his preface promises that the philosophy of religion shall be his next task. How the relation of ethics to faith would be developed by him may be seen in his very remarkable lecture on this subject, delivered in 1881. Here his spirit has its natural flight, unhindered by controversy or by ethical limitations.

We turn, finally, from these very insufficient suggestions of the contents of the work to a single element in it which will be novel to most readers, and interesting to all. Dr. Martineau is led in his preface to describe the personal experiences which gave its character to his work, and in so doing he offers us a most fascinating and instructive glimpse of his own intellectual autobiography. It seems that he was originally trained to be a civil engineer, and his first philosophical studies were controlled by scientific conceptions. "So self-evident appeared the maxims of mechanical causality, that in my heart I deemed it blindness if any one professed a different vision." . . . "It is no wonder, that, in skimming over my notes of work in those distant years, I seem to be communing with some tight-swathed, logical prig, in whose jerky confidence and angular mimicry I am humbled to recognize the image of myself." It was the discipline of teaching these subjects which changed his views; yet the change was not so obvious to himself as it was to his friend, J. S. Mill. "Though he saw to the bottom of my apostasy, he did not cut me off as a lost soul." Finally, under the guidance of Professor Trendelenburg and the inspiration of Greek philosophy, he gained what he describes as a 'new intellectual birth.' "It was as if the stereoscope through which I had looked at Plato or Aristotle had had its double picture, — Greek and English, — with distorted halves, producing only a blurred and overlapping flat; while now the slide of true correspondence was there, and the eye, after a momentary strain of adaptation, beheld the symmetrical reality in all its dimensions." . . . "The metaphysic of the world had come home to me; and never again could I say that phenomena, in their clusters and chains, were all." To many a student there will be nothing of more value in these volumes than these suggestions of what the author calls "the transitions of his thought, and the testing crises of his life." FRANCIS G. PEABODY.

WORK OF THE CHALLENGER EXPEDITION — III. GEOLOGICALLY VIEWED.

THAT the work of a dredging and sounding expedition should add much to our knowledge of the geology of dry land, except by inferences from submarine formations, is hardly to be expected. Nevertheless, this report contains many facts and observations useful to geologists. Several of the phototype plates are extremely striking illustrations of geological phenomena, showing more on one sheet than many pages of text would do. Such, for instance, are the plates illustrating glacial markings in Nova Scotia (i. p. 158), the trap-hills of Kerguelen (p. 338), and the wonderful lava cascade of Kilauea.

Only two of the series of special reports, actual and projected, treat of essentially geological matters; one already printed being on the petrology of St. Paul's Rocks, by Prof. A. Renard. These rocks, far removed from any continent, consist of a number of small islets separated by deep chasms, through which the ocean unceasingly pours and rises into breakers. The rock-mass, according to Professor Renard, is peridotic; and, while admitting the possibility of the volcanic origin favored by analogy, he has been led, rather, to presume that the rocks are a remnant of upheaval of an orographic character. This view has been opposed by Professor Geikie, and in this journal by Mr. Wadsworth (*Science*, i. 1883, p. 590), and would seem yet unestablished.

The second report referred to is that of Dr. Murray, on the deposits of the deep-sea bed. One of the most attractive plates in the work before us is that (p. 926) illustrating the ooze formed by the diatoms, radiolarians, foraminifera, and other organic remains on the sea-bottom, as seen under high magnification. After the removal of the calcareous portions, and the determination of the carbonic acid, the remainder is divided by Dr. Murray into mineral matter, the *débris* of siliceous organisms, and fine sediment. The material found in inland seas and along continental shores consists in large part of terrigenous deposits, the different colored muds and sand, and volcanic *débris* of inorganic origin; while corals and corallines afford sand and mud of organic origin. The abyssal deposits, on the other hand, in large part, seem to consist of ooze derived from remains of minute animals, such as pteropods, diatoms, etc., and especially of a red clay such as results from the degradation of the ooze and of decomposed pumice. The transition between the former and the latter is gradual, but in the great deeps the clay almost exclusively predominates. The terrigenous deposits reveal the equivalents of chalks, green sands, marls, or shales, but in the deep-sea deposits, according to Dr. Murray, differ pro-

foundly from the series of rocks known in the geological formations. The latter present no analogies to the red clays and oozes, in which, for instance, quartz may be said to be practically absent. The deduction from this is made, that the deeps are of great antiquity. In order to account for such vast accumulations as were there discovered, it is necessary to suppose that these basins have remained the same for a vast period of time.

From the red clays south of the equator, quantities of ear-bones of whales, sharks' teeth, etc., were obtained, which were embedded in nodules of peroxide of manganese, derived from the salts of that metal contained in the sea-water. Some products of volcanic eruptions also occurred, and, more interesting than either, certain spherules for which a cosmic origin is confidently claimed. These are mostly extremely small (not more than a millimetre or two in diameter), and may be collected from the dry and powdered ooze by a magnet. These contain sometimes a centre of meteoric iron coated with magnetic oxide, sometimes what seems to be an alloy of cobalt and nickel: others are chondritic, and appear to consist of bronzite or enstatite. All these are characteristically meteoric minerals; and it is indeed remarkable that the investigations of a Nordenskiöld in the arctic snows, should, in their proof of the gain of this planet by the deposit of cosmic material, be upheld and augmented by an investigation of the abysmal ooze of the great deep.

To the narrative are appended, among other documents, a bibliography, sufficiently exact for general purposes, of papers and publications, official and otherwise, to which the voyage has given rise. There is a list of the special reports already printed (more than forty), and of nearly as many more to follow. The concluding part will include an index to the whole, which it is to be hoped will be intrusted to a competent person for preparation. There is a science of indexing, to which we are confident the person who indexed this narrative never served an apprenticeship. Considering the importance, variety, and multitude of facts recorded in these pages, and that there is no systematic arrangement of them in the text, a really thorough, sensible, and scientific index was indispensable. The one which exists, though voluminous enough, is far from meeting the least of these requisites. In this particular, and a few others, we have, as it were, indicated a few spots upon the sun; but we should do much less than justice to the editors, and to the authorities who have sanctioned the work, were we to omit a distinct enunciation of the opinion that it, and the series it is intended to introduce, as a whole, form the most magnificent contribution to natural science, and monument of enlightened research, which has ever been given to the world in any age or by any country.

THE CHALLENGER REPORT ON THE STALKED CRINOIDS.

THIS magnificent work, which has just been issued by the British government, is beyond question the most important contribution to the literature of the living crinoids since the days of Johannes Müller. When Müller wrote his classical work, 'Ueber den bau des Pentacrinus caput medusae,' in 1841, but a single species of stalked crinoids from the existing seas was known. Carpenter now describes six genera, with thirty-two species, of which two genera and eighteen species were brought to light by the Challenger. In the present report he describes also the remarkable comatulid genus, Thaumatocrinus, obtained from a depth of eighteen hundred fathoms, which has underbasals, and interradial plates interposed between the first radials, and a row of anal plates, thus combining, in a measure, the characters of recent and paleozoic crinoids.

The work, though primarily a report upon the crinoidal collections of the Challenger expedition, is, in fact, an almost complete monograph of all recent stalked crinoids known to this time. The descriptive part and illustrations are so excellent and copious as to leave nothing to be desired in this particular.

A large portion of the volume is devoted to comparative discussions of the morphological relations between recent and ancient crinoids, to which he has brought all the resources of a mind equipped with the most varied and accurate knowledge of both living and extinct forms. The importance of this portion of the work in stimulating further researches cannot be overestimated.

In his classification, Carpenter follows Leuckart, and separates the stalked echinoderms from the remainder of the group, under the name 'Pelmatozoa,' which he makes a 'branch' of the 'phylum' Echinodermata, with three 'classes,'—Crinoidea, Cystidea, and Blastoidea. The Crinoidea are the strictly brachiate Pelmatozoa, for which Burmeister, in 1856, proposed the name 'Brachiata,' taking rank with

Report on the Crinoidea dredged by H. M. S. Challenger during the years 1873-76. Part i. General morphology, with descriptions of the stalked crinoids. By Dr. P. HERBERT CARPENTER.