in shape." Looking again at the illustration, for "rows" he finds that the bones which seem to be arranged in rows are those which he may afterwards learn to be the metacarpals and phalanges. Supposing, however, that he guesses the carpus rightly, which of its bones is semi-lunar or crescentic in shape? I think if the picture were put before *any* ordinary observer, told to point out a crescentic bone, he would select the scaphoid. There is, thinks the student, still a clue left, for the semi-lunar "occupies the centre of the first row." But the first row contains *four* bones; at least he has read that "the eight bones are clustered together so as to form two groups," and he is not told that these groups are not the "rows" afterwards mentioned. He gives it up, and reads the other bones to learn them and find the semi-lunar by the exhaustive process. The guide he finds to the cuneiform bone is that it is "on the ulnar side of the semi-lunar," which he has perhaps failed to guess rightly, and articulates with certain other bones, which are to be afterwards described, and are unknown to him; and so on.

The mode of progression is like that I made once in Ireland, when on asking a peasant my way I was told to take the last turning before coming to the next milestone. There were a good many steps to retrace after finding the next milestone.

I have no doubt at all of the moral influence of Mr. Marshall's plan *if the student perseveres in using his book;* he will have exercised patience, attention, command of temper, and careful criticism of words, but I do not think his anatomical will equal his moral gain.

The process described above simply distracts the student's attention from the form of what he is studying. Would Mr. Marshall wish the Map of England taught in the same manner—no names or references given to the counties, and Hampshire to be recognised because it is in the last row and adjoins certain other counties, which in their turn adjoin it?

ART STUDENT

Barytes from Chirbury

I HAVE to thank Mr. Woodward for pointing out that the plane (412) has been established for barytes. It was first given by Helmhacker (*Denksch. der K. Akad. der Wiss. Wien.* vol. xxxii. 1872) as occurring on crystals from Svárov and Krušná hora in Bohemia, but is rejected by Schrauf as insufficiently determined. The distinguishing peculiarities of the Chirbury crystals are (1) the predominance of the plane E which does not truncate an edge as is the case in Carl Urba's crystals; (2) the frequent occurrence of ω and ξ; (3) the tendency of the face o to develop small faces on its edges which are inclined to o at angles near 3°. Such faces are Q and Y, and I have since determined a face Λ on the edge $o\mu$ with indices near (25.1.27).

British Museum, November 26 H. A. MIERS

THE ORIGIN OF CORAL REEFS[1]

II.

THE most detailed investigation of coral-reefs which has yet appeared has just been published by Prof. A. Agassiz.[2] This able naturalist is engaged in prosecuting a series of researches into the biological phenomena of the seas on the eastern side of the United States, under the auspices of the United States Coast Survey, and in the course of these explorations he has had occasion to devote himself to the detailed study of the coral-reefs of the Florida seas. For purposes of comparison he has likewise visited the reefs among the West Indian Islands, as well as those on the coast of Central America. His observations are thus the most exhaustive and methodical which have yet been published, and the deliberate conclusions to which he has come deserve the most attentive consideration. He traces the history of a coral-reef from its latest stages as dry land to its earliest beginnings, and even beyond these to the gradual evolution of the conditions requisite for the first starting of the reef. His familiarity with the nature of the bottom all over the area in question, and with the life so abundant in the tropical waters, gives him a peculiar advantage in this inquiry. The upheaval of recent coral-formations to considerable heights above the sea in various parts of the region enabled him to examine the inner structure and foundations of the reefs, and to obtain therefrom altogether new data for the solution of the problem. Following him in his induction we are led back to a comparatively recent geological period, when the site of the peninsula of Florida was gradually upraised into a long swell or ridge, having its axis in a general north and south direction, sinking gently towards the south, but prolonged under the sea as a submarine ridge. The date of this elevation is approximately fixed by the fact that the Vicksburg limestone was upraised by it, and this limestone is assigned to the Upper Eocene series. As a consequence of the elevation, a portion of the sea-bottom was brought well up into the waters of the Gulf Stream, which were probably shifted a little eastward.

No marine fauna yet explored equals in variety of forms or number of individuals that which peoples the waters of the Caribbean Sea and the Gulf of Mexico from the depth of 250 to about 1000 fathoms. This prolific life is traced by Prof. Agassiz to the copious food-supply carried by the warm tropical currents, combined with the food borne outwards from the sea-board of the continent. The corresponding abundant fauna found by the *Challenger* in the Japanese current may be regarded as its counterpart in the Pacific Ocean. Prof. Agassiz points also to the diminished richness of the fauna on the western side of the continents as being probably connected with the absence of those warm equatorial currents which bring such an abundant supply of food to the eastern shores. "No one," he remarks, "who has not dredged near the hundred-fathom line on the west coast of the great Florida Plateau can form any idea of the amount of animal life which can be sustained upon a small area, under suitable conditions of existence. It was no uncommon thing for us to bring up in the trawl or dredge large fragments of the modern limestone, now in process of formation, consisting of the dead carcasses of the very species now living on the top of this recent limestone." Mollusks, echinoderms, corals, alcyonids, annelids, crustacea, and the like, flourish in incredible abundance on the great submarine banks and plateaux, and cover them with a growing sheet of limestone, which spreads over many thousands of square miles and may be hundreds of feet in thickness. In these comparatively shallow waters, and with such a prodigiously prolific fauna which supplies constant additions to the calcareous deposit, the solvent action of the carbonic acid upon the dead calcareous organisms is no doubt reduced to a minimum, so that the growth of the limestone is probably more rapid than on almost any other portion of the sea-bottom.

From the charts we learn how extensively submarine banks are developed in the West Indian region in the track of the warm currents. East of the Mosquito Coast, in Central America, one of these banks may be said to stretch completely across to Jamaica. Similar banks rise off the Yucatan coast; likewise on the windward side of the islands, where the ocean currents first reach them.

That these banks lie upon volcanic ridges and peaks can hardly be doubted, though we have no means of telling what depth of recent limestone may have accumulated upon them. Among the islands, recent volcanic masses rise high above sea-level, in Martinique reaching a height of more than 4000 feet. And as usual in volcanic regions there are numerous proofs of recent upheaval, such as the Basse Terre of Guadaloupe, the successive terraces of recent limestone in Barbadoes, and the upraised coral-reefs of Cuba, which lie at a height of 1100 feet above sea-level.

The West Indian seas have long been famous for their coral-reefs. Prof. Agassiz insists that the distribution of these reefs is determined by the direction of the food-

[1] Continued from p 110.
[2] "On the Tortugas and Florida Reefs." *Trans. Amer. Acad.* xi. (1883).

bearing ocean currents. They flourish on the windward side of the islands and along the whole eastern coast of Honduras, Venezuela, and Yucatan. But on the leeward shores they do not exist at all. Cuba is fringed both on the north and south side with reefs, but the southern reefs, directly bathed by the Gulf Stream and exposed to the prevailing winds, are more flourishing than the northern reefs, which are to some extent cut off from the equatorial current by banks and islands.

The depth at which corals will flourish in these seas has been found to be rather less than that which has been ascertained to be in general their downward limit elsewhere. Prof. Agassiz concludes that they do not thrive below a depth of six or seven fathoms in the Florida seas, though on the outer reef, directly exposed to the open currents and prevalent winds, they descend in scattered heads to about ten fathoms.

Each successive stage in the growth of an atoll seems to be laid open for study in the prolongation of the Florida reefs. The map of that region (Fig. 2) shows a remarkable broken line of islets and strips of land running parallel with the coast, first in a southerly direction, but gradually curving round until it takes a due westerly trend. This westward curve is attributed mainly to the influence of the strong counter-current which, with a width of ten to twenty miles, sweeps westward into the Gulf of Mexico along the left side of the Gulf Stream, and heaps up organic debris in its track. Florida is growing westward in the line of this current. Reef after reef is added to the land at the east end, while towards the west, new reefs successively begin on the bank, as its surface is gradually built up by the accumulation of organic debris

The last and youngest of the reefs marked on the maps and charts is the group known as the Tortugas. But immediately to the west of this group Prof. Agassiz has found a prominence on the submarine bank, on which corals have begun to grow. Large heads of Astræans and Madrepores have fixed themselves at a depth of from six to seven fathoms, and Gorgoniæ are found a little lower. This is the beginning of an atoll. The Tortugas, which present a further stage of development, consist of an elliptical, atoll-shaped reef, in three chief parts, whereof the largest forms a crescent, fronting to the east

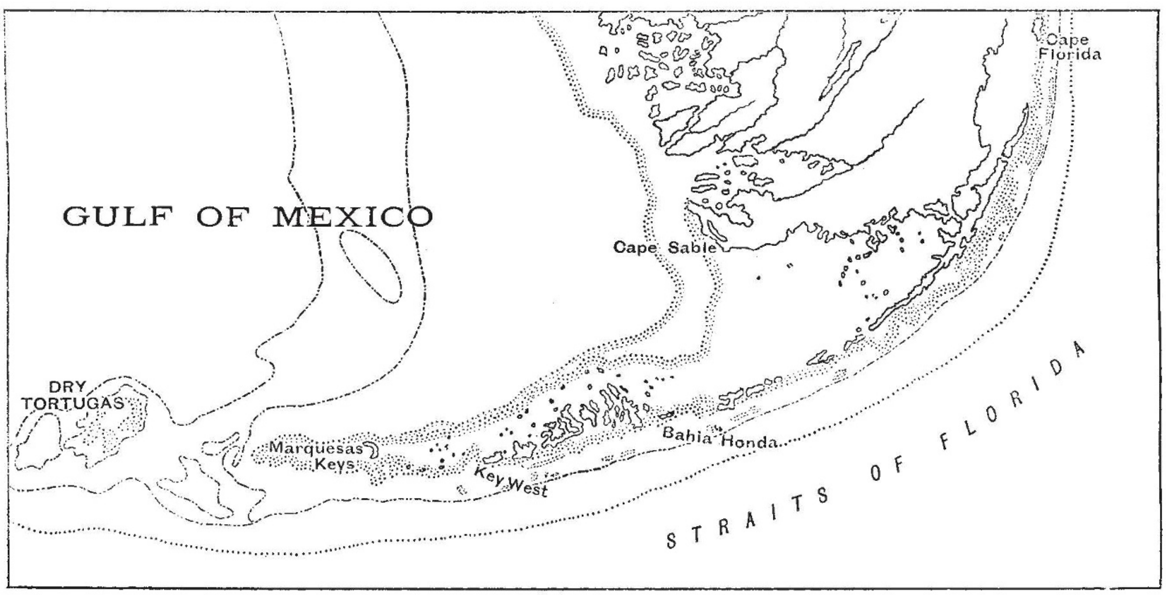

FIG. 2.—Map of the Florida Reef and Keys.

round the edge of the submarine bank, while the two other portions have grown south-westwards along the bank. Three channels between these portions allow powerful tidal currents to rush across the central chiefly submerged parts of the atoll. Seven islands have been formed at the higher parts of the reef by the accumulation and induration of calcareous debris tossed up on the reef by the waves. To the breakers and currents combined with the distribution and habits of growth of the reef-builders Prof. Agassiz entirely attributes the form and growth of the reef. The most important corals are the Madrepores, which flourish in extensive patches, two common species of *Porites* occurring in clusters over the shallow tracts of coarse sand, and *Mæandrina areolata*, growing between the marine lawns of *Thalassia*, with occasional patches of *Anadyomene*. Immense masses of nullipores and corallines grow on the tops of the dead branches of Madrepores which have been killed by exposure to the air during extreme low tides or when strong winds have blown the water off the flats. Large heads of Astræans and *Mæandrina* occur here and there towards the edge of the reef, which is occupied mainly by clusters of *Gorgoniæ*. The destruction of the reefs by the waves is very great, the sea being occasionally discoloured with the chalky sediment to a distance of from six to ten miles after a storm. Broken coral-heads, and branches, dead corallines, shells of mollusks, old serpulæ tubes, stalks of *Gorgoniæ*, and other organisms are thrown up in lines that consolidate into a low dyke, which in turn is pounded up and removed by the breakers. A prodigious quantity of calcareous sediment is thus produced, much of which is swept into the interior of the reefs, where it accumulates in flats of sand and silt. It is only on the outer edges of the reef, where the scour of the sea is greatest, that the corals can flourish; elsewhere they are choked and buried under the deposit of calcareous sediment. Some of this sediment accumulates in steep submarine banks, like sand-dunes, which shift to and fro as winds and currents vary; though by the action of the carbonic acid of the sea-water they are apt to be cemented into solid slopes, some of which have an angle of as much as 33°. So great is the destructive and transporting influence of the sea under the combined or antagonistic working of tides, currents, and wind-waves, that the whole mass of the reef as well as the flats and shoals inside may be said to be in more or less active movement. Hence none of the landmarks furnished by the islands can be relied upon for the location of buoys.

A still more perfect example of an atoll formed under similar conditions is that of Alacran on the opposite coast of Yucatan. Its eastern face is a great arc of about 20 miles, where, exposed to the open sea and easterly winds, the corals flourish vigorously. On the eastern or interior face of the western chord of the reef, however, the silt derived from the pounding of the breakers to the eastward has already killed the corals. The lagoon is occupied by detached coral-heads with lanes of deep water between them.[1]

To the east of the Tortugas, nearer the mainland of Florida, older stages of development among coral-reefs may be traced. By the westward drift of the calcareous sand and silt the lagoons have been converted into flats, and these in succession have been turned into more or less continuous dry land. There is no evidence of subsidence. The area seems to have remained stationary for a long period, or if there has been movement at all, it has been in an upward direction. Should the present condition of things be prolonged, there will be a further extension of the Florida coast-line. By the heaping up of the shells of dead organisms in the track of the counter current, the submarine bank will continue to be brought up within the depth at which reef-building corals can flourish. Successive clumps of reef-builders, springing up and growing outward, will build up atoll-shaped reefs. The abrading action of the waves upon these reefs will furnish detritus to be drifted into the lagoons and channels, which will eventually be silted up into dry land.

An interesting indication of the progress of these changes is furnished by the terrestrial flora and fauna of the reefs. The plants of the mainland are found likewise on the reefs, but become fewer in number as they are followed southward, until on the Tortugas,—the last addition to the dry land,—the flora consists of a few Bay-cedars, a hop-vine with a thick white flower, Bermuda grass, and a solitary mangrove tree. One of the species of land-shells common at Key West has found its way to the Tortugas. No terrestrial reptiles have yet reached that furthest atoll, though at Key West, less than 100 statute miles to the east, many of the frogs, toads, lizards, and snakes common to the southern mainland have already established themselves.

It will be observed that the conclusions arrived at by Prof. Agassiz from his own independent researches entirely confirm those previously announced by Mr. Murray. That two observers, who have enjoyed exceptional advantages in the investigation of this subject, should come to practical agreement must be admitted to be a strong argument in favour of the views which they have adopted.

Putting together all the data which have here been summarised, I think we are driven to admit that barrier reefs and atolls may be formed without subsidence of the sea-floor. Whether this has been the usual or only an exceptional manner of their origin is a question that will depend for its solution upon whether or not it can be shown that there are general phenomena which can only be explained by subsidence. Three such phenomena may be adduced: I am not aware of any others that deserve serious consideration.

1. One of the early difficulties which Darwin's explanation satisfactorily solved was the necessity for the existence of so many peaks, coming up from the depths of ocean just to the zone in which reef-building corals live. No cause was conceivable which should have so generally arrested the upward growth or upheaval of these submarine heights at the limit where coral-reefs might begin. And this difficulty has always been looked upon as furnishing one of the strongest arguments in favour of the theory of subsidence, for that theory completely removes it, by showing how, in a general submergence, peak after peak would sink, and come within the sphere of the operations of the reef-builders.

The difficulty is met in a totally different way by those who believe it to be more formidable in appearance than in reality. They contend that, while it must not be forgotten that many peaks do rise above the sea-level, and many submarine banks still fall far short of the coral-zone, two powerful causes conspire to bring submarine banks to a common uniformity of level at a short distance below the surface of the ocean. On the one hand, those portions of volcanic mountains that rise above the sea-level are worn down by the atmosphere and the waves, and unless otherwise preserved, must inevitably be reduced to the lower limit of wave-action, which is probably nearly coincident with the lower limit of reef-builders. On the other hand, submarine banks in tropical seas are built up towards the surface by the accumulation of the aggregated remains of plants and animals which live on the bottom or fall down to it from upper waters, and the magnitude of this upward growth is hardly yet adequately realised.

In balancing these opposite views, we must, I think, admit that subsidence is adequate to provide platforms for coral-reefs, but that these platforms could likewise be furnished by the two other processes just referred to. Subsidence has been invoked because no other solution of the problem seemed admissible. But as another solution has been found the argument in favour of subsidence has no longer the same force. The new solution, being based upon facts which are everywhere observable in the coral regions, appears to me to be more probable than the older one, which is only an inference resting on no positive proofs.

2. The precipitous descent of the outer face of the reefs to depths far below those at which corals can live is another difficulty which finds a ready explanation on the theory of subsidence. If it were true, as is popularly assumed, that a coral reef presents towards the ocean a vast perpendicular wall of limestone, entirely composed of solid coral, there could be no escape from the conclusion that subsidence must have occurred, to permit of such an aggregation of coral-rock. We learn, however, that much misconception exists on this subject. Some of the earlier accounts of coral-islands speak of "unfathomable" depths at a short distance seawards from the reefs; but more recent soundings afford no confirmation of these statements. Instead of being the summits of vast submarine pillars of limestone, atolls, as well as barrier-reefs, appear to be really planted on the tops of submarine peaks and ridges. The outer face of the reef is undoubtedly steep, in some places vertical. At Tahiti, for example, as shown in Fig. 2, the living face of coral may extend to a depth of 30 to 35 fathoms, beneath which huge detached blocks of coral are piled up and cemented together, forming a steep face, which descends to about 150 fathoms at a distance of 180 fathoms from the upper edge of the reef. The sea-bottom beyond that point is covered with coral sand and slopes at 25° to 30°, after which the angle lessens to 6°. By the abrading action of the breakers in tearing off blocks of coral, and strewing them down in steep talus-slopes, a platform is prepared on which the actually growing part of the reef can build outwards.

In Darwin's section of the Gambier Islands the thickness of the encircling reef is made to be about 2000 feet.[1] Prof. Dana by one estimate puts it at 1150, and by another at 1750 feet. He assumes that in general the thickness of solid coral must be considerable, though he admits that calculations based on the seaward continuation of the slope of the land are liable to error from many causes.[2] Even if we admit (what cannot be proved) that the calcareous mass of any coral-reef does attain a thickness of many hundred feet, it would not necessarily con-

[1] *Bulletin Mus. Comp. Zool.*, v. No. 1.

[1] "Coral Reefs," 2nd edit. p. 65.
[2] "Corals and Coral Islands," 2nd English edit. (1875), p. 126.

sist wholly of solid coral.[1] Prof. Agassiz has followed the growth of a reef upon a platform of calcareous organic debris, and he has found elevated coral-reefs which rest on such a platform. Mr. Murray's observations explain how a reef may grow outward on a talus of its own debris. There appears to be no reason, indeed, why a calcareous mass of almost indefinite thickness might not be formed without the aid of subsidence. Its upper zone might be directly due to coral growth, while the larger part of the mass might be composed of an aggregate of coral debris mixed with the remains of mollusks, echinoderms, and other calcareous organisms. So rapid is the destruction of organic structure through the solution and redeposit of carbonate of lime by infiltrating water, that a special and careful search might be required to determine the actual limits of the true reef and of its calcareous platform, and even such a search might not be successful.

After a full consideration of this second difficulty I feel compelled to admit that no valid argument in favour of subsidence can be based on the steepness of the seaward face of a reef and the thickness of the calcareous mass of the reef itself.

3. The depth of some lagoons and lagoon-channels furnishes probably the strongest argument in favour of Darwin's views. Occasionally a depth of forty fathoms is reached, and as this is beyond the depth at which reef-builders ordinarily live, it has been regarded as a proof that subsidence has taken place.

This third difficulty is thus met by the opponents of subsidence. We must remember, they say, that from the very conditions of their growth, patches of coral tend to assume an annular or atoll-like form, because the outer parts grow vigorously, while the central portions eventually die. Where the coral-patches coalesce and extend along a bank or shore, it is their outer or seaward faces that flourish. The inner parts, as they are more and more cut off from the food-supply, gradually die. While the outer face of the reef grows seaward, the inner margin is attacked partly by the solvent action of the carbonic acid of sea-water, partly by wind-waves, and the tidal scour sweeps away much fine detritus through gaps in this reef. In this way the lagoon-channel is widened and deepened. In a perfect atoll, that is, an unbroken annular reef of coral, the lagoon could not be deepened by any mere abrasion of the dead coral and removal of the detritus in suspension, but solution by carbonic acid would still come into play. It is further to be borne in mind that small lagoons are shallow and are being filled up, and that it is only the large ones, encircled by nearly continuous reefs, where the corals in the lagoon and along the margin are dead, and where the effects of solution may be conceived to have been longest in operation, that the depth of the lagoon descends below the limits at which reef-builders live.

I do not regard this solution of the difficulty as wholly satisfactory. Of the fact that dead calcareous organisms are attacked and carried away in solution by the carbonic acid of sea-water there cannot be any question, and this process must be of great geological importance. Whether the solvent action is sufficient to account for the exceptional depth of some lagoons, is still, I think, open to inquiry. It seems to me not improbable that these comparatively few deep lagoons may owe their depth partly to subsidence. But if this be the case it would lend, I am afraid, but slender support to a theory of wide oceanic depression. That there must be some areas of subsidence over the coral regions is almost certain, and the few scattered deep lagoons may possibly indicate some of these areas.

Having thus fully examined the arguments on both sides of this interesting and important question, I feel myself reluctantly compelled to admit that Darwin's theory can no longer be accepted as a complete solution of the problem of coral-reefs. No one could be more impressed than myself with the simplicity of this theory, the brilliancy of its generalisation, its remarkable fitness in geological theory, and the grandeur of the conceptions of geographical revolution to which it leads. I am fully alive to the serious changes which its abandonment will make in some departments of geological speculation. But in the face of the evidence which has now been accumulated, I can no longer regard the accepted theory as generally applicable. That it may possibly be true in some instances may be readily granted. There may be areas of subsidence, as there certainly are areas of elevation, over the vast regions where coral-reefs occur. It may be conceded that subsidence may sometimes have provided the platform whereon coral-reefs have sprung up, and may have contributed to heighten some reefs and to deepen some lagoons and lagoon-channels. But I do not believe that we are now justified in assuming subsidence to have taken place, from the mere existence of atolls and barrier-reefs. Its occurrence at any locality must be proved by evidence of special local movement. It may have gone on at many localities where atolls and barrier-reefs are found, but the existence of such reefs is no more necessarily dependent upon subsidence than upon elevation. These subterranean movements must be looked upon as mere accidents in a general process of coral-growth which is wholly independent of them.

I may in conclusion refer to one or two difficulties which have long been félt to be serious drawbacks to the theory of subsidence, but which disappear when the newer views of the origin of coral-reefs are accepted. If, as Darwin supposed, the coral-islands of the Pacific and Indian Oceans represent the last peaks of submerged continents, it is incredible that continental rocks should not be found among them. The oceanic islands (except of course those composed of coral-rock) are of volcanic origin and show none of the granites, schists, and other rocks which might have been looked for on such elevated summits. They have been piled up by the accumulation of lavas and tuffs discharged from the earth's interior, and, where they occur, point to upheaval rather than subsidence. Again, as Mr. Murray has shown, the inorganic deposits of the ocean-floor are composed of volcanic debris with a singular absence of the minerals that constitute the usual crystalline rocks of our continents.

No satisfactory proofs of a general subsidence have been obtained from the region of coral reefs, except from the structure of the reefs themselves, and this is an inference only, which is now disputed. From the nature of the case, indeed, traces of subsidence can hardly be expected. A few examples have been cited, such as the occurrence of trunks of cedar-trees in a layer of red soil at Bermuda, lying between the calcareous deposits and at a depth of 42 feet below low-water mark. This indicates a recent subsidence of that tract; but it may be merely local, and may be due to the sinking down of the roof of one of the caverns into which the limestone is so abundantly honeycombed. Occasionally along the margins of lagoons trees are found at the water edge, in a position suggestive of subsidence. But the removal of the calcareous rock by solution or wave-action might equally account for their condition.

Of elevation in the region of atolls and barrier-reefs, there is almost everywhere more or lees distinct evidence. Prof. Dana has collected the facts which prove that recent elevatory movements of unequal and local extent have occurred in all parts of the ocean.[1] Upheaval has taken place even in areas where barrier-reefs and atolls are in vigorous growth. Such an association of upheaval with an assumed general subsidence requires, on the subsidence theory, a cumbrous and

[1] Prof. Dana (*op. cit.*) cites examples of raised coral-reefs 250 to 300 feet ove sea-level; but we do not yet know how much of the rock is solid coral d how much may be formed of aggregated organic debris.

[1] Corals and Coral Islands," 2nd edit. p. 284.

entirely hypothetical series of upward and downward movements. These are unnecessary if we can be convinced that coral-reefs grow up independent of terrestrial movements, which may in one area be in an upward, in another in a downward direction. From this point of view the reefs stand up as the result of a complex series of agencies, among which the more important are on the one hand, the temperature, solvent power, currents, tides, and waves of the sea, and on the other hand, the amount and direction of the supply of pelagic food, the upbuilding of calcareous deposits to the zone of reef-builders, the outward vigorous growth of the coral-masses and their decay and death, and the solution of their skeletons in the inner parts of the reefs. All these causes are known and visibly active. Without the cooperation of any other supposed or latent force they appear to be entirely adequate to the task of building up the present coral-reefs of the oceans. ARCH. GEIKIE

DR. JOHN LAWRENCE LECONTE

INFORMATION has just been received in this country announcing the death of Dr. LeConte. He was born in New York on May 13, 1825, and was the son of a distinguished officer in the United States army, himself an entomologist. He adopted the medical profession, and during the secessionist war he entered as medical officer of volunteers. The foregoing necessarily brief, specially biographic account is chiefly derived from information furnished in Dimmock's "Special Bibliography of American Entomologists, No. 1."

LeConte could have been only nineteen years old when he published his first entomological paper on certain new species of North American *Coleoptera* (*Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. ii.). From that time forward a continuous series of works and papers on North American *Coleoptera* was produced by him until his death. He made a speciality of *Coleoptera*, and, with few exceptions, all his writings were devoted to that order of insects, and through his exertions the beetles of the United States are now almost as well known as are those of Europe. At the time of his death his published papers must have been nearly 200. Moreover he was the acknowledged authority in the United States on all matters coleopterological, a position which must naturally have caused him vast trouble and correspondence, sometimes with inadequate results. Latterly he worked greatly in company with Dr. G. H. Horn, of Philadelphia, a worthy follower of his tutor and a worthy successor. Their joint labours culminated *this year*, when was published ("Smithsonian Miscellaneous Collections," No. 507) a "Classification of the *Coleoptera* of North America," a volume extending to nearly 600 pages. It is needless here to refer to the revolution this work and other memoirs (chiefly by Dr. Horn) created in the minds of coleopterists as to the sequence of main divisions, &c. All working entomologists are sufficiently alive to the importance of the new ideas put forth. In fact this volume might have been considered a model of a special monograph were it not for a somewhat crude "Introduction" on insects in general that precedes the systematic portion.

In the present condition of entomological science in the United States the loss of Dr. LeConte seems almost irreparable. He and his coadjutor, Dr. Horn, and one or two others, stood almost alone amongst the prominent American entomologists in holding no special official position in connection with their subject.

LeConte once made a lengthy stay in Europe, and was well known personally in this country to all the prominent Coleopterists. Moreover he was honorary member of several of the European entomological societies, including the Entomological Society of London; his personal friends in this country were numerous. Since the death of Say (whose scattered works were carefully collated and re-edited by the subject of this notice) entomological science in America has not had to deplore so severe a loss, and Say's death was not fraught with the same significance.

R. MCLACHLAN

THE LATE MR. DARWIN ON INSTINCT

AT the meeting of the Linnean Society this evening (December 6) a highly interesting posthumous paper on Instinct, by Charles Darwin, will be read and discussed. We have been favoured with an early abstract of the same, which we here present to our readers.

After detailing sundry facts with reference to the migratory instincts of different animals, Mr. Darwin proceeds to suggest a theory to account for them. This theory is precisely the same as that which was subsequently and independently enunciated by Mr. Wallace in NATURE, vol. x. p. 459. Thus, to quote from the essay: "During the long course of ages, let valleys become converted into estuaries, and then into wider and wider arms of the sea; and still I can well believe that the impulse [originally due to seeking food] which leads the pinioned goose to scramble northward, would lead our bird over the trackless waters; and that, by the aid of the unknown power by which many animals (and savage men) can retain a true course, it would safely cross the sea now covering the submerged path of its ancient journey."

The next topic considered is that of instinctive fear. Many facts are given, showing the gradual acquisition of such instinctive fear, or hereditary dread, of man, during the period of human observation. These facts led Mr. Darwin to consider the instinct of feigning death as shown by sundry species of animals when in the presence of danger. Seeing that "death is an unknown state to each living creature," this seemed to him "a remarkable instinct," and accordingly he tried a number of experiments upon the subject with insects, which proved that in no one case did the attitude in which the animal "feigned death" resemble that in which the animal really died; so that the instinct really amounts to nothing else, in the case of insects at all events, than an instinct to remain motionless, and therefore inconspicuous, in the presence of danger. From the facts given with regard to certain vertebrated animals, however, it is doubtful how far this explanation can be applied to them.

A large part of the essay is devoted to "Nidification and Habitation," with the object of showing, by an accumulation of facts, that the complex instincts of nest-building in birds and of constructing various kinds of habitations by mammals, all probably arose by gradual stages under the directing influence of natural selection.

The essay concludes with a number of "miscellaneous remarks" on instincts in general. First the variability of instinct is proved by sundry examples; next the fact of double instincts occurring in the same species; after which, "as there is often much difficulty in imagining how an instinct could first have arisen," it is thought "worth while to give a few, out of many cases, of occasional and curious habits, which cannot be considered as regular instincts, but which might, according to our views, give rise to such." Finally, cases of special difficulty are dealt with; these may be classified under the following heads:—(1) Similar instincts in unallied animals; (2) dissimilar instincts in allied animals; (3) instincts apparently detrimental to the species which exhibit them; (4) instincts performed only once during the lifetime of an animal; (5) instincts of a trifling or useless character; (6) special difficulties connected with the instinct of migration; (7) sundry other instincts presenting more or less difficulty to the theory of natural selection.

The "Conclusion" gives a summary of the general