

illustrated the anatomy of the 'true ear' in jelly-fishes, mollusks, birds, fishes, snakes and vertebrates. An interesting discussion followed this paper in which Messrs. Kingston, Evans, R. B. Whyte, besides the lecturer, took part.

Mr. Andrew Halkett of the Marine and Fisheries Department, then read his paper 'On Gannets and Cormorants, with special reference to Canadian forms.' His paper was full of interesting notes of observations in the field and on the shores of the Atlantic and Pacific in British North America.

(1) 'Note on the Occurrence of *Remopleurides* in the Upper Trenton (Ordovician) of Ottawa, Canada; (2) 'On a new species of *Turrilepas* from the Trenton limestone of Governor's Bay, Ottawa, Canada,' are the titles of two brief papers presented by Dr. H. M. Ami. Brief descriptions of each were given and the salient points of difference between them and their nearest allies indicated. The *Remopleurides* is new and nearer *R. Canadensis*, Billings of the Chazy, whilst the *Turrilepas* (opercular valve) is distinct from the only form known from the Ordovician of the Ottawa Valley, viz.: *Turrilepas Canadensis* Woodward, described in 1880, from the Utica formation.

Dr. Ami then drew the attention of the members present to Professor W. H. Hobb's paper 'On the Diamond Field of the Great Lakes,' a subject of considerable importance, and gave an abstract of the results reached from a careful scientific enquiry into the facts relating to the eight specimens of diamonds discovered in glacial and other gravels of Wisconsin, Ohio and Michigan—in material which came over during the glacial period from Canada. This paper was illustrated with lantern slides as was also the next 'On the Principal Places of Geologic Interest about Ottawa,' in which several interesting sections were given and the attention drawn to work still remaining to be done. Mr. A. E. Barlow's paper 'On the Bridge-water Conglomerates,' was taken as read owing to the absence of the author from town. Interesting discussions took place on the specimens exhibited at the meeting and other points of interest in connection with the papers read.

DISCUSSION AND CORRESPONDENCE.

BUCKLEY ON THE BUILDING AND ORNAMENTAL STONES OF WISCONSIN.*

PROFESSOR MERRILL's review of this book I have read, † and in some respects it seems to me to do an injustice to Dr. Buckley.

A State Geological report may be reviewed from the point of view of the citizens of a state, or as a report primarily designed for scientists. It is the latter view which Mr. Merrill, who is connected with a national institution, has naturally taken. The book is objected to upon account of its size. This criticism is perfectly justified from the point of view of general science. However, the citizens of the State of Wisconsin interested in the stone industry desire detailed descriptions and tests of the stones furnished by each of the important quarry centers of the State. Therefore the publication of this material is fully justified in a State report. Of course, the reader who is interested only in science may omit this part of the subject.

In respect to crushing strength tests, of which Mr. Merrill speaks so lightly, whether he is right or not in reference to their uselessness, they must be made in order to promote the building stone industry in a state, for the strength of a stone is one of the questions which an architect invariably asks, and therefore one which the owner of the quarry must be able to answer provided he wishes to put his stone on the market.

Moreover, beside being justified on account of the local value, Dr. Buckley's strength tests do contain material which is of general scientific interest. For instance, Dr. Buckley finds that a number of the limestones of Wisconsin have the enormous crushing strength of 30,000 to 40,000 pounds per square inch (p. 392). Also a number of granites in Wisconsin have crushing strengths which run between 40,000 and 50,000 pounds per square inch (p. 390). The strengths of these rocks are unparalleled by any previous rocks tested. They therefore have an important bearing upon the general scientific question of the depth of the zone of fracture.

* Bull. No. IV. Economic Series No. 2. Wisconsin Geological and Natural History Survey. 1898.

† SCIENCE, N. S., Vol. XI., No. 262, pp. 24-25.

Of Dr. Buckley's explanation, p. 383, of the unfavorable action of freezing temperatures, Mr. Merrill says there is 'an unconvincing air of freshness.' For my own part, I think Dr. Buckley is correct in his explanation of the resistance which many porous rocks, like sandstones, exhibit to alternate freezing and thawing, while other rocks which may contain no more than one per cent. of pore space suffer severely under such conditions. This matter cannot be fully expounded in this review, but Dr. Buckley's explanation in brief is that in rocks in which the pore spaces are large and connected, the water is drawn off or distributed by capillarity, leaving the pore space only partly filled by water. When this water freezes there is room for expansion within the pores without rupturing the rocks. On the other hand, in some rocks in which the pore spaces are very small and discontinuous, the pores remain entirely filled by water, and when they freeze the expansion ruptures the rock (pp. 20-25, 374-375). Dr. Buckley's conclusion is fully warranted by his experiments, which show that fine-grained, compact limestones and granites which have a very small pore space, often lose more in strength by freezing and thawing than do the sandstones having a large percentage of pore space. I am not aware that experiments have before been made which show the actual effect of freezing and thawing on the strength of the rocks. Nor have experiments shown the relation of the size of the pores to the diminution in strength due to freezing and thawing, and Dr. Buckley's results on this point are believed to have economic value. However, whether this be so or not, they have a scientific value bearing on the disintegration of rocks in the belt of weathering.

Another matter discussed, upon which Dr. Buckley has made a contribution of general value to the science of geology, is the more accurate determination than has heretofore been done of the pore space of rocks. Tolerably well indurated sandstones he finds to vary in pore space from 10 to 20 per cent. or more, and in one case, that of the Dunnville sandstone, the pore space is over 28 per cent. (pp. 402-403). These results are of great importance as showing the actual amount of material which

must be added by underground waters in order to completely cement a rock. From Dr. Buckley's results it is a safe inference that in the cementation of clean sandstones to quartzites, there must have been contributed by underground waters at least one-quarter of the entire volume of the rocks. In determining the pore space of building stones, their specific gravities have also been obtained by a method more accurate than has heretofore been used.

Dr. Buckley's observations on joints in the State of Wisconsin (pp. 458-459, Pl. 49) have an important bearing upon structural geology. These observations are shown upon the map and indicate that the dominant joints of the sedimentary rocks of Wisconsin are in nearly vertical position and in two sets nearly at right angles to each other, trending NW-SE and NE-SW. The position of these joint systems with reference to the folding has an important bearing upon theoretical structural geology which cannot here be discussed. In connection with certain structural work of my own I have searched for such information in many volumes, but nowhere else have I found a set of observations upon joints over so wide an area.

In conclusion it seems to me that the size of Dr. Buckley's book is justified by the necessity of putting in a State report the information which the people of the State wish. It seems to me further that the report differs from a number of previous State reports in containing considerable material which is of general value to geology.

C. R. VAN HISE.

HYDROSTATIC VS. LITHOPIESTIC THEORY OF GAS WELL PRESSURE.

THE paper read at the Orton Memorial Meeting at Columbus, entitled 'Edward Orton Geologist,' and published in *SCIENCE*, January 5th, contains a reference to Professor Orton's theory of nature of gas and water pressure in gas wells that calls for some comment.

The writer has for some time not been entirely satisfied with the 'Hydrostatic Theory of Gas Pressure.' He noticed that Professor Orton, himself, a short time before he died, expressed himself in a way as to indicate he was not altogether satisfied with his own theory.