

est discrepancies apparently occur, it is found, that, by tracing the development of each branch of Pueblo art by means of its own internal evidence of the successive periods of growth through which it has passed, we establish its continuous evolution from the simplest beginnings. Mr. W. H. Holmes has clearly shown how the ceramic art of these peoples has naturally developed from the simplest sources, and such as were more or less common to most of the American aborigines in a comparatively low stage of culture. In the case of their architecture, a similar derivation from very primitive forms can be traced. The builders gradually learned to utilize their environment, and perfect the system, until it culminated in the many-storied fortress-pueblo of a single building (such as the ruined pueblos of the Chaco); yet these highest achievements of their art in building contain within themselves a record that these people at one time dwelt in simple circular lodges, such as were common to many American tribes at the period of their discovery.

VICTOR MINDELEFF.

GEOLOGY OF NEW JERSEY.

UNDER the wise and efficient management of Professor Cook, the very modest annual appropriation of the geological survey of New Jersey is made to yield, year by year, substantial contributions to the geology of the state. The report for 1886 shows that the admirable topographic survey of New Jersey, carried on by the state in co-operation with the U. S. geological and coast and geodetic surveys, is approaching completion. It is being published on a scale of one mile to the inch; and the sheets for the northern part of the state, which were issued some time ago, have been generally accepted as the finest piece of cartographic work, for so large an area, that has been done in this country. They are in constant demand for all the uses requiring an accurate horizontal and vertical delineation of the surface of the country, from laying out water-works and railroads to arranging bicycle tours.

In view of the substantial benefits already accruing from this map before its completion, the wisdom and practical importance of such work cannot be questioned; and it is to be hoped that other states will hasten to profit by New Jersey's enlightened example.

The results of this topographic survey are to be used, on a reduced scale, as the basis of a new geological map of the state.

In the purely geological part of this volume, Dr. Britton's chapter on the crystalline or primitive rocks of New Jersey occupies a prominent

place. Three conformable groups are recognized: 1. Massive group, composed chiefly of indistinctly bedded syenitic and granitic or gneissic rocks, and probably equivalent to the Ottawa gneiss or lower Laurentian of Canada; 2. Iron (magnetite) bearing group, embracing a great variety of gneissic and schistose strata poor in white mica, sparry limestone and dolomite, with graphite and serpentine, and bedded deposits of magnetite, franklinite, and other ores (this group agrees well with the Grenville series or upper Laurentian of Canada); 3. Gneissic and schistose group, including biotite and garnetiferous gneisses, mica, hornblende, talc, tremolite, cyanite, chlorite, and other schists; vein granite, bedded diorite, and impure limestone and serpentine. This group resembles Dr. Hunt's Montalban system; and, since it is conformable with the iron-bearing group, the view is advanced that the Montalban may be simply an upper division of the Laurentian. It is interesting to note here that other students of the great Appalachian belt of crystalline strata have been led to propose more or less similar re-arrangements of the crystalline terranes, all of which goes to show the extremely unsettled state of eozoic geology. Dr. Britton introduces a series of sections to show that the same conformable sequence of his three groups obtains in all parts of the highland district; but in view of the massive character of the first group, and the general paucity of outcrops at critical points, this view can scarcely be regarded as definitely established.

It has long been known that the rocks of the highlands, like those of the Appalachian belt generally, are involved in a series of closely appressed folds the axial planes of which are usually inclined at a high angle to the south-east. This report, however, brings out more clearly than ever before, another important feature of these folds; viz., that their axes are not horizontal, but are inclined at an average angle of thirty degrees to the north-east. Since the pitch of the folds is always in the same direction, this involves a series of transverse faults with the uplift on the north-east; and more or less important examples of such faults have already been observed, especially in the iron-mines.

Among the paleozoic strata of this region, none are more interesting, or have proved more puzzling to geologists, than the red conglomerate and associated limestone and slate composing the Green Pond Mountain Range. In the earlier reports of the survey these were referred to the Potsdam, Trenton, and Hudson River groups. The later investigations, however, have resulted in the accumulation of proof, both stratigraphical and paleontological, that these rocks belong much higher in the scale; the red conglomerate being the equiva-

lent of the Oneida, the horizon to which Mather referred it forty years ago, the limestone being clearly of lower Helderberg age, while the slates are shown to belong to the Hamilton group. The Medina, Oriskany, and corniferous groups are also recognized here, and the entire thickness of this great outlier is estimated at 2,750 feet.

Perhaps no formation in this country, equally simple in origin and structure, has provoked so much discussion as the triassic of the Atlantic seaboard. The principal problems which it presents, it is well known, are the monoclinical dips of the strata, and their exact relations to the associated masses of trap. As regards the first, geologists are now pretty generally satisfied that the uniform inclination of the beds is not due to their original deposition on a sloping surface, but to faulting or some similar subsequent disturbance. But, while the studies of Prof. W. M. Davis on the triassic of the Connecticut valley have greatly strengthened the view that the trap sheets of that region are mainly contemporaneous lava-flows, regularly interstratified with the sandstones, Professor Cook is unable to accept this explanation for the trap ranges of New Jersey, holding that they are mainly intrusive and subsequent to both the deposition and disturbance of the sandstone. It is satisfactory, however, to observe that both observers are obliged to qualify the expressions of their views by using the word 'mainly,' which really makes the difference one of degree only; and it may very well be that the trap is more generally intrusive in the one field than in the other, or the exposures of the trap may be more favorable for showing its intrusive aspect in New Jersey and its contemporaneous aspect in New England.

The surface geology is described under the heads of 'glacial drift' and 'yellow gravel.' The former characterizes the surface of the northern quarter of the state, and the latter of the southern three-quarters. The problems of the age and origin of the yellow gravel are discussed at some length, but not satisfactorily solved.

The concluding chapters on economic geology treat of the iron and zinc mines, the cretaceous and tertiary marl-beds, water-supply, and drainage.

CHALLENGER REPORT.

THREE enormous volumes, aggregating over eighteen hundred pages and one hundred and forty plates, represent the contribution of the Challenger expedition to the scientific knowledge of this attractive group. The reporter, Prof. E. Haeckel of Jena, has devoted some ten years to

Report of the scientific results of the exploring voyage of the Challenger. Vol. xviii.: Radiolaria. London, Government. 4°.

the study of the collection, and his work forms the largest single report of the whole series.

The Challenger expedition found Radiolaria universally distributed throughout the ocean, and their skeletons nearly equally wide-spread over its bottom; their relative abundance and species differing in different localities, and these differences being correlated with some of the most interesting and intricate problems of general oceanography. It was fortunate, as observed by Dr. Murray, that so distinguished a naturalist should have been willing to undertake a task so laborious and lengthy as the examination of the thousands of minute forms obtained by the Challenger. Professor Haeckel, as will be seen by the most cursory examination of the plates, was extremely fortunate in having the co-operation of Mr. Adolf Giltseh, who made all the drawings of the sixteen hundred new 'species' figured for the report.

The Radiolaria are marine rhizopods, whose unicellular body always consists of two parts, — an outer calymma, which has no nucleus and from which the pseudopodia extend; and, separated from this by a membrane, an inner capsule with one or more nuclei, serving as the special organ of reproduction and general organic centre. Digestion and relations with the outer world in general are attended to by the calymma, and the distinguishing feature of the class is furnished by the constant capsule-membrane separating the two layers. The radiolarians are usually furnished with a skeleton which presents the greatest beauty and utmost variety of form, and is generally composed of silica, or, in certain cases (Acantharia), of an organic substance called 'acanthin.' The individuals are usually single: in only a small minority are the unicellular organisms united in colonies or caenobia.

A systematic catalogue, which forms the termination of the work, and includes all the Radiolaria known up to 1884, contains twenty 'orders,' eighty-five 'families,' seven hundred and thirty-nine 'genera,' and four thousand three hundred and eighteen 'species.' It is hardly necessary to say that these groups have no such value in terms of organization as those in common use by systematists for higher groups of animals. Professor Haeckel's attitude toward systematic biology is analogous to that of an anarchist toward the civil law, and, like that, if adopted by all naturalists, would be likely to result in an indefinite number of individual despotisms. The multiplication of names and groups, apart from their value in relation to other organisms, is pretty well justified by the enormous number of differentiable forms described. It is more than probable, also, in the absence of discriminative natural selection operat-