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).