not less precipitous, is composed of granite, up almost to the tops of that side.

VI. » In some parts of the sea, as we shall hereafter mention, reefs do » occur, which fringe rather than encircle islands, the distance from the » shore being so small, where the inclination of the land is great, that » there is no difficulty in understanding the growth of the coral. Even » in these fringing reefs, as I shall call them in contradistinction to the » encircling, the reef is not attached quite close to the shore. This ap- » pears to be the result of two causes, namely first, that the water imme- » diately adjoining the beach is rendered turbid by the surf, and therefore » injurious to all zoophytes, and secondly, that the larger and more effi- » cient kinds only flourish on the outer edge, amidst the breakers of the » open sea. The shallow space between the skirting (fringing) reef and » the shore, has however a very different character from the deep channel, » similarly situated, with respect to those of the encircling order.”

Mr. DARWIN needed not to have brought forward any evidence, such as he does in the foregoing, antagonistic to his theory. It is evidence in favour of it, that is here adduced, of contravening there is a superabundance. Howbeit in many places along the shores of Indonesia may be seen small spaces, where the fringe of coral is fully attached to the shore, at about the level of spring tide ebbs; these are spaces, where there is no heavy surf on the beach, nor mud in the water. Surf alone does not render the water turbid, but as it generally has sand or mud tossing about in it, these matters kill the zoophytes within the sphere of their action, by friction on their skins or by choking their mouths. Were we not aware from what we have to examine as we proceed, that Mr. DARWIN is not merely a master in the art, but a perfect adept in the science of assertion, we should imagine that he gave

no attention to the Cocos lagoon, altho' it was the only one of the class, which he had an opportunity of observing, because masses of growing coral are to be seen in it, larger and harder, than any that he could have seen along the exterior reef, except the reef itself, or, as for distinction it may be named, the breaker wall, and as to that wall, it is mainly composed of small coral and shells firmly cemented together; the exterior, on which the billows fall into breakers, being covered with a shelly glaze (much like that on coarse earthenware) and which forms its grand security against the demolishing action of the breakers. At the Cocos he could farther have observed, that along the exterior of the islets, from W. S. W. by the Southward to E. N. E., a considerable extent of the upper platform on which the soil of the isles is laid, has been undermined (not overflowed but undermined) and as broken up, by the action of the surge from the breakers, and the debris, partly thrown up along and upon the outer margins of the islets and partly transported by the surge and tide into the lagoon. The denuded space, now intervening between the foot of the beach and the breaker wall, is generally below ebb tide level, and on many places has several feet depth of water, lying on a sandy bottom, so presenting the same sort of appearances, that are elsewhere observable between the shores and fringing reefs, subjected to the action of breakers. We need not to be informed, that these shallow spaces present very different aspects and quality of bottoms, from those of the submarine valleys or ravines, between the submarine prolongations of supermarine ridges, or ranges forming the shores, or between the exterior walls of submarine craters and the shores of the upheaved central islands.

VII. » Having thus specified the several kinds of reefs, which differ in » their forms and relative position, with regard to the neighbouring land, » but which are similar in all other respect, it will I think, be allowed, » that no explanation can be satisfactory which does not include the whole » series. The theory which I would offer, is simply this, that as the land » with the attached reefs subsides very gradually from the action of sub- » terranean causes, the coral building polypi soon raise again their solid » masses to the level of the water, but, not so with the land, each inch

»lost is irreclaimably gone, as the whole gradually sinks, the water gains
»foot by foot on the shore, till the last and highest peak is finally sub-
»merged.”

This theory involves the (most probably true) assumption, that the interior mass of the globe is in a state of fluidity and may also be for the nonce admitted as accounting for the origin of lagoon reefs, but it is utterly incapable of affording a reasonable answer to the question which has to be put upon it. How is it that the lagoon islands have remained above the level of the ocean, and the bottoms of lagoons remained stationary and consequently becoming filled up with the growth and debris of coral, during all the time that their basements have been sinking? Mr. DARWIN himself admits that the coral builders can build no higher, than the level of low water, “spring tides” he says, but we might allow him that of the neaps, without enabling him to answer the question as for dust and sand and fragments; these must have had a resting place, that is a reef elevated beyond the limit of the coral builders, *before* being accumulated to afford materials for the sea and wind to carry on to the surface, inside of the reef, and *after* the elevation of those surfaces became such, that the sea could no longer surge over that surface, it could have received no farther accession to its elevation from that agent, and after it became covered with vegetation, dense and lofty enough to arrest the force of the wind, neither could that agent any longer add to the elevation, by bringing these materials on to it, except, on the mere margins of the isles, or islets. Hence, the theory must be pronounced as being the reverse of “satisfactory.” Moreover a moderate attentive investigation of the Cocos islets affords ample reasons for believing, that they have stood, up to the present time, above the level of the ocean, during hundreds, if not thousands of years, without having meanwhile had so much as one inch of these earthy materials laid on to the main areas of their surfaces, and farther, in the course of this paper, we shall observe good reasons for concluding, that neither has their general basement sunk at all, during that long lapse of time.

VIII. „Before I explain this view more in detail, I must enter on
» a few considerations, which render such changes of level not at all
» improbable. Indeed the simple fact of a large portion of the continent
» of South America still rising under our eyes, and abounding with proofs
» of similar elevations on a grander scale, during the recent period, takes
» away any excessive improbability of a movement similar in kind, but
» in an opposite direction. Mr. LIJELL, who first suggested the idea of
» a general subsidence, with reference to coral reefs, has remarked, that
» the existence of so small a portion of land in the Pacific, where so
» many causes, both aqueous and igneous, tend to its production, render
» such sinking of the foundation probable. There is however another argu-
» ment, of much greater weight, which may be inferred from the incon-
» siderable depth at which corals grow. We see large extents of ocean,
» of more than a thousand miles in one direction, and several hundreds
» in another, scattered over with islands, none of which rise to a greater
» height than that, to which the wave can throw fragments, or the wind heap
» up sand. Now if we leave subsidence out of the question, the founda-
» tion on which these reefs are built, must in every case come to the sur-
» face, within that small limit, we may say twenty fathoms, at which co-
» rals can live. This conclusion is so extremely improvable, that it may
» at once be rejected, for in what country can there be found a broad
» and grand range of mountains of the same height, within a hundred and
» twenty feet? But, on the idea of subsidence the case is at once clear,
» as each point, one after another, was submerged, the coral grew upwards,
» and founded the many islets now standing at one level.

That a large portion of South America is rising under our eyes, or even within some centuries of time past, is not generally acknowledged to be a fact. Captain FITZROY, with reference to the eastern coast, observes on the Bellaco rock (which lies near the shore), that its elevation is much the same when first discovered, two hundred and fifty years ago, and consequently that, „there can have been extreme-
» ly little, if any change in the relative position of sea
» and land, during the lapse of that time” and with regard to the west coast, his remarks are as follows. „In a ride along
» the beach of Concepcion Bay, with Mr. ROUSE (the British
» consul) we examined the solid wall of Penco Castle, and found
» on one side, the date 1686, and on another 1687. This
» castle and the adjoining foundations of houses, are so near
» the level of the sea, that I am surprised the inhabitants should

„not have feared of being frequently inundated, even by tides
„only a few feet higher than usual. If all this coast has been
„upheaved, during comparatively modern times, how is it,
„that the foundations of Penco still stand at the water's edge,
„very little above the level of high spring tide?" The scientific men who accompanied the U. S. A. exploring expedition, under command of commodore WILKES, have likewise concluded against the opinion, that any great extent of that country has been at all elevated, during recent times (1). Even Mr. DARWIN himself, could not help remarking that, „the site of
„the ruins of the old town of Callao is at present so low
„and narrow, that no people in their senses, would willingly
„chose such a situation for building a town upon." But to be sure by way of making amends for this awkward fact, „he
„found on the adjacent isle of San Lorenzo, at a height of
„eighty five feet above the sea, a bit of cotton thread, a plaited
„rush, and the head of a small stock of Indian corn, *proving*,
„he thinks, that the island has been elevated to the amount of
„eighty five feet since man inhabited this part of Peru, *proving*" etc.! Not having had the advantage of seeing Mr. LYELL'S work, I remain ignorant of the many causes, aqueous and igneous, tending at once to produce and to consume land in the Pacific. Query, is the existence of so small a portion of land, in the Great Antarctic Ocean, owing also to these „many
„causes?" Perhaps so, too many cooks being employed in the work etc. The still more weighty argument has already been weighed and found wanting. The supposition, that the volcanic eruptions rose from the crust under the ocean, up to within a short distance below the surface, before bursting open, splitting, and partly falling down outside of the solidified shells, when no longer sufficiently supported and compressed by the

(1) Mr. DARWIN, altho' frequently employing the phrase „recent period," has no where defined its duration, nor beginning nor ending etc. We are therefore reduced to guess, that it may mean, the whole or part of the time elapsed since the creation of ADAM (according to the commonly received chronology).

hydraulic pressure, includes the assumption, and throws into the opposite scale, the heavy improbability that their tops would in general, remain standing at nearly an equal height and that enough for the habitudes of the coral builders, and besides these considerations, we have to conclude, that these volcanic walls even of the dyke form, but certainly those of the circular or nearly so, would long retain heat, thereby enabling the coral-lives to live and work at depths, where the temperature of the water was elsewhere too low for them, par example the crater in the isle of Amsterdam (South Indian ocean) has been open to the sea some two hundred years and yet, the temperature of the water rising through it's walls, is still raised to boiling heat. Whereas on the idea of subsidence the case is utterly dark, no light being shed by it on the *modus operandi*, whereby the upper platforms of these isles were by the coral builders first raised above the sea level, and afterwards retained at that elevation, *whilst* the foundations were undergoing the process of subsidence, with reference to the oceanic « extents of more than a thousand miles by several hundreds, « scattered over with islands, none of which rise to a greater height « than that to which the sea can throw fragments, or the wind « heap up sand.” We shall defer the notice, till we come to the more special statement of the situation etc. which we see looming a head.

IX » Having endeavoured on general grounds, to shew that the belief « of a general subsidence is almost necessary, to account for the exist- « tence of a vast number of reefs on one level, we will now see how far « the same idea will apply to the peculiar configuration in the several « classes. Let us imagine an island, merely fringed by reefs, extending « to a short distance from the shore, in which case, as we have remarked, « there is no difficulty in understanding their structure. Now let this is- « land subside by a series of movements of extreme slowness, the coral « at each interval growing up to the surface (level of low water spring « tides), a little reflection will shew, that a reef encircling the shore at a « greater or less distance, according to the amount of subsidence, would « be produced. If we suppose the sinking to continue, the encircled is- « land must by the submergence of the central land, but upward growth « of the ring of coral, be converted into a lagoon island.”

Instead of the words "almost necessary" Mr. DARWIN doubtless intended, that we should understand and adopt the meaning of "absolutely necessary", but from what has already been, and yet remains to be said on this point, we shall not be disposed to adopt his necessity, not even so much as "almost." Having already told us very truly, that all his classes of reefs agree in structure, even in the most minute details, it seems to follow that there is no more difficulty to be encountered for understanding that of any one, than that of any other. By supposing the sinking of the central land and the upward growth of the coral ring to continue, until the former had disappeared below the surface of the sea, and the other reached to the level of low water tides, we should indeed have a lagoon reef produced, but certainly no lagoon islands.

X. » It will at once be evident, that a coral reef closely skirting the » shore of a continent, would in like manner, after each subsidence, rise » to the surface. In the intervening space, the water always encroaching » upon the land, would not a barrier reef necessarily be produced, simi- » lar to the one extending parallel to the coast of Australia? It is indeed » but uncoiling one of those reefs, which encircle at a distance so many » islands."

Would not a submarine prolongation of the most coast wise ridge of Australia, or of New Caledonia, or its parallel submarine ridges, be equally effective as the basements of those coral reefs? Altho' coils are in most instances circles, yet circles are not coils; but be that as it may, if the mere straightening of a circular line, as we suspect it, is all the specific difference between one class and another, then we can see no necessity for getting up a difference of classes. But the why it is, or has been, that those barrier builders have not, as have their brethren at the encircled island, formed or finished with islands, Mr. DARWIN has not enabled us to understand.

IX. » Thus the three great classes of reef, lagoon, encircling and barrier » are connected together by one theory. (1)

(1) The remainder of this paragraph need not be quoted, because we see no need for making the remarks which it is brought to answer.
(J. C. R.)

We have seen, that there is no ground in fact, altho' some such may to Mr. DARWIN's fancy have appeared needful, for making more than one class of reefs, and therefore no difficulty in connecting them on any theory, as well, as on the facts of any special instance.

XII. »I should perhaps have entered before into the consideration of »one apparent difficulty in the origin of lagoon islands. It may be said »that, granting the theory of subsidence, a mere circular disc of coral »would be formed and a cup shaped mass. To this the reply is, that »in the first place, even in reefs closely fringing the land, the corals do »not grow on the shore itself, but leave a shallow channel, secondly, the »strong and vigorous species, which alone build a solid reef, are never »found within the lagoon, they only flourish amidst the foam of the never »tiring breakers. Nevertheless the more delicate corals tho' checked by »several causes, such as strong tides and deposits of sand, do constantly »tend to fill up the lagoon, but the process must become slower and slower, as the water in the shallow expanse is rendered subject to accidental impurities. An curious instance of this happened at Keeling (the Cocos) »Island, where a heavy tropical storm of rain killed nearly all the fish (1) »When the coral at last has filled up the lagoon to the height of lowest »water at spring tides, which is the extreme limit possible, how afterwards »is the work to be completed? There is no high land whence sediment can »be poured down and the dark blue colour of the ocean bespeaks its »purity. The wind carrying calcareous dust from the outer coast is the »only agent, which can finally convert the lagoon island into solid land, and »how slow must that process be!"

Mr. DARWIN's explanation of the apparent difficulty is, like the difficulty itself apparent, but nothing more. That which not only "may" but must "be said" is what has been said already. How does the reef, whether disc, or cup, or saucer shaped, obtain an island to be laid on it's top, and there kept above the level of the sea, whilst the foundation of the reef, is undergoing the process of subsidence? but no reply to this question has Mr. DARWIN found convenient to furnish. His

(1) Not nearly all, but perhaps, nearly one in a hundred thousand. To have »killed nearly all" would have required such »a storm of rain" as has not, so far as we know, fallen from the sky, since the one that launched NOAH's ark. (J. C. R.).

»secondly” is simply an assertion made at hap hazard. The combination of all the species of coral builders, is required for the building of a reef, in situations exposed to the breakers of the ocean. The smaller, or more delicate filling in the chinks and crevices and so cementing the work as it is carried up. But, that strong tides check the growth of coral, whilst strong breakers cause it to flourish (in so far as many years observation at the Cocos have enabled us to form an opinion), that is to the effect of concluding that the said check exists nowhere outside of Mr. DARWIN’S imaginative faculty. Now the lagoon may be or has to be filled up, provided the bottom did not, or does not continue it’s downward motion. No miraculous information is required, but if the bottom continues to have that motion, then something of that nature to be given and received becomes very desirable. Meanwhile even if the bottom should stop in it’s descent, Mr. DARWIN certainly sets Eolus to perform an extremely long winded task, in setting him to fill up the lagoon with solid land, by bringing calcareous dust from the outer coast, through a dense and lofty forest of perennial vegetation. But be all this as it may, we must not forget that he unhesitatingly assures us of the fact, which we do most readily admit as being a fact, viz. that “the level of lowest low water of spring tides is the extreme limit upwards to which the coral builders can carry on their works.”

XIII. »Subsidence of the land must always be most difficult to detect, »excepting in countries long civilized, for the movement itself tends to »conceal all evidence of it. Nevertheless at Keeling island (the Cocos) »tolerably conclusive evidence of such movement could be observed. On »every side of the lagoon, in which the water is as tranquil as in the »most sheltered lake, old coconut trees were undermined and falling. »Captain FITZROY likewise pointed out to me on the beach the foundation »posts of a storehouse, which the inhabitants said had stood seven years »before just above high water mark, but was now daily washed by the tide. »Upon asking the people whether they ever experienced earthquakes, »they said that lately the island had been shaken by a very bad one, »and that they remembered two others during the last ten years. I no »longer doubted concerning the cause, which made the trees fall, and »the storehouse to be washed by the daily tide.”

Is it possible that a professing geologist, is ignorant of the important differences in circumstances and resulting inferences, between the causes of undermining and overflowing! In the former the certain inference is that the level of the land so undermined is higher, higher perhaps by thousands of feet, than that of the sea, whilst an overflowing action or process denotes, that the level of the sea is, at the time of producing that effect, higher than that of the land. That Mr. DARWIN had seen the key to the phenomenon of "old cocoa-nut trees being undermined and falling" but, was unable to recognise it, appears from his having observed as follows. "It seems from some old charts (1) that the long island to windward (the S. Eⁿ. isle) was formerly separated by wide channels into several islets, and this fact is likewise indicated by the less age of the trees in certain positions" (2) page 548. We have said that this observation is a key to the undermining process, along the lagoon shores. Thus whilst these

(1) Had Mr. DARWIN examined those upfilled channels with sufficient attention, he would have concluded, that they were filled long before Europeans passed eastward by Cape of Good Hope, and seeing that these places are almost exclusively occupied with the low crooked growing „species of teak" (Pitch teak) and the few coconut trees interspersed not rising to half the height of those on the original islets, that the vessel on board which the chart was drawn passed the islets at such a distance, that these low trees were not visible, and consequently the spaces were presumed to be openings between the islets. MR. DARWIN probably received directly, or through captain FITZROY his knowledge of the chart in question from Mr. LEISK, who had seen in my hand, whilst talking upon the subject with Mr. J. B. GRAY a copy, which I had made from the original. That original had no date, but indications are observable of the time being early in the last century. Indeed even in the present time, a vessel passing at not less than ten miles distance, would observe only the original islets and as such separated from each other. (J. C. R.).

(2) Not „less age," but stunted growth; there as elsewhere a proportion is dying of old age. These channels being generally filled up with coarse debris, the coconut tree (which requires to have fine sand about it's roots) does not therein grow at all vigorously, nor produce more than a very few very small nuts in the course of the year.

channels remained open, the debris of coral was laid down in a point form along each side from their inner ends; when finally filled up, that process having begun between these points as being farthest from the breakers, formed each pair into one, that extended inwards to some distance in the lagoon, but after the channel had thus been obliterated, the waves of the lagoon acting upon these points, have gradually undermined them and transported the materials to right and left along the shore on both sides. The whole of the process is indeed still to be seen in the channels between some of the other islets, some still open, some almost closed, and others just completed, of which the closed points are in course of being "undermined" &c. We think it probable, that lakes are to be found somewhere on the earth, somewhat more sheltered than is the Cocos lagoon, of nine miles in length by seven in width, having two direct navigable communications with the ocean, through which its swell partially enters into the lagoon, at times when fresh gales take place in that direction, and the shelter from winds being no more, than is thus described by Mr. DARWIN himself: "This
"expanse, (of the lagoon) is on all sides divided either from the
"dark heaving waters of the ocean by a line of snow white
"breakers, or, from the blue vault of heaven, by the strips of
"land crowned at an equal (*unequal* as see above) height, by
"the tops of the coconut trees."

After telling us, that Western South-America is still rising under our eyes, and that it is more subject to earthquakes, than any other region of the earth, he leaves us at a non plus for the reasons on which he concluded, that earthquakes at the Cocos are indicative of their undergoing the process of subsidence. We might indeed, after being informed by Captain FITZROY, of his having discovered an astonishing peculiarity in the tidal movements of this ocean, viz, that it, "has high water on all sides at once, "whilst it is low water in the central parts at the same time", we should I say, have been liable to surmise that the peculiar effect of the earthquakes on the islands situated in it, was an-

other of its peculiarities, and somehow connected with the former, but, seeing that Mr. DARWIN assures us, that the earthquakes at Vanikoro Island in the Pacific, have the same effect, we are left to imagine, that the phenomenon can only be accounted for on the principle, that is said to have been memoranded by a certain physician, to wit, "eating a red herring is a cure for a sick Englishman, but death for a sick Frenchman."

XIV. »At Vanikoro, the encircled island already mentioned, I gathered »from captain DILLON's account, that the alluvial land at the foot of the »mountain was very small in quantity, the channel extremely deep and »the islets on the reef itself, which result from the gradual accumulation »of fragments, singularly few in number, all of which together with the »wallike structure of the reef, both inside as well as outside, indicated »to my mind, that without doubt the movements of subsidence had lately »been rapid; at the end of the chapter it is stated, that this island is »shaken by earthquakes of extreme violence."

Captain DILLON did not profess to minutely describe the island geologically, but merely as a sailor, taking a brief view of its most obvious features. But the adage, various men various minds, is well exemplified in the present instance, by the fact, that the phenomena which, to Mr. DARWIN's mind, indicated without doubt, that the movements of subsidence had lately been rapid, indicated to mine, almost, tho' not quite so certainly, that the island plug is of comparatively recent uprising from it's crater-cradle and is still progressing upwards.

XV. »I may here mention a circumstance which, to my mind, had »the same weight as positive evidence, tho' bearing on another part of »the question. Mr. QUOY, when discussing in general terms the nature »of coral reefs, gives a description, which is applicable only to those, which »skirting the shore, do not require a foundation at any greater depth, »than that from which the coral-building polijpi can spring. I was at first »astonished at this, as I knew, he had crossed both the Pacific and In- »dian oceans and must, as I thought, have seen the class widely encir- »cling reefs, which indicate a subsiding land. He subsequently mentions »several islands, as instances of his description of the general structure. »By a singular chance, the whole can be shewn by his own words in »different parts of his account to have been recently elevated. There- »fore, that which appeared so adverse to the theory, became as strong »in it's confirmation."

Doubtless I have to blame my own duncishness, not Mr. DARWIN'S logic, for not being able to perceive in the foregoing paragraph any reasonable solution of the question, which that incites me to propound, to wit, how does the elevation of some of the coral reef skirted islands, prove the subsidence of the coral encircled islands? — or, in other words, how does a matter of fact description of the former, become a perfect confirmation of the theory of the subsidence of the latter? as for the structure of these reefs, Mr. DARWIN has himself declared that, "it is the same in all, even to the most minute details."

XVI. »Continental elevations, as observed in South America and other parts, seem to act over wide areas with a uniform force; we may therefore suppose that continental subsidences, act in a nearly similar manner. On this assumption, and taking on the one hand lagoon islands and on the other raised shells and corals, together with mere skirting reefs, as our proof of elevation, we may test the truth of the theory, that their configuration has been determined by the kind of subterranean movement, by observing whether any uniform result can be obtained. I think it can be shown that such is the case in a very remarkable degree, and that certain laws may be inferred from the examination, of far more importance, than the mere explanation of the origin of the circular or other kinds of reef."

That continental elevations, *have* taken place over wide areas, is probable enough, but that such *are* taking place any where in the present era of ages, requires somewhat stronger evidence for the truth of the assertion, than a bit of cotton thread &c. or old coconut trees being *undermined and falling*. On what grounds we are called upon to admit, that skirting reefs are indications of recent elevation, we do not perceive, and therefore may be allowed to hold the opinion, that a skirting reef may be attached, or all but so, to land or an island, which has not been moved so much as a foot upwards, during the last five or six thousand years. As to the important laws, that are to be inferred from the examination, we shall look at them, when they are introduced to our notice.

XVII. »I may here briefly notice the remarkable absence of the reef »building polypi over certain wide areas of the intertropical seas, for »instance the West coasts of America and of Africa, and the islands in »that side of the Atlantic (also the coast of Western Australia, on which »there are comparatively with the Eastern coast of Africa, no coralline »formations of any considerable importance), it would appear the effec- »tive (reef building) species do not occur there, of which circumstance I »apprehend no explanation can be given, any more than why it has been »ordained that certain plants, as heaths, should be absent from the New »World, altho' so common in the old."

Mr. DARWIN will certainly think that we are monstrously presumptuous in attempting, as we are about doing, to give a "probable explanation," after he has apprehended that none can be given; but n'importe, here comes the result of our attempt.

Along and to some considerable extent in longitudinal distance from the western coast of *Intertropical* (1) America, Australia and Africa, currents having a low temperate and consequently no sufficient food for the polypi &c., run from the extratropical seas towards the Equator, thence proceeding and spreading out to the westward. The water driven onwards by the trade winds and warmed by the solar heat is accumulated in the western regions of the oceans, where, fraught with food and material for the use of the coral builders and constructions of their accumulations and thence running off, from the Equator, along the eastern coasts of those continents, these warm waters, enable those coral builders to extend their works proportionably far towards the extropical regions. It may be supposed, that this does not account for the abundance and activity of these workers in the middle regions of the Pacific, but the supposition must be withdrawn, after the fact is known, that the thermo-equatorial westerly winds, which annually extend alternately to the southward and northward as far as the coral formations, bring along with them sufficiently warm water and

(1) By this appellation meaning the range of the trade winds, or from 30° North to 30° South of the Equator.

plenty of materials. Moreover the tidal undulations produce the same effects on those coasts respectively, the warm super-undulation descending on the western sides of the oceans, and the sub-undulations rising cold from the ocean depths on their eastern sides.

XVIII. »The usual direction of the island groups in the central parts
»of the Pacific is N. W. and S. E. This must be noticed, because sub-
»terranean disturbances are known to follow the coast lines of the land.
»Commencing on the shores of America, there are abundant proofs that
»the greater part has been elevated within the recent period, but as co-
»ral reefs do not occur there, it is not immediately connected with our
»present subject. Immediately adjoining that continent there is an extent
»of ocean remarkably free from islands and where of course, there exists
»no possible indication of change of level. We then come to a N. W.
»b. W. line, dividing the open sea from one strewed with lagoon islands
»and including the two beautiful groups of encircled islands, the Society and
»Georgian Archipelagoes, wherein no marks of elevation exist. This great
»band, having a length of more than four thousand miles by six hundred
»broad, must according to our view be an area of subsidence. We will
»at present pass over the space of ocean immediately adjoining it, and
»proceed to the chain of islands including the New Hebrides, Salomon
»and New Ireland; any one who examines the charts of the separate
»islands in the Pacific, will be struck with the absence of all distant or
»encircling reefs round these groups, yet it is known that coral occurs
»abundantly close in shore. Here then, according to the theory, there
»are no proofs of subsidence, and in conformity to this, we find in the
»works of FORSTER, LESSON, LABILLARDIÈRE, QUOY and BENNET, con-
»stant allusion to the masses of elevated coral. These islands form
»therefore a well determined band of elevation; between it and the great
»area of subsidence there is a broad space of sea, which we passed over
»in going from the former to the latter, irregularly scattered with islets
»of all classes, some with proofs of recent elevation and merely fringed
»by reefs, others encircled, and some lagoon islands. One of the latter
»is described by captain COOK as a grand circle of breakers without a
»single spot of land. In this case we may believe that an ordinary lagoon
»island has been recently submerged. On the other hand, there are proofs
»of other lagoon islands having been lifted up, several yards above the
»level of the sea, but which still retain a pool of salt water in their
»centres. These facts show an irregular action in the subterranean for-
»ces, and when we remember that the space lies directly between the
»well marked area of elevation and the enormous one of subsidence, al-
»ternate and irregular movement seems almost probable.”

Mr. DARWIN has no admissible reason for commencing this discussion at the shores of America. The chart of the ocean between those and the eastern shores of Asia, shows, that the commencement of the subterranean, or submarine, or subcrustean action, by which the Indonesian and Polynesian components were produced, commenced not at the former, about four thousand miles distant from the islands of Eastern Polynesia, but at the latter, not so many hundred miles distant, and thence proceeded eastward, gradually diminishing in power after the united action of the two lines, hereafter to be mentioned, had become weakened, until it ceased to eastward of the Marquesas and Low Island (or Dangerous) Archipelago. The absence of islands on the vast expanse of ocean between the west coast of America and Eastern Polynesia shows, that with the exception of the Gallapagos, Juan Fernandez and two or three other small isles, which, lying near to that coast, have doubtless been produced by the subterranean action developed along the western side of that continent, and which was distinct from that, which produced the components of Polynesia as well as of Indonesia; the subterranean action which produced Australia and Tasmania was also distinct from both, altho' probably all were exerted contemporaneously or nearly so. We now proceed to show, that Mr. DARWIN'S assertions and inferences are both alike erroneous and untenable, as also, that the supposition proposed in paragraph III, respecting the origin of encircling reefs, not only affords a more probable account of these, but also of the elevation and composition of the encircled islands, which Mr. DARWIN has not ventured to attempt accounting for, altho' evidently not subsiding ones, as appears from his own description of Otaheite, and *ensuite* we shall suggest a theory, respecting the origin of lagoon islands much more probable than his. But we must deal with his statements *seriatim* before going elsewhere. Firstly. It is not true, that no marks of elevation exist among the islands lying within the vast extent, which he says, must be admitted as being an area of subsidence, as vide the following facts.

„Aurora Island,” (one of the Dangerous Archipelago) has been upheaved at two successive periods, the last, long subsequent to the first, altogether two hundred and fifty feet.

„Margarets Isle,” in the S. W. side of the same Archipelago, has been upheaved endways and bodily, so that it's lagoon is now left dry.

„Walkonsky's Isle,” lying in the midst of this Archipelago has had one end lifted high above the water, whilst the other is still a water washed reef, but the entrance to the lagoon is left dry. Here we have to remark en passant, that Bow Island, one of the *points d'appui* adopted by Mr. DARWIN for the support of his theory, lies S. W. $\frac{3}{4}$ W. at not more than one hundred and fifty miles distance from Walkonsky's and S. W. about two hundred from Margaret's Isle, and besides these are several other lagoon islands, which have been elevated within Mr. DARWIN'S area of subsidence; amongst those, we may mention here:

„Penrhyn's Isle,” lat. $9^{\circ} 1' S.$ long. $157^{\circ} 34' W.$ has been elevated about fifty feet above the sea, yet it's lagoon is still of large dimensions, studded with coral patches and the entrance affording a boat passage, in and out of it.

„Enderby's Isle.” Lat. $3^{\circ} 8' S.$ long. $171^{\circ} 8' W.$ has been recently elevated eighteen feet above the level of it's previous height, and has had it's central lagoon dried up.

„Mc. Kean's Isle.” Lat. $3^{\circ} 35' S.$ Long. $174^{\circ} 17' W.$ has been recently elevated twenty five feet above the level of high water.

Turn we now to the following observations, by captain WILKES of U. S. A. exploring expedition.

„My opportunities for observation of the coral formations
„have been numerous, and I have had every facility for viewing
„to advantage, not only those that exclusively belong to it,
„but also the reefs which surround the high volcanic islands
„and which afford the most safe and convenient harbours of
„the Pacific. The result in my mind is, that the theory of
„DARWIN, which holds that an equal amount of subsidence of
„the land and of upward growth of coral is taking place, is
„alike at variance with the configuration, extent, and general

„ construction of those reefs. In all the islands of coral, that
„ I have examined, there are unequivocal signs of their under-
„ going dissolution by the action of the sea, that is to say,
„ they have formerly been elevated above the reach of the surf,
„ and have, after the upper platforms of that elevation had
„ been undermined and broken down by the action of the waves,
„ been again elevated, and the then uppermost platforms, again
„ undermined, more or less, by the same action of the surf.
„ I have observed coral blocks standing on their smallest ends
„ on the tops of reefs and low isles. To account for this po-
„ sition of these blocks, it has been assumed that they have
„ been thrown up by the surf, but their position, height, and
„ situation, are such, as to utterly contradict that idea, and
„ show that they have certainly formed parts of an upper shelf,
„ or platform, of which they are now the only remains. It
„ would be utterly impossible for any waves, rising from the
„ present level of the sea, to toss such great blocks to any dis-
„ tance at the height whereat they are now standing, but even
„ if that supposition were admissible, they could not possibly
„ have been placed, and then left by the sea, standing as they
„ are, on their smaller ends, on the highest points of the reefs
„ and isles.”

After thus stating the facts, with respect to those isles, and which are also observable on the coral isles and reefs of this (the Indian) ocean, and the Indonesian seas, captain WILKES goes on to say that, „ as all the coral isles lie on areas sub-
„ jected to the effects of volcanic action, we have no reason
„ to doubt that they would be as liable to be upheaved and de-
„ pressed by it, as those of unquestionably igneous origin. The-
„ refore with so great and powerful an agent at hand, it seems
„ to me that there is no necessity for resorting to a theory such
„ as that of Mr. DARWIN’S, inadequate of itself, and at variance
„ with the facts observed.” On this opinion I have however to remark that, whilst we know that some isles and reefs have undoubtedly been upheaved, we have no authentic instances of any having been depressed, and so Mr. DARWIN’S theory is, as

we have already indicated, utterly inadequate to account for even so much as the existence of a small lagoon isle, whose surface is covered with forest vegetation, and standing above the level of the utmost range of the surf upon it's shores. Yet the fact of a vast number of such islands existing not only in the Pacific, but also in the Indian Ocean and adjacent intertropical seas, at or nearly at one and the same height, does demand a theory for it's explanation, because the irregularity of subcrustian volcanic action, evidently unfits it for being admitted as having been the general cause of so much uniformity of effect, and this, leads us to state, what we believe to be, at once a true and an adequate cause, or theory, namely that the level of the general ocean has suddenly subsided, in consequence of the subsidence of one, or more, or all, of it's beds towards the centre of the globe, so leaving all the previously waterwashed lagoon and other reefs standing thenceforth as islands elevated above it's new level, and the probability is as we shall have occasion to observe, that such general subsidence of the ocean level has taken place oftener than once or twice. In the course of our subsequent remarks we shall have occasion to state this opinion more in detail, and solve the apparent difficulties, which may be alleged to stand in the way of it's adoption. We now go on to agree with Mr. DARWIN, that the range which includes the New Hebrides, Solomon's Archipelago, New Ireland &c. is indeed a well marked band of elevation, but differ in toto from his assumption, that it furnishes evidence bearing at all favourably on his theory. Our reasons shall be submitted presently. We do not see any grounds assigned for calling upon us to believe that the lagoon reef, seen and described by captain COOK, had ever been any other than a lagoon reef, and therefore may believe that no island had ever existed and been submerged in it. The last sentence of this paragraph we need not stop to notice, after what we have already adduced against the assumptions which it includes, being admitted as truths.

XIX. »To the westward of the New Hebrides line of elevation we
»have New Caledonia and the space included between it and the Austra-
»lian barrier, which FLINDERS, on account of the number of reefs, propo-
»sed to call the Corallian sea. It is bounded on two sides by the grandest
»and most extraordinary reefs in the world, and is likewise terminated
»to the northward by the coast of Louisiade, most dangerous on account
»of it's distant reefs. This then according to our theory is an area of
»subsidence I may here remark that as the Barrier is supposed to be
»produced by the subsidence of the coast of the main land, it may be ex-
»pected that any of the outlying islands would have formed lagoon islands.
»Now BLIGH and others distinctly state, that some of the islands there are
»precisely similar to the well known lagoon islands in the Pacific. There
»are also encircled islands, so that the three classes supposed to be pro-
»duced by the same movement are there found in juxtaposition, as like-
»wise happens, but in a less evident manner at New Caledonia and in
»the Society Archipelago.”

Before we have done we shall submit reasons for belie-
ving that this area is not one of subsidence, but only of in-
ferior elevation. Regarding the lagoon islands, even if their
numbers were much greater than they are, we have already
indicated, that we are not reduced by their existence, to discuss
Mr. DARWIN'S theory any farther, at least until he shows how
he has managed to make them, out of lagoon reefs, and we
know that whatever movements N. Eastern Australia and the
foundations of the Barrier may have made, previously to the
time of Captain Cook, not only is there not a particle of evidence
to, shew that these have since subsided, but rather the reverse
some parts which were then altogether wavewashed reefs being
now partially clothed with vegetation, par exemple “the Eas-
tern fields;” and knowing as we do, that none of the numerous
isles or islets, situated in the vicinity of the New Caledonian
reef, lies outside of it, but all, or nearly all, not on it's top,
but inside, between it and the coast, some at miles of distance
from the former, his assertion respecting the origin of those
isles therefore falls into the water of Lethe, leaving us to
adopt the probability that they are based on original eminences

(1) Suery for Mr. DARWIN. Is not Vanikoro one of the New Hebrides range?

in the submarine valley, that runs or lies between the coast and the submarine ridge, on which that Barrierreef has been built up. In truth the existence of those isles, in that situation, puts Mr. DARWIN'S theory at once hors de combat, as far as New Caledonia is concerned.

XX. » The New Hebrides line of islands may be observed to bend abruptly at New Britain, thence to run nearly east and west, and lastly » to resume it's former N. W. direction in Sumatra and the peninsula of » Malacca. The figure may be compared to the letter S. laid obliquely, » but the line is often double. We have shewn that the southern part, » as far north as New Ireland, abounds with proofs of elevation; so is it » with the rest. Since the time of BOUGAINVILLE, every voyager adduced » some fresh instance of such changes throughout a great part of the East » Indian (Indonesian) Archipelago, I may specify New Guinea, Waigio, » Ceram, Timor, Java and Sumatra. Coral reefs are abundant in the » greater part of these seas, but they merely skirt the shores. In the same » manner as we have followed the curved line of elevation, so may we, » that of subsidence. At Keeling Island (the Cocos) I have already mentioned, that there exist proofs of the latter movement, and it is a very interesting circumstance, that during the last earthquake by which that » island was effected, Sumatra, tho' distant nearly 600 miles, was violently shaken. Bearing in mind, that there are proofs of recent elevation » on the coast of the latter, one is strongly tempted to believe, that as one » end of the lever goes up, the other goes down and carries with it Keeling » Island (the Cocos), which would have been submerged long ago, in the » depths of the ocean, had it not been for the wonderful labours of the » reef building polypi."

Mr. DARWIN should be very careful of the books and charts, on whose authority he sets forth these assertions, for assuredly those documents are unique, or at least, have been engraved and printed solely for geologists of his class and calibre; therefore, if lost, will most likely be lost to the world. For our parts we are quite innocent of having ever hitherto received the knowledge of their existence, and even, if they were accessible to us, we should prefer trusting rather to the ones in common use by common navigators on this hemisphere. On these, we see, that the New Britains lying east and west, form a convexity to southward, having their eastern part trending northward into parallelism with New Ireland, and their

western to N. W. in parallelism with the adjacent side of New Guinea; that great and in many parts, lofty mountainous island, trending N. W^d. shews that the line of elevation pursues that direction by Gilolo and the N. Eastern Peninsula of Celebes, directly towards the large and lofty island of Mindanao, the most southern of the Philippines. Howbeit, directly on the middle line of Mr. DARWIN'S area of elevation, we find to westward of New Guinea, the low Aru Islands of coralline formation, extending about an hundred miles, north and south, or directly across the back bone of his said elevation, all only a few feet above the level of the sea and with swamps, alias filled up lagoons, on their interior surfaces. Mr. DARWIN seems to have made his move from the Australian Barrier reefs to the Cocos, at such a height in the atmosphere, that he did not recognize the N. Wⁿ. side of Australia, nor a certain island (of evidently volcanic formation) considerably elevated, with a high cliff shore, and that fringed by a coral reef, lying to eastward of the Cocos, of course, on his grand area of subsidence. Doubtless it is not laid down on his charts nor mentioned in those books to which he refers, but if he will enquire of it, at any master mariner, sailing on this ocean, under the name of Christmas, or Moni Island, they will inform him, both of it's existence, and of it's whereabouts. Returning to *our* charts of the area included between New Guinea on the eastward and N. Eastern Sumatra on the west, the southern chain of Indonesia, on the south side, viz, from Wetter Island in the east, to Sumatra on the west, and on the other, the southern coasts of Booro, Booton, Celebes and Borneo, it will not be quite safe for Mr. DARWIN or any body else, to direct a ship to traverse over it in the night time, without keeping a pretty sharp lookout ahead and on the lee bow, for low isles and reefs &c. Malgré his information, that there are no low coral isles, or reefs in existence within the said area, other than such as "merely skirt the shores," we need not stop to point out the individual spots, which in our own case we should be careful to avoid running, or attempting to run over, even in the day time, but there is

one, which has a special claim upon our attention, and, as we imagine, on Mr. DARWIN's also. It is named, "the Brill", lies about fifty miles distant W. S. W. from the nearest point of Celebes, and is thus described by HORSBURGH, in his East India Navigation directory. "The Brill is about four miles "in extent each way. It is very dangerous, being steep to (on "the outside); with a fresh breeze and any considerable swell, "there is a continued chain of breakers round the verge of the "shoal, but, within the breakers, the water is smooth and of "a light green colour." Now to our mind (not to mention our eyes, which have viewed it, all round), this appears to be, "a circle of breakers without a single spot of land," which therefore whether "grand" or mediocre, may be fairly classed with the one mentioned by Mr. DARWIN, as discovered by captain Cook in the South Pacific, and which the former has told us that, "we may believe to have been a lagoon island recently submerged". Will he also tell us, why we may not imagine this also to be a lagoon island recently submerged? and if he cannot, how he will reconcile it's existence and description with his assertion that the East Indian (Indonesian) Archipelago is rising, whilst this is standing still, a lagoon reef, about the central line of that (his) area of elevation? We have farther to ask him, if, under the denomination of "coral reefs which merely skirt the shores," we are to include the coral isles, which just barely elevated above the sea level, are in the offing from the anchorages in the great bay of Rembang (N. Coast of Java) and the chain of ditto, which commencing in Edam to N. E. of Batavia Roads (1) lies along the coast of Java to near the Sunda Straits, leaving the proper navigable passage for ships to and from Batavia, between them and that coast, whilst, close to the middle length of the chain, are in their offing, the southernmost isles of the grand group called, "the Thousand Isles," and thence extending far out towards the N. E. of Su-

(1) Edam has a lagoon on it's centre, now nearly filled up by the remains of the leaves of the surrounding trees blown into it.

matra, all of coral formation, none higher, nor even so high as the Cocos above the sea, but some so low, as to be partially overflowed by the high water tides? Again we have to ask, if the numerous low coral isles and reefs (of the former none higher than the Cocos) which are along the S. W. coast of Sumatra on it's submarine extension or "bank of soundings," all so far from the shore as to leave navigable passages between, and many from five or six to twenty miles distant in the offing, are to be classed as being reefs, which merely skirt the shore? Of these, all the way from Indrapour, south of Padang to near Acheen Head, some are always in sight, far and near from ships sailing between them and the coast, and besides these (which may be considered as being a continued chain of coral low isles and reefs washed by the break), there are, first, Little Fortune Island, lying six miles distant from the main of the S. Eⁿ. Point of Sumatra, the intervening space being safely navigable by ships of any size, however large; next, Rat Island and lagoon reef, six miles distant from the main; and thirdly, Trieste, at about fifty miles, standing on the verge of the bank of soundings in between 60 and 70 fathoms depth of water. To this isle Mr. DARWIN's special attention is requested, not without reason as he will see by the following matter of fact description. It is a small low isle (with a pool of brackish water on it's central part), standing in the N. Eⁿ. part of a large elliptically formed lagoon, which is surrounded by the remains of a coral wall, standing now as a line of small peaks, the highest just above the sea level, and having on some of their tops small bushes of the dwarf mangrove tree, which grows in salt or brackish water. The interior of the lagoon has a white sand bottom, with about four fathoms depth of water on it's central part, and thence gradually shoaling towards the sides, the lagoon having been more and more filled up towards the wall by it's debris being carried onwards with the surge of the breakers. Now, seeing that all these coral composed isles and reefs of breakers, stand as aforesaid on the submarine extension of the S. W. Coast of Su-

matra, it is clear that if that coast has been elevated within the recent period, as Mr. DARWIN affirms, this must also have been the case with all these isles and reefs, and of course also with the Cocos, which, as aforesaid, is not only as high as any, but higher than many of them; what consequently becomes of his "Six hundred miles long lever?" Oh, but proofs are proofs, and therefore whatever may have happened to the lever, Mr. DARWIN may still continue to affirm that on the Cocos proofs exist that they are undergoing a progress of subsidence into the depths of the ocean, "their upper platforms with the isles lying thereon being meanwhile permanently borne up some feet above the sea level by the wonderful labours of the reef building polypi". Wonderful labours indeed! Mr. DARWIN may fairly demand, that they be placed in "the third (the highest) tier of wonders above wonders."

XXI. »As I have remarked, the islands in this great Archipelago are »only skirted with reefs, and it appears from the statements of those who »have visited them, as well as from an examination of the charts, that »lagoon islands are not found there. This in itself is remarkable, but it »becomes far more so, when it is known that they are likewise absent in the »West Indian Sea, where coral is most abundant, and every one is aware »of the numerous proofs of recent elevation in most parts of that archi- »pelago; again it is reported that lagoon islands do not occur in the Red »Sea, and proofs are given of recent elevation on a large part of the sho- »res of that sea. Excepting on the theory of the form of reefs being deter- »mined by the kind of movement to which they have been subjected, it is »a most anomalous circumstance and which has never been attempted to »be solved, that the lagoon structure being universal and considered as cha- »racteristic in certain parts of the ocean, should be entirely absent in others »of equal extent."

We shall see before we have done, that reasons are to be found, for not expecting to find lagoon islands on the central line of direction of the highly elevated islands, nor on the central portion of elevated groups. Howbeit, if Mr. DARWIN or any one for him, has found a proper lagoon island, existing within the range of hurricanes, or of heavy monsoonstorms, then, and then only, we shall have to agree with him, that their absence in the West Indian and other areas of the inter-tropical seas, constitutes an anomaly, of which however it may

be perhaps possible enough to find a better solution than that brought forward by him. Their absence in the Red Sea, may be passed over for the present, with remarking, that if Mr, DARWIN chooses, he may go into, or upon it's area, and find single, double and treble lines of barrier reefs of coral formation, running to great distances in parallelism with the coast and having gateways here and there, through which vessels pass in or out, the outer barrier being in some places twelve to fourteen miles distant from the general outline of the nearest coast, in short, altogether entitled to take place with their more lengthy brethren in the offing of N. En. Australia and west side of New Caledonia, and if he goes to the position of 18° N. lat. and $50^{\circ} 50'$ E. long, he will (unless it has very lately disappeared), see, "a ring of coral, about two miles across, "with breakers all round the outer edge, and apparently deep "water inside," in short the very, and the only sort of thing, which in so far, as we can see, or he has shewn, might or could result from the disappearance by gradual subsidence, of one of his descending isles, a lagoon reef, to wit.

XXII. »To proceed with our examination, to the westward of the line »of subsidence, of which Keeling Island (Cocos) is the index, we have an »area of elevation. For, on the northern end of Ceylon and on the eas- »tern shores of India, elevated shells and corals, such as now occur in »the neighbouring seas, have been observed; again, in the middle of the »Indian Ocean, the Laccadive, Maldive and Chagosline of atolls, or lagoons, »show a line of subsidence. The best characterized of these, namely the »Maldive Islands extend in length four hundred and eighty miles, »with an average breadth of sixty. These atolls agree in most respects »with the lagoons of the Pacific. They differ however in several of them »being crowded together, such little groups being separated from other »groups by profoundly deep channels. Now if we look in a chart at the »prolongation of the reef towards the northern end of New Caledonia, »and then complete the work of subsidence, so as to continue producing »the same results, we should have the original reef broken up into many »patches, each of which, from the vigorous growth of coral on the out- »side, would have a constant tendency to assume a rounded form. Every »accidental break in the continuity of the first line would determine a fresh »circle. In the case there fore of the Low or Dangerous Archipelago, in »the Pacific, I believe that the lagoon islands, were moulded round the

»flanks of so many distinct islands, but, in the Maldivas, that one single
»mountainous island, bordered by reefs, and very nearly of the same ac-
»tual figure and dimensions with New Caledonia, formerly occupied that
»part of the ocean.”

The Cocos begs leave from Mr. DARWIN to send him word that she cannot in fairness accept for herself alone an honour, to which her thousand compeers in the Java Sea, and hundreds standing on the submarine extension of the S. W. Sumatran coast, are equally, and some even considerably better entitled, and besides that, Mr. DARWIN should bethink himself, that a single name can scarcely deserve to be denominated an „Index.” Had he brought in N. Wⁿ. Australia, and Christmas Island, she might have hesitated, or, been guided by the decision proved by them, but in their absence, can do no more, than with due respect for the profferer, decline the proffered distinction. As for Ceylon and S. Eⁿ. India, we defer for the present taking them into consideration, and proceed to the Laccadives in the middle of the Indian Ocean, but only at between twentyfive and forty leagues distant from the supermarine coast of Malabar, and on a line of parallelism thereto, and that, altho' the time has very probably been, when they were lagoon reefs or isles (N. B. Mr. DARWIN is the first, to give them the name of „atolls,” which hitherto has been confined to the Maldivian range), they (the Laccadives) have long ceased to be so, and the present isles are laid down on the leeward (the N. Eⁿ.) sides of their respective basement reefs; the cause, for their being so situated, we have already indicated, in reference to the West Indian and some other areas of the inter-tropical oceans, and on the same ground, with the Laccadives, he may class the Cargados Garajos Isles and banks. As for the Maldivian range of lagoons with rings of isles placed around their circumference, these, lying on the same line as the Laccadives, or more exactly on the western side of the submarine prolongation of India, and that line being seen to be bending round in the Chagos, spreading out in the Seychelles, and going on towards Madagascar, affords an indication of their

origin, to be hereafter more fully noticed. We cannot however agree with Mr. DARWIN, in taking an average breadth of the range, nor in crowding several of them together, because we know, that they are on two parallel lines, the eastern having many more, and therefore being much longer than the western, and, there being no more than nineteen altogether, if several of them were crowded together, they could scarcely extend over a length of four hundred and eighty miles, without leaving much wider spaces intervening, than any that are actually to be found.

The northward prolongation of the New Caledonian reefs, are not "*towards*," but *onwards*, from the northern end of that island, at which end, the central ridge is separated into two, having a valley intervening between. On the submarine (1) prolongations of these two ridges and valley, and on eminences in the latter, those northern prolongations of reefs and isles are in all probability based. We see no reason for assuming, that the gradual subsidence of such an island as New Caledonia could produce a range of lagoons, at all similar to that of the Maldives, but we do see, the following reasons why it could not. As soon as the bottoms of the lowest places of the coast sunk below the level of low water spring tides, the coral builders would commence their work, and elevate these (according to Mr. DARWIN'S own assumptions) *pari passu*, with the subsidence of the higher, and higher lands, so finally completing an unbroken line, or lines of reef, from the one end to the other of the submerged island. For any "*accidental breaks*," in the continuity of the reef," so formed, we cannot perceive any reasonably assignable cause, always excepting Mr. DARWIN'S earthquakes, of the Cocos and Vanikoro species, nor even scarcely those, for the production of such unfathomably deep and wide channels, as those between the Maldivian atolls. Farther, the assumption of a rent, or separation in such

(1) I prefer the term "*submarine*" to submerged, because the latter involves the assumption of the land having previously stood above the sea, an assumption not to be made or granted, without proofs, being adducible.

a reef, becoming wider and wider, we cannot admit, because we know that the coral grows, not less, but more vigorously on the sides of gateways than on the outer sides of the reefs, so tending to fill up even original gaps, instead of leaving rents to widen &c. On the whole view of the case, we are therefore led to the conclusion, that Mr. DARWIN has neither shewn, nor can shew on his theory, any admissible grounds for his belief, that any one great island, whether similar, or dissimilar in figure and dimensions to New Caledonia, ever did occupy this part of the ocean, at least, in what *we* call "the recent period," that to wit, which has elapsed since the era wherein the last, grand and general crash of the crust of the globe occurred, which took place, subsequent to the deposition of the coral measures and the other contemporaneously formed strata.

XXIII. »Lastly, to the extreme westward, the coast of Africa is closely »skirted by coral reefs, and according to facts stated in captain OWEN'S »voyage, has probably been uplifted, within a recent period. The same »remark applies to the northern part of Madagascar and, judging from »the reefs likewise at the Seychelles, situated on the submarine prolonga- »tion of that great island. Between these two, N. N. E. and S. S. W. »lines of elevation, some lagoon and widely encircled islands, indicate a »band of subsidence."

We must note, that the uplifting of Eastern Africa, and also some of the other upliftings, must be surveyed more fully, and we must observe that, when Mr. DARWIN'S theory seems to need the admission of submarine prolongations, he adopts them most manfully, and on this occasion, he having brought the one from Madagascar into the Seychelles, we shall not have to bring that of India much farther, to reach the Chagos. But the only lagoon islands (Juan de Nova and Cosmoledo) which exist to the northward of Madagascar, do evidently repose, not in his band of subsidence between Eastern Africa &c. but, on this, his prolongation of the line of elevation. Of elevated islands lying on said band of subsidence, we know of none, besides the Comoros, which altho' they have on parts o

their shores fringing reefs and these in some places projecting considerably far out, have none of them "widely encircling reefs" of coral, or any other formation, consequently, do not, like the proper encircled islands, afford secure and convenient anchorages.

XXIV. » When we consider the absence of widely encircling reefs and » lagoon islands in the several archipelagoes and wide areas, where there » are proofs of elevations, and on the other hand, the converse case of » the absence of such proof, where reefs of these classes do occur together » with the juxtaposition of the different kinds produced by movements of » the same order, and the symmetry of the whole, I think it will be diffi- » cult (even independently of the explanation it offers, of the peculiar » configuration of each class, to deny a great degree of probability to this » theory. Its importance, if true, is evident, because we get at one glance, » an insight into the system by which the surface of the land has been » broken up, in a manner somewhat similar, but certainly far less perfect, » to what a geologist would have done, who had lived his ten thousand » years, and kept a record of the passing changes. We see the law almost » established, that linear areas of great extent, undergo movements of an » astonishing uniformity and, that the bands of elevation and subsidence » alternate. Such phenomena, at once impress the mind with the idea of » a fluid gradually propelled onwards, from beneath one part of the solid » crust to another."

We have shown that lagoon isles and reefs are present in situations, where Mr. DARWIN affirms that they are absent, and we know so much of some of those areas, to which he refers, as to induce the expectation, that if all were completely explored (which most of them have not yet been), islands widely encircled by coral reefs, would be met with, but, their absence furnishes no proof that this theory of his concoction is founded on truth, whilst it is fatally deficient, in not accounting for the construction of any of the lagoon islands, such as the Cocos for instance, which he insist upon making a keystone to his theory, an "index" &c.

We therefore are, perforce of reason, compelled to deny, that it affords any recognizable consonance to truth, and we farther opine, that, the laws of which he speaks, as having almost established, never will be so, whilst the life of the

human species endures. The idea of "a fluid most gradually (regularly and continuously) propelled onwards, from beneath one part of the solid crust to another", but especially, as moving in vast undulations of elevation and depression, the latter undisturbed by earthquakes and upheavals of low islands (1), amounting to thousands of feet, has not yet been proved to be the right one.

XXV. »I cannot at present, do more than allude to some of the results, »which may be deduced from these views. If we examine the points of »eruption over the Pacific, and Indian Oceans, we shall find that all the »active *Volcanoes* occur within *the areas of elevation*. (The Asiatic land »must be excepted, inasmuch, as we are entirely in want of information »of all kinds respecting it). On the other hand in the great spaces sup- »posed to be now subsiding, between the Radack and Dangerous Archi- »pelagoes, in the Corrallian Sea, and among the atolls which front the »West Coast of India not one occurs. If we look at the changes of level, »as a consequence of the propulsion of fluid matter beneath the crust, as »before suggested, then, the area to which the force is directed, might »be expected to yield more readily, than that, whence it was gradually »retiring. I am the more convinced that the above law is true, because, »if we look to other parts of the world, proofs of recent elevation almost »invariably occur, where there are active vents; I may instance the West »Indies, the Cape de Verds, Canary Islands, Southern Italy, Sicily and »other places. But, in answer to this, those geologists who, judging from »the isolated volcanic mounds of Europe, were inclined to believe that »the level of the ground was continually oscillating up and down, might »maintain that on these same wide areas, the amount of subsidence had »been equal to that of elevation, but, that we possessed no means of know- »ing it. I conceive it is by eliminating this source of doubt, that the »alternate bands of opposite movement, deduced from the configuration »of the reefs, directly bear on this law. I need not do more than simply »state, that we thus obtain (if the view is correct) a means of forming »some judgment of the prevailing movements, during the formation of »even the oldest series, where volcanic rocks occur interstratified with se- »dimentary deposits."

Of course, allusion was all that could be made in this abstract or resumé of the contents of so many chapters, of the then forthcoming volume (made up on this department

(1) Vide the earthquakes occurring under the Cocos, and the upheavals of many low islands, as already mentioned.

of the author's discoveries) without damaging it's importance and therefore it's sale. But fortunately, this contains enough of specimens, for enabling us to pass judgment on the whole. We should (as aforesaid) expect to find active volcanoes only in elevated positions, whether continental or insular, i. e. on the central line of direction, in which the volcanic upheaving force was proceeding. If Mr. DARWIN had brought forward, so much of the information which he surely possesses, as should have defined in latitude and longitude the whereabouts of his "Asiatic band" perhaps some items at least, of the total information wanted, might have been supplied to him. As regards the islands supposed by him to be now subsiding, we opine that the inhabitants, may very safely take that supposition as being nothing more than a supposition; many folks besides Mr. DARWIN find little or no difficulty in convincing themselves, that their favorite opinions are the truth, and nothing but the truth, but, seldom find much ease or success in the attempt to convince others, who have adopted different and contravening conclusions. The word "answer" does not seem to be here used so appropriately, as the word observe, or remark, would have been. Howbeit if Mr. DARWIN does not mean, what we in common with captain WILKES, and probably most of those who have received the light of these lucubrations, suppose that he did, namely, that an equal or proportional amount of subsidence and of elevation is taking place, then, pity it is, that he has not told us what he did intend us to understand. "The volcanic mounds" in islands, are we presume, at least as much isolated, as those that exist in the continent of Europe; if so, the configuration of the reefs, must be admitted, only as neutral spectators, not as active coadjutors in the establishing of Mr. DARWIN'S law. We think, that we can on a very different theory than his, obtain "some judgment" of the prevailing movements of the earth's crust, during the formation of all it's series of strata, from the most primary, up to the latest sedimentary deposit formation.

XXVI. » Any thing which throws light on the movements of the ground

» is well worthy of consideration and the history of coral reefs, may, in
» another manner elucidate such changes in the older formations. As there
» is every reason to believe that the lamelliform corals, grow only abun-
» dantly at a small depth, we may feel sure where a great thickness of
» coral limestone occurs, that the reefs on which the zoophytes flourished,
» must have been sinking. Until we are enabled to judge by some means,
» what were the prevailing movements at different epochs, it will scarcely
» ever be possible to speculate with any safety, on the circumstances, under
» which the complicated European formations, composed of such different
» materials, and in such different states were accumulated.”

We have already shewn, that, admitting for the nonce, Mr. DARWIN'S assertion, that the lamelliform corals only can build up reefs to within the influence of the action of the billows of the sea, and can only live at depths of "say twenty fathoms" (which is as much as that influence extends with power enough to break up, or displace mere accumulations of the exuvia of shelly mollusks and corallines), it follows that all of these, living at greater depths may lay, and very probably have laid the foundations and increased the masses upwards, until it had reached to the height at which those efficient coral builders could go on with the work to completion. But, having himself subscribed to the opinion, which is held by many modern geologists, that the temperature of the atmosphere, and consequently of the ocean, was much higher, during a former *era of ages*, than it is at present, that higher temperature, doubtless enabled all corals, and shelly mollusks, to live and grow at proportionally greater depths, and he must therefore admit this consequence, as another argument against the correctness of his theory. Moreover, there is a strong probability, that all the masses of existing reefs, as well, as of "the great thicknesses of coral limestone," were formed during that era of high temperature, an era for assuming the existence of which, we have still more sufficient authority than that of Mr. DARWIN, or any other geologist whomsoever he be.

XXVII. » Nor can I pass quite over the probability of the above views
» illustrating those admirable laws, first brought forward by Mr. LYELL, of
» the geographical distribution of plants and animals, as consequent upon

»geological changes. Mr. LESSON has remarked, on the singular uniformity
»of the Indo-Polynesian Flora, throughout the immense area of the Pa-
»cific, the dispersion of forms having been directed against the course of
»the trade wind. If we believe that lagoon islands, those monuments
»raised by infinite numbers of minute architects, record the former exis-
»tence of an archipelago or continent in the central part of Polynesia,
»whence the germs could be disseminated, the problem is rendered far
»more intelligible. Again if the theory should be so far established, as
»to allow us to pronounce that certain districts, fall within areas of ele-
»vation or subsidence, it will bear directly upon that most mysterious ques-
»tion, whether the series of organized beings, peculiar to some isolated
»points, are the last remnants of a former population, or the first crea-
»tures of a new one, springing into existence.”

These views, being as we have shewn, obtained, from erroneous data, cannot at all illustrate any laws whatever. Mr. LYELL's work bringing forward laws of the geographical distribution of plants and animals, as consequent on geological changes, we have not seen, and therefore cannot here investigate, but we have no doubt, that such laws have been established and do exist. Mr. LESSON may have been, but Mr. DARWIN could scarcely be ignorant of the fact, that, the thermo-equatorial belt of westerly winds with easterly currents, is always moving over a considerable space between the equatorial limits of the trade winds, progressing flankwise, alternately from, north to south, and vice versa, en suite of the solar declination, and extending nearly to, and at times in each season, even beyond the tropic, over which the sun is, or has shortly been, in the Zenith. Consequently no problem exists to be solved, with respect to the fact of the uniformity of the Indonesian and Polynesian Floras, even if the general climate of both, were not as it is, one and the same, except in so far, as mere difference of latitude, between any two given localities, may influence their respective details. By these same thermo-equatorial winds and currents, doubtless the human population of all Polynesia, has also been originally brought from the westward. We now presume to think that we have in the course of the foregoing remarks, cleared away the sandy foundations on which Mr. DARWIN has erected his theoretical fabric, so lea-

ving it tottering to its fall. If Australia be included in Mr. DARWIN'S notion of isolated points, we should have been obliged by his informing us of any other, offering more ostensible reasons for putting forward the mysterious question for a solution. If that country be not included in his said notion, then we would ask why it has not? certainly it affords a somewhat broader ground for the discussion, than does the doubtful distinction of species, between the land turtles and a lizard or so, of the Gallapagos Islands, and those of the germs to be found elsewhere, and here; we may farther observe, with reference to the foresaid question, that malgré the outcry raised by bigotry, cant, and interested hypocrisy, against the work entitled "Vestiges of Creation," its main principle, points to a solution, at once agreeable to facts, and to the most elevated ideas, which the human intellect can conceive of the Creator's omniscience, in creating organizations, capable of being developed into variations of forms, aptitudes and faculties, harmonizing with the development of the capacities of the land, the water and the atmosphere, by successive geological changes.

XXVIII. » Briefly to recapitulate. In the first place, reefs are formed
» around islands, or on the coast of the mainland at that limited depth
» at which the efficient classes of zoophytes can live, and where the sea
» is shallow; irregular patches may likewise be produced afterwards, from
» the effects of a series of small subsidences; encircling reefs, grand barriers,
» or lagoon islands, are mere modifications of one necessary result. Se-
» condly, it can be shewn, on the above views, that the intertropical ocean
» throughout more than a hemisphere, may be divided into linear and pa-
» rallel bands, of which the alternate ones, have undergone within a recent
» period the opposite movements of elevation and subsidence. Thirdly,
» that the points of eruption, seem invariably to fall within areas subject
» to propulsion from below. Fourthly, as the traveller who is an eye
» witness of some great and overwhelming earthquake, at one moment of
» time loses all former associations of the land being a type of solidity,
» so will the geologist, if he believes in these oscillations of level, the
» deeply seated origin of which is betrayed by their forms and vast di-
» mensions, perhaps be more deeply impressed with the neverceasing mu-
» tability of this our world."

Briefly to recapitulate. Reefs may and probably have been commenced in great depths by the calcareous exuviae of all

or many of the creatures which lived, or have lived in those depths, and collected that earth in their shells, spines &c and these foundations have been and are, by the gradual ascension of these remains, accumulated upon, until high enough even for enabling Mr. DARWIN'S *only efficient* reefbuilders to commence work and carry it on to completion, i. e. to "the level of lowest water spring tides", his conclusion on this branch of his theory, is therefore inadmissible. No evidence, worthy of recognition, has been adduced by him, at all capable of supporting his assumption, that a series of small subsidences has ever, any where, taken place, but even if that were taken for granted, the production of lagoon islands, by taking as Mr. DARWIN has done, the Cocos for a specimen, cannot be, nor has been a result of such, or any other sort of subsidences, and we here defy him, to find a geologist, who having his mind unbewitched (in favour of a theory of his own invention), and keeping his eyes open, whilst investigating the formation of the Cocos, shall, after doing so affirm, that he agrees with Mr. DARWIN'S conclusions, and can corroborate his assertions, respecting them. Secondly, we have given some, and could have given more instances, of upheavals, alias propulsions from below, (during Mr. DARWIN'S recent period) *within* the great area which he adduces as the most certain one of subsidence, and as being the main foundation of his theory. Thirdly, we have shewn, that lagoon reefs are standing on his principal area of elevation. Vide the Brill in the eastern part of the Java Sea, Rat island and reef off Bencoolen and Trieste reef and islet on the S. W. Sumatran coast submarine extension; also in *his* elevation of the Red Sea, extensive barrier reefs and at least, one well defined lagoon reef; and however bravely, on false views, "it may be shewn, that the intertropical oceans may be divided &c", it cannot be even surmised, on any truthful data. Fourthly, we have to remark, that if the geologist has information worthy of his profession, he needs no theory, much less one, so wild, as worthless as this of Mr. DARWIN'S conception, to be deeply impressed with the

fact, that the levels of sea and land are, in common with every other created entity, always in a state of mutability, motion being the primary agent, employed through all time, in the evolutions of creation throughout the universe.
