the downthrow side of the fault, a fine-grained sandstone occurs, only distinguished from typical Bunter by being somewhat paler. Probably this is, however, a fine-grained Keuper, as at the north-east end of the bank, a few yards away, and about a dozen feet higher up than the fault line, is a mass, *in situ*, of sandstone, coarse, soft, dull reddish-brown, micaceous, and containing rolled marl fragments — undoubted Keuper — so that the Keuper comes right down to the fault plane, or to within five or six feet of it.

We can roughly calculate the throw of the fault thus: At the cave in Mount Segg [see Sketch Map] the dip is 9° at right angles to the scarp. At the Bunter Quarry, on the Bissell Hill scarp, the dip is about 13° at right angles to the scarp. We may assume the dip to remain fairly constant for the distance between the two scarps. Taking its average value as 11°, which is equivalent to a rise of 1 in 5, and the rectangular distance between the respective boundary lines as 2200 feet, we have in 2200 feet a rise of 440 feet, *i.e.* the base of the Keuper at Bissell Hill, had there been no fault, would have been 440 feet higher than at Mount Segg. But we find that it is actually at about the same altitude, viz. 300 feet above sea-level. There must, therefore, have been a downthrow to the north-west of about 440 feet, and without this the Keuper would have been long since removed.

The fault is represented in the Sketch Map as a single line of fracture dying out in each direction. Whether this is really the case is open to question, as there is no evidence to be obtained. It may continue, perhaps, in a south-westerly direction to merge into a fault which passes near the village of Churchill,[1] each having a downthrow to the west.

Conclusion.—We have seen that the top beds of Bissell Hill agree perfectly with the Keuper Beds [f 5] of the main escarpment, and that the lower beds of each agree in being undoubted Upper Bunter [f 3]. The Keuper capping is isolated from the main mass and is therefore an outlier, and has been produced by the downthrow of a strike fault parallel to the two escarpments.

At A and B [on the Sketch Map] are scattered numerous rock fragments, chiefly derived from the Clent district to the north-east.

NOTICES OF MEMOIRS.

NOTE ON A PAPER ON "EOZOÖNAL STRUCTURE OF THE EJECTED BLOCKS OF MONTE SOMMA."

IN a letter to the Editor, Sir W. Dawson, of Montreal, has communicated his reasons for the belief that the appearances described lately by Dr. Johnston-Lavis and Dr. J. W. Gregory, in their paper on "Eozoönal Structure of the Ejected Blocks of Monte Somma,"[2] have no relation to *Eozoön Canadense*, either in mode of occurrence and mineral character or in microscopic structure. He

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[1] See Geol. Survey Map, Sheet 54 N.W.

[2] Scientif. Trans. Roy. Dublin Society, series ii, vol. v, part vii, pp. 259-277, five plates; October, 1894.

refers especially to the typical specimens of Eozoön in which the laminæ remain as calcite, while the chambers are filled with serpentine, or more rarely with malacolite, and the canals and tubules with serpentine or dolomite.

1. As to mode of occurrence and mineral character, in the Vesuvian paper it is wrongly stated that the typical Eozoön is enclosed in a pyroxenic igneous rock. The best specimens have all been found in the thick "Grenville Limestone" of Sir William Logan, estimated by him at 750 feet in its average thickness, though with a few intercalated thin bands of gneiss and quartzite. In the vicinity of Côte St. Pierre in the Seigniory of Petite Nation, where some of the best specimens of Eozoön are found, the outcrop of this limestone has been traced continuously and mapped by the Geological Survey for twenty-five miles, and in the same district it occurs over an extent of more than one hundred miles on the reverse sides of synclinal and anticlinal folds, where it may be recognized by its character and associations as well as by its holding Eozoön. It is true that grains, nodules, and thin interrupted bands of a white variety of pyroxene (malacolite) occur sparingly in this limestone; but neither in their chemical composition nor in their mode of occurrence have we any proof or even probability of an igneous (intrusive) origin. This was the matured conclusion of the late Dr. Sterry Hunt; and Dr. F. D. Adams, at present our best authority on these rocks, is of the same opinion.

The Grenville Limestone has been much bent and folded, and with its accompanying beds has been subjected to regional metamorphism. In the Petite Nation localities, however, it has not, as far as known, been invaded by igneous dykes or masses.

Specimens of Eozoön included in this limestone vary from single individuals ranging from an inch to six inches in diameter to aggregated groups of a foot or more; and microscopic examination shows that, in some of the beds in which they occur, there are innumerable fragments showing the same structures scattered on the bed-planes, and associated with the minute globular chamberlets which I have named *Archæosphærinæ.* The specimens of Eozoön may be seen weathered out on the surfaces of the limestone exactly in the manner of Stromatoporæ on the surfaces of the calcareous rocks of the Cambrian, Ordovician, and Silurian.

In certain layers of the Grenville Limestone grains and concretions of serpentine and malacolite occur without Eozoön, and specimens of Eozoön with only so much of such minerals as may be contained in their chambers. There are also instances in which specimens of Eozoön occur attached to or partially imbedded in such nodules, just as Sponges and other organisms occur associated with flints in chalk, or as Stromatoporæ occur in connection with concretions of chert in Palæozoic limestones. The origin of the concretions themselves must have been contemporaneous with the formation of the limestone.

2. *Form and Structure.*—An inverted position of Eozoön seems to have been adopted by the authors of the paper and by Zittel.

Although the plates apparently show some of the forms described in the paper as lying parallel to igneous veins, and as their selvages, or as rounded masses like nodules and geodes, on closer inspection essential differences may be observed. The Vesuvian specimens consist of continuous laminæ of crystalline igneous matter, including interrupted or lenticular layers of calcite. Eozoön on the contrary, when well preserved, consists of a continuous skeleton of calcite made up of broad layers slightly pitted on their surfaces, and connected at intervals; while the siliceous material appears as a substance filling wide flattened mammillated chambers more or less limited, and presenting amœboid lobes at their extreme edges, and passing finally in the upper part into rounded chamberlets. This difference should commend itself to any palæontologist, but I am aware that it may be overlooked by cursory observers. Scores of specimens have been sent to me of banded rocks, supposed by their finders to resemble Eozoön, though, in arrangement of parts, the converse of it.

Perfect detached individuals of Eozoön are usually of inverted conical form, springing from a narrow base and widening upward in the manner of some sponges and corals. When close together they often become confluent, and when these confluent masses or layers appear to be hollow or doubled, I believe that this usually results from the folding of the containing bed; and the laminæ may be observed to be bent and crushed at the flexures.

In the specimens figured in the paper, the characteristic microscopic structures of Eozoön are entirely absent. There is no trace of the beautiful and complicated system of canals; and the fibrous structures compared with the minute tubulation are merely prismatic fibrous crystals, like the secondary veins of chrysotile which sometimes cross and deteriorate our specimens of Eozoön. With reference to these chrysotile veins, while their filling of minute and often transverse and branching cracks shows that they are merely aqueous deposits of later origin than the structures which they traverse, and while their appearance under high powers is very different from that of the tubuli of the calcite layers, they have no doubt been, when parallel to the layers, and in poor specimens, fertile causes of error. They are absent from the more perfect specimens. I may also explain that while the finely tubulated margin of the calcareous layers can be seen to terminate abruptly against the filling of the chambers, it passes gradually in the interior of the layer into the larger canals when these are present. Naturally also, the finely tubulated wall often fails to show its structure, just as anyone who has examined large series of sections of Nummulites may observe in these fossils; and the tubuli are often filled with dolomite or calcite very difficult to distinguish from the substance of the calcareous lamina.

The late Dr. Carpenter quite understood the distinction between the veins of asbestiform serpentine and the organic structures, and he hoped to have prepared an exhaustive memoir on the subject, including my material as well as his own. Had this intention been fulfilled many subsequent mistakes might have been avoided.

The writers of the paper do not seem to notice that in the St. Pierre specimens the fine canals and tubuli are often filled with transparent dolomite, difficult to perceive without very good preparations and properly managed light. In roughly prepared specimens, and without careful attention to illumination, these delicate structures are often quite invisible. I have sections properly prepared which show the finest and most complicated tubulation in a manner equal to anything I have seen in any fossil Foraminifera from more recent formations, while other slices cut from the same specimen, but possibly slightly heated or subjected to mechanical jars in polishing, show little except a curdled appearance of the serpentine and a multitude of cleavage-planes in the calcite. In like manner in preparing decalcified specimens, a little heat or an acid too strong or not quite pure may remove all the dolomitic casts of tubuli, and may erode those of serpentine. From causes of this kind I fear many who have pronounced very decided opinions on Eozoön have not actually seen perfect examples of its structure.

While, therefore, I must agree with the writers of the paper that their specimens from Somma belong to the category of those banded structures found in concretions and geodes, and at the lines of contact of igneous and aqueous rocks, with which those who have advocated the organic origin of Eozoön are not unfamiliar, and which they have all along been solicitous to distinguish from it, I must emphatically deny that they resemble, either in composition, mode of occurrence, or form and structure, the Laurentian Eozoön of Canada.

REVIEWS.

I.—SYNOPSIS OF THE AIR-BREATHING ANIMALS OF THE PALÆOZOIC [ROCKS] IN CANADA, UP TO 1894. By Sir WILLIAM DAWSON, C.M.G., LL.D., F.R.S. Pages 71–88, from the Transact. Roy. Soc. Canada, Section IV, 1894.

LITTLE more than fifty years ago very few relics of any *air-breathing* animals were known to exist in strata of Palæozoic age. Since then Canada, especially the Eastern Province of the Dominion, has yielded numerous interesting examples of such animals, high in grade above the common kinds of fossil creatures of protozoan, cœlenterate, and molluscan families. Logan's discovery, in 1841, of fossil Batrachian footsteps in the Lower Coal-measures at Horton Bluff, in Nova Scotia, was the first indication of the existence of air-breathing vertebrates in the Carboniferous rocks (Proceed. Geol. Soc. London, vol. iii, 1842, p. 712). In 1844 Dr. King announced the discovery of foot-prints in the Carboniferous of Pennsylvania; and Von Decken the finding of skeletons of Batrachians in the coal-field of Saarbruck. The first discovery of the osseous remains of any Palæozoic land vertebrate in America was that of *Baphetes planiceps*, found by Sir W. Dawson in the Pictou coal-field in 1850 (Quart. Journ. Geol. Soc. vol. x, 1856,