from the shock of the long journey, but a number appear to be active in their new home.

In this connection it may be interesting to note that the common east-coast soft clam, Mya arenaria, which was introduced on the Pacific coast several years ago, has become thoroughly acclimated there, and is now very abundant.

WORK OF THE CHALLENGER EXPEDITION. — II. FROM A ZOÖLOGICAL STAND-POINT.

After the investigation of the physical features of the world of the sea, it was expected and has proved that the greatest additions to our knowledge would be made by the expedition in the direction of biology. From the summaries furnished by the specialists engaged on the various monographs, and printed at intervals in the text of these volumes, a few facts may be cited in the endeavor to give an approximate idea of the scope and character of the results.

The main purpose of the expedition, on the biological side, was to investigate the marine life of the sea, and incidentally to examine the life of certain isolated oceanic islands, — faunae pregnant with meaning for the naturalist, though scanty in species or individuals. Both objects were carried out in a manner satisfactory to naturalists, and creditable to the officers of the expedition. The air-breathing vertebrates, of course, were little sought after, but interesting observations are recorded on the sea-elephant and fur-seal; and the bones of cetacea dredged from the sea-bottom were sufficiently numerous and interesting to justify a special report on them by Professor Turner. The expedition seems to have needed a live harpooner, for it got no porpoises during the whole voyage, though many played about the ship. The birds collected, though not extremely numerous, were of great interest, and have been reported on by Dr. Sclater, the Marquis of Tweeddale, Dr. Finsch, Count Salvadori, Messrs. Saunders, Salvin, and Garrod. The death of the latter prevented the completion of his work on the anatomy of the petrels, which was taken up by the late W. A. Forbes, who made an exhaustive report on the subject, showing that the order of Tubinares must be divided, as proposed by Garrod, into two very distinct families characterized by numerous and important differences, — which indicate not only a great antiquity for the whole group, but a great amount of extinction among its past members, in the process of which nearly all the intermediate or less specialized forms are believed to have disappeared. Professor Cunningham has reported on the marsupial mammals; Professor Parker, on the development of the green turtle; and Professor Turner, on the human crania collected during the voyage. The report on the deep-sea fishes, by Dr. Günther, is still a desideratum, but will unquestionably be of great interest. Some preliminary notes appear in this volume. A great similarity between the fish fauna of the Japan seas, the West Indies and adjacent Atlantic Ocean, and the Mediterranean, is clearly shown. At St. Paul's Rocks a new species of Holocentrum was found, but the fish fauna had a generally Antillean character. A remarkable fish, Bathypterois, was found on the coast of Brazil, with rudimentary eyes, and part of the pectoral fins modified to form extremely long tactile filaments. Another, Ipnops, dredged in the ocean at a depth of 1,900 fathoms, had the eyes modified to such an extent as to resemble two scale-like plates on the top of the much-flattened muzzle. No image can be formed in them, but they may serve for detecting minute quantities of light. Still another, Echiostoma, has eyes and formidable teeth, with long filaments extending from the chin and pectorals. A series of luminous globular bodies extends along the lower part of the body, and others of larger size are found on the head. The bones and ligaments of the deep-sea fishes are very soft, and the muscles loosely connected with each other. This is partly due to the expansion which they undergo in being raised quickly from regions where the water permeating all their bodies is under immense pressure; but the tissues must be loose to admit of such permeation, or they would be crushed and ruined under a weight which shivers solid glass to powder. Many of them are blind; many of them have phosphorescent organs, or secrete a phosphorescent slime; others have distensible stomachs and wide mouths, which ingulf fishes much larger than themselves.

Turning to the division of invertebrata, we find ourselves more than embarrassed with riches. The mollusks being in the hands of Rev. Boog-Watson and Mr. E. A. Smith of the British museum, who have so far submitted only preliminary notices, we learn chiefly of some special rarities, such as the paper-thin volute, Guivillea, from the depths of the Southern Ocean, or the beautiful Pecten Watsoni, of the section Amussium. Mr. Smith reports, in harmony with the results of the Blake expedition, that among the bivalves dredged from a depth of over 2,000 fathoms

he does not find one which might not have been expected at 100 fathoms or less. The deepest haul producing any bivalve was 2,900 fathoms, where Callocardia was found in the Pacific, and an almost exactly similar species was obtained at 1,000 fathoms off the Azores, in the same latitude of the Atlantic. On the whole, lamellibranchs were scarce: but this may have been owing to the use of the trawl instead of the dredge. The greatest depth at which any gastropod was found was 2,650 fathoms, in the South Atlantic; and this was a little Stylifer parasitic on an echinoid. The fossil genus Actaeonina was a find worth having; and many, like Gaza and other trochids, were of great beauty. A number of arctic species were found at home in the antarctic sea; and several others seem to wander over most of the world. Professor Haddon reports a chiton (C. [Leptochiton] alveolus Sars) from 2,300 fathoms, which was the only really deep-sea species found of this ancient group, though several others of the same genus range over 300 fathoms. Among the nudibranchs, an immense creature, Bathydoris abyssorum of Dr. Bergh, as big as a cocoanut (twelve centimetres long), forms a remarkable transition between Tritoniidae and Doridiidae, and was obtained at 2,425 fathoms. It is the largest nudibranch known, and was purple, brown, and orange colored when alive. Among treasures from shallower water were a living Nautilus pompilius and a partly decorticated Spirula.

It is impossible to give an account of the varied, beautiful, aberrant, or exquisite forms of the crustacea, star-fish, echinoids, and brittle-stars which were brought up from the deep sea. Their attractions for the eye of the aesthete as well as of the naturalist are obvious to any one who may examine the charming woodcuts which illustrate their form and structure. The sea-lilies are among the most attractive; and yet it is hard to choose from among so many any special group as, on the whole, the most beautiful.

Among the worms, decidedly the most extraordinary is Syllis ramosa, — a creature living in sponges, not satisfied with shaking off its progeny by dropping sections from its tail, but which actually branches in all directions laterally, and shares with these collateral relations the ramifications of its stomach. In another form, Genetyllis, the head is composed of little more than two enormous eyes, with a large median nerve-mass with which the retina of each is continuous. Some worms have tubes five yards long: others ornament their dwellings with hyaline sponge spicules or spiny processes. They reach depths of 3,125 fathoms, and range to the surface, the Serpulae and Terebellae being the most noteworthy in this respect.

The consideration of the calcareous and horny sponges was undertaken by Dr. N. Polé-jaeff of Odessa, who, after demolishing all previous attempts at their classification, aptly compares the systematist to a man wandering in the dark, — a condition in which the synopsis of his memoir certainly leaves its reader. The number of species was not large, and none of them came from great depths, though many were undescribed. The group of sponges to which the beautiful Venus's flower-basket, Euplectella, belongs, offers, as might be expected, many new and exquisite species, which are illustrated in a manner worthy of their attractions. Prof. F. E. Schulze reports that the Challenger collection has more than doubled the number of known species, which now amounts to more than one hundred. The tropical zone of the Pacific is the richest region, eighteen species having been obtained at one haul, in the vicinity of Papua; but the largest total number of species comes from the Southern Ocean. They are essentially abyssal animals. The richest additions to any single group of marine animals made by the expedition were to the Radiolaria. These rhizopods are now known to differ from the foraminifera and heliozoa chiefly by the separation of their unicellular body into an inner and an outer series of constituents. With few exceptions, they are remarkable for their skeletons, of the most varied and delicate form, and of siliceous or chitinous structure. They swim in numbers at the surface, or even at great depths; and the ooze at even the greatest known depths is often composed of astonishingly vast numbers of their delicate skeletons. From a few hundred known forms, the work of the Challenger has expanded the list to several thousands, among which Professor Haeckel has distinguished six hundred and thirty-four genera, included in twenty-four families and several orders. It must, however, be borne in mind that these systematic divisions are far from having the zoölogical value of divisions similarly styled in higher groups, though here perhaps necessary from the multitude of species. We have regretted the necessity, from considerations of space, for omitting references to the admirable and epoch-making work of Professor Moseley on the corals, confirming and extending the work of the elder Agassiz, or that on the foraminifera and diatoms, both of which exhibit forms of great beauty, which are excellently

figured. But nearly every page contains matter which would be of interest to readers of *Science*, and unfortunately we cannot yet print numbers in twelve hundred pages quarto. We are obliged to reserve our concluding paragraphs for the geological aspects of the voyage.

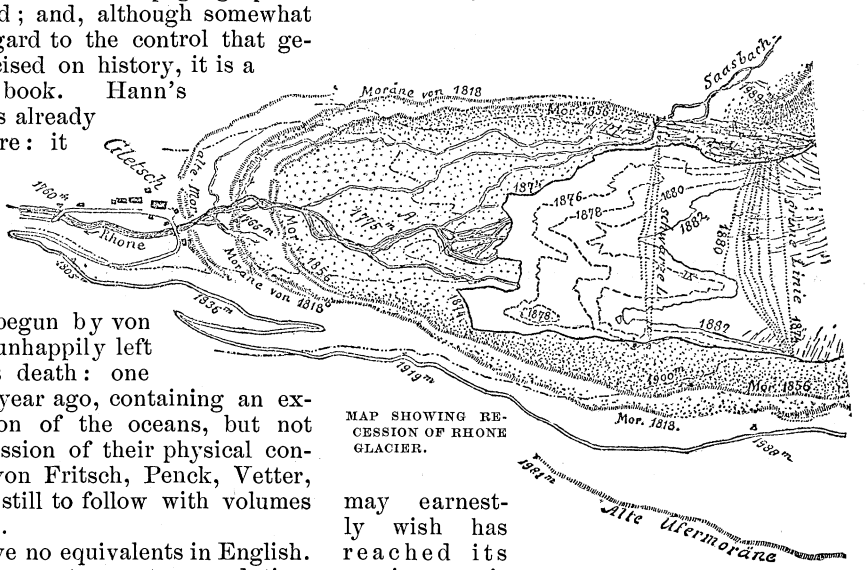
GLACIERS, AND THEIR RÔLE *IN NATURE.*

PROFESSOR RATZEL'S 'Bibliothek geographischer handbücher' reaches its fourth volume in Heim's comprehensive review of what may be called 'glaciology,' — a general discussion of glaciers, and the part they play on the earth's surface. It is fully up to the high standard attained by the earlier numbers of the series. Ratzel's 'Anthropogeographie' was the first issued; and, although somewhat venturesome in regard to the control that geography has exercised on history, it is a very suggestive book. Hann's 'Klimatologie' has already been reviewed here: it has everywhere received high praise, and at once takes its place as a standard work. The 'Ozeanographie,' begun by von Boguslawski, was unhappily left incomplete on his death: one part was issued a year ago, containing an exhaustive description of the oceans, but not reaching the discussion of their physical conditions. Drude, von Fritsch, Penck, Vetter, and Zöppritz are still to follow with volumes on special subjects.

These books have no equivalents in English. It is becoming very monotonous to record, time after time, that German writers are so far in advance of us; but the fact is very plain. If such works cannot be originated here, we wish that they might at least be translated and republished, so as to come within reach of our teachers and students.

Professor Heim has hitherto been known rather as a worker on mountain structure than on glaciers. His studies in the direction of the latter subject, so far as they are published, have been concerned chiefly with the share that ice has had in mountain sculpture; but the book now before us shows deliberate and careful work on all topics connected with glaciers of the present time. The reference made to their former extension is sufficient for a volume that professedly does not discuss that part of the question. As in the earlier numbers of the series, illustrations and references to authorities are practically wanting. An index is also absent in this volume; but its place partly taken by a well-arranged table of contents and page-headings. Our many students of the difficult problem of North-American glaciation will find much of value in the summaries of recent Swiss studies on the structure of glacial ice, of observations in Greenland on the motion of the great glaciers there, and of the many suggestions to account for glacial motion, as well as in the accounts of existing glaciers and their oscillations.

The remarkable recession of the Swiss glaciers during recent decades, which travellers may earnestly wish has reached its maximum, is finely illustrated in the figure of the glacier of the Rhone, of which a part is copied here. The measurements carried on of late years, under the direction of the Swiss alpine club, give precise data on this matter, and, if continued long enough, will undoubtedly in the end lead to the discovery of the cause of glacial oscillations in the peculiarly dry or wet, warm or cold, weather of some antecedent series of years; the effect leisurely following the cause, as the excess or deficiency of upper snow supply arrives at the lower end of the ice-stream. A view of the Rhone glacier, as it was at its recent maximum extension about 1820, is given in de Charpentier's 'Essai sur les glaciers,' and offers a striking contrast



MAP SHOWING RECESSION OF RHONE GLACIER.

Handbuch der gletscherkunde. VON ALBERT HEIM. Stuttgart, *Engelhorn*, 1885. 16+560 p., map. 8°.