

Mr. Atkinson and Prof. Mattieu Williams are working in this field, and that their results are received with interest, gives promise that the human race will some time attain to a thoroughly intelligent style of daily life.

LITERARY NOTICES.

THE STRUCTURE AND DISTRIBUTION OF CORAL REEFS. By CHARLES DARWIN. Third Edition, with an Appendix by Prof. T. G. BONNEY. With Illustrations. New York: D. Appleton & Co. Pp. 344. Price, \$2.

THE formation of coral reefs was one of the subjects investigated by Darwin during the voyage of the *Beagle*. The information which he obtained from his own observations and the reports of other investigators, together with the mode of accounting for these structures resulting from his study of this material, are embodied in the present work. The first edition of the book was published in 1842, a brief sketch of the author's views having been read in 1837 before the Geological Society, of London, and published. Darwin's theory of coral reefs speedily won acceptance among men of science, and had been taught in scientific lectures and textbooks for a generation before any considerable rival appeared. In 1874 Darwin issued a revision of his book, containing additional facts obtained by later explorers. The only important work on the subject which had appeared since 1842 was Prof. James D. Dana's "Corals and Coral Reefs," issued in 1872. Prof. Dana had accepted Darwin's theory in the main, though objecting very decidedly to some of its minor features. In 1880 Mr. John Murray, one of the naturalists of the Challenger Expedition, advanced a theory widely at variance with that of Darwin, which has found vigorous supporters, and various modifications of both the leading hypotheses have been offered by later investigators. But the majority of those qualified to judge of this difficult question have shown a disinclination to give up Darwin's theory for that of Murray—so much so that the Duke of Argyll, evidently jealous for Scottish honor, in 1887 accused scientific men of disregarding Murray's work from subserviency to their idolized Darwin. The duke's article was entitled "A Conspiracy of

Silence," and drew forth a vigorous reply from Prof. Huxley in the review in which it appeared, besides arousing a spirited discussion in the columns of "Nature." The new edition of "Coral Reefs" affords the means of forming an intelligent opinion as to the merits of Darwin's views. It is, by the way, the first edition that has been published in this country. The body of the work has been left as revised by the author for the second edition, but occasional foot-notes, and an appendix comprising a careful summary of the more important memoirs published since 1874, have been added by Prof. T. G. Bonney. In the first three chapters the three chief classes of coral formations— atolls or lagoon islands, barrier reefs, and fringing or shore reefs—are described. The fourth chapter deals with the distribution of coral reefs and conditions favorable to their increase, their rate of growth, and the depths at which reef-building corals can live. Darwin's theory of the formation of the different classes of coral reefs then follows. Coral polyps do not flourish below a depth of twenty or thirty fathoms, but reefs are found rising from much greater depths—how are these to be accounted for? The theory regards barrier reefs and atolls as having been developed successively from fringing reefs. The latter are so named because they closely skirt the shores of islands and continental land, increasing by growth on the outer edge, where the conditions seem to be most favorable for the life of the corals. Imagine such a reef formed around a volcanic island, and the island then to begin sinking beneath the sea. The reef will be carried down with it, but the active growth at the outer edge will still keep this part at the sea-level, while the inshore part where growth has stopped will become deeply submerged. We now have an island surrounded by a deep channel, outside of which is a ring of coral—that is, an island encircled by a barrier reef. Suppose the subsidence to go still further until the highest point of the island disappears, the growth at the outer edge of the reef still keeping it up to the surface, and there results a ring-shaped reef inclosing a lagoon—that is, an atoll. It can not be denied that this theory accounts for the channel within a barrier reef and the ring shape of atolla, besides answering the question asked above,

all in a very natural way. But it has been objected to on account of the amount of subsidence in the floor of the Pacific and Indian Oceans which it would imply, and for other reasons. Mr. Murray attempts to find a foundation at a suitable depth for the corals to begin work upon without supposing subsidence. He thinks this could be furnished by the accumulation of skeletons of minute animals and plants, upon natural elevations of the sea-floor, although when such remains fall to greater depths they are mostly dissolved by the aid of the carbon dioxide in the water. He thinks that a coral plantation rising on such a base would tend to assume the atoll form owing to the more abundant supply of food to the outer portions, and the removal of dead coral rock from the inner portions by the force of currents and by solution. He believes that barrier reefs have been built out from the shore, and that the channel within them is hollowed out by the same agencies as the lagoon of an atoll. The death of Darwin occurred so soon after the promulgation of this theory that he did not have an opportunity to publish any examination of it, but to a friend, Mr. T. Mellard Reade, who had expressed the opinion in a letter that it was "a very far-fetched idea," he replied: "I am not a fair judge, but I agree with you exactly that Murray's view is far-fetched. It is astonishing that there should be rapid dissolution of carbonate of lime at great depths and near the surface, but not at intermediate depths where he places his mountain-peaks." Besides a statement of Murray's theory, Prof. Bonney's appendix contains abstracts of the views of Alexander Agassiz, H. B. Guppy, G. C. Bourne, Bayley Balfour, W. O. Crosby, and J. D. Dana, together with an expression of his own opinion as to the value of the various objections to Darwin's theory. The volume contains three folded charts, and has an adequate index. It is bound uniformly with the other works of Darwin issued by the same publishers.

NATURAL RELIGION. By F. MAX MÜLLER. London and New York: Longmans, Green & Co. Pp. 608. Price, \$5.

THIS book includes the first course of Gifford lectures, twenty in number, delivered by Prof. Müller before the University

of Glasgow in 1888. The Gifford lectures rest upon a fund of eighty thousand pounds which was left by Lord Adam Gifford by will in 1885, to be applied in specific sums to the establishment in four Scotch universities of chairs for "Promoting, advancing, teaching, and diffusing the study of Natural Theology," or "the knowledge of God, the Infinite, the All, the first and only cause, . . . the knowledge of his nature and attributes, the knowledge of the relations which men and the whole universe bear to him, the knowledge of the nature and foundation of ethics or morals, and of all obligations and duties thence arising." The will provided for changes of lecturers at short intervals, so that the subject might be presented by different minds; that no tests should be required of them save that they be "able, reverent men, true thinkers, sincere lovers of and earnest inquirers after truth"; and that they should treat their subject as a strictly natural science, and under no restraint. Prof. Müller's course naturally assumes the character of an introduction to the courses that are to follow. Much of it is therefore given to laying down the lines and adjusting the bearings; and the discussions comprised in it touch chiefly upon the three points of the definition of natural religion; the proper method of its treatment; and the materials available for its study. The definition is found in the seventh lecture to be, "Religion consists in the perception of the infinite under such manifestations as are able to influence the moral character of man." Of methods, the historical is preferred as the one most likely to lead to results of permanent value. Its object is to connect the present with the past, to interpret the present by the past, and to discover, if possible, the solution of our present difficulties, by tracing them back to the causes from which they arose. It has to be, and is, defended against the common misapprehension that the historian cares only about facts, without attempting to interpret them; and against the opposite school of philosophers who think that our own inner consciousness is the one and only source from which to draw a knowledge and understanding of natural religion—forgetting that their inner consciousness "is but the surface of the human intellect, resting on stratum upon stratum of an-