

penetrate one another, to dovetail into each other, and gradually to blend one into the other, both in lithological character and fossil contents.

Will any palaeontologist take it on himself to say that there is a greater difference between the fauna of the Atlantic chalk and the chalk of England, than there is between the lower and upper divisions of the rocks of the Carboniferous period? Of course the Atlantic chalk is not to be represented only by the low forms found in the deep-sea soundings, as they do not represent its entire fauna. Years ago the late Mr. Salter pointed out at Glengariff, Co. Cork, that more fossils occur at changes of strata than elsewhere; such as the uppermost limits of a series of argillaceous or arenaceous beds, or at the top of a bed, if grits and shales alternate. This I have since found to be a good general rule, more especially when subordinate beds appear in a group. In Limerick, as well as other places in Ireland, masses of limestone may be without fossils, or, at least, conspicuous fossils; but if subordinate beds appear, such as the cherty zones, the aspect of affairs immediately changes, and, as a general rule, the rocks immediately subjacent to such changes are almost entirely made up of fossils and their *dbris*. Similar changes are not only possible, but also most probable, in the Atlantic chalk. However, they are not likely to be proved in our day. But as in the limestone, so in the Atlantic chalk, in such places the mass of the fossils belonging to the latter ought to be found.

In considering such a question as the present, I would suggest that such fragile accumulations as those of the Kainozoic epoch ought to be considered of only minor importance; as most of them would be denuded away as the land sank, while those that chance to remain would only form very subordinate strata. Moreover, Edward Forbes long since suggested that both from palaeontological and petrological considerations, it might be better if the division between the Mesozoic and Kainozoic epochs were obliterated. Furthermore, it has to be borne in mind that while in new strata very minute breaks can be detected; in old strata, like the Carboniferous period, it would be nearly impossible; and most of the great advocates for the minute division of the newer rock would not allow them in the old, as they explain everything they cannot understand by a "fault."

Connemara, Jan. 29

G. HENRY KINAHAN

#### Eozoön Canadense

THE organic nature of Eozoön Canadense may, I trust, be regarded as established conclusively by the evidence which has been adduced by Dr. Carpenter, Dr. Hunt, and myself, and I think I am safe in saying that it is accepted by all or nearly all those best qualified to judge. Since, however, the doubts expressed by your correspondent, Mr. Reade, may be shared by many who have not had full opportunity to satisfy themselves on the subject, I think it may be useful once more to direct attention to the facts serving to answer the objections which he has stated, and which, on more full consideration of the questions involved, I trust he may abandon.

Your correspondent objects: First, That the supposed Liassic serpentine or ophiolite of Skye shows structures similar to those of Eozoön. In answer to this it is not necessary to have recourse to the supposition that creatures similar to Eozoön have continued to exist up to the Liassic age, since, as Dr. Hunt has shown,\* there is reason to doubt the accuracy of the observations which refer this rock to the Liias; and, further, Profs. King and Rowney, in a recent paper on Eozoön in the Proceedings of the Royal Irish Academy,† have figured this supposed Eozoön, and have thus shown that the portions of it which they consider similar in structure to the Canadian specimens do not possess such structure. I would not, in any Canadian specimen, accept such appearances as those represented in their figure as the Eozoön. This objection is therefore wholly irrelevant.

He objects: Secondly, That Eozoön occurs only in metamorphic rocks, and usually mineralised by serpentine. To this I answer: (1.) It unfortunately happens that Eozoön is a fossil of the Laurentian period, and that the rocks of this age are in a more or less metamorphic state in every part of the world where they are known. When we shall have found unaltered Laurentian rocks it will be time to inquire if this fossil occurs in them, and in what state of preservation. (2.) I have elsewhere shown that the chambers and canals of Eozoön are filled not only with serpentine but with other mineral substances, as

Loganite, Pyroxene, and Calcite. There is thus, as Sir William Logan affirmed previous to the discovery of the minute microscopic structure, no connection between the forms of the supposed organism, and the mineral substances in connection with which they appear.

In the third place, in order to be enabled to make the assertion above referred to, your correspondent "disposes of" the Tudor specimen, which, as compared with the others examined, occurs in a comparatively unaltered sediment. With regard to this specimen, I affirm, and the published figures show: (1) that it presents the characteristic features of Eozoön, more especially resembling the specimens from the Calumet and from Perth; (2) that other specimens found in the same locality confirm its determination as Eozoön; (3) that the matrix containing the Tudor specimens is a coarse limestone not more metamorphic than many Silurian beds holding fossils. I have, however, to state that the recent explorations of Mr. Vennor, of the Geological Survey, seem to show that the beds which afforded the Tudor specimen, though unconformably underlying the Lower Silurian, overlie the highly metamorphic Lower Laurentian of the district, and, therefore, instead of being, as heretofore supposed, comparatively unaltered Lower Laurentian, they may prove to be even as late in age as the Cambrian. It is in these rocks that the worm-burrows which I observed some time ago occur.\*

Fourthly, he alleges imitative forms which Profs. King and Rowney consider to be "identical with the thing itself." Now, imitative forms are not unknown to palaeontologists. I have seen rill-marks figured as fossil leaves, and trails of worms and other mere markings, as fossil plants of various kinds; and many dendritic crystallisations are wonderfully like mosses and algae. I have on my table at this moment a curious group of rounded concretions of black oxide of manganese in a coal-formation sandstone, which I received a few days ago from a very judicious collector, who believed that it was an undescribed fruit. But such things do not invalidate the evidence of real fossils. It is to be observed, however, that while it is extremely easy to assert that such imitative forms are identical with fossils, and even to make this appear plausible in descriptions and drawings, careful examination of actual specimens, with attention to chemical conditions and modes of occurrence, may be necessary in order to draw the proper lines of distinction. In the case of Eozoön, the imitative form has neither been shown to unite the general arrangement, microscopic structure, and mode of occurrence of the fossil, nor perfectly to resemble it in any one of these respects.† In so far as my own comparisons have extended, I am prepared to demonstrate the difference between all such crystalline, dendritic, and concretionary forms, and the Canadian Eozoön.

Your correspondent merely confines himself to general assertions and to starting difficulties. His authorities, Profs. King and Rowney, in the paper above referred to, have ventured on the more dangerous ground of constructive criticism, and have endeavoured to explain the way in which they suppose Eozoön to have been produced. In doing so they have been obliged to resort to an extravagant and complex theory of pseudomorphism, which I fancy most of the palaeontologists will throw down in despair of comprehending it, and which I am sure any competent mineralogist or chemical geologist who studies it, will reject as much more trying to his faith than anything required to explain the occurrence and preservation of Eozoön as a fossil.

Lastly, your correspondent desires further investigations with reference to the questions involved in the organic character of Eozoön. It may satisfy him to be informed that Dr. Hunt and I have just sent to Dublin a reply to the objections of Profs. King and Rowney, in their paper above referred to; and that I have for some time been pursuing investigations of Primordial and Silurian fossils akin to Eozoön either in structure or mode of preservation. When these investigations are completed, I hope to show that Eozoön has several foraminiferal successors in the older paleozoic rocks of Canada, and that fossils of various kinds occur in those rocks infiltrated with mineral matters in a manner not dissimilar from that observed in the Laurentian Eozoön.

J. W. DAWSON

McGill College, Montreal, Jan. 18

#### Natural Science at Cambridge

"M. A." will best satisfy himself as to the grounds for the sentence which appeared in NATURE for January 12, to which he

\* Silliman's Journal, March 1870.

† Proc. R.I.A., July 1869.

\* Journal of Geological Society, xxii. 608.

† Messrs. Rowney and King themselves virtually admit this.