

of structure consisting of small parts of canals filled with the dark colouring matter of the limestone," and in only "a few rare instances" are detected "with a higher power in the margin of some of the septa traces of the fine tubulation characteristic of the chamber wall of *Eozoön*." 3rd. It is almost an isolated example, and the measure of the metamorphism of its matrix together with its character—organic or otherwise—from its generally doubtful nature as shown by Dr. Dawson's own description) could only be ascertained and settled by independent inquiry.

I may also here observe that other cases of "chambers and canals stated to be injected with calcite appear to me to be of a no more reliable character. If, indeed, we accept the Tudor specimen and Madoe fragments as *Eozoön*, why refuse this term to the Skye specimens which apparently possess the true features (chamber casts and nummuline layer) in a much more marked manner? As regards imitative forms, Dr. Dawson and myself are in agreement, excepting that I must contend, from all the facts we are acquainted with, that *all* *Eozoön* forms are imitative, and not merely those that the exigencies of the discussion demand looked at from the organic standpoint.

Respect for your space prevents me going into further details, but I may be permitted to suggest that the truth of the matter in no way hinges upon the possibility of comprehending the constructive pseudomorphic theories advanced by King and Rowney. In what way though, excepting by pseudomorphism, I would ask, does Dr. Dawson account for the presence of the *imitative forms* which he thinks have confused other observers? And if we believe pseudomorphism to have originated them, why is it so trying to our faith to consider *Eozoön Canadense* to have been formed in the same manner? The fact is, chemical geology and the replacement and alteration of minerals—occurring as they do in the forms of other minerals—have been little studied by palaeontologists, or probably *Eozoön* might have remained "unconstructed" to this day. It is well known that not only do minerals assume by replacement the crystalline forms proper to the mineral replaced, but also amorphous shapes filled with one mineral may be replaced by another without in any way destroying the original form.

There can be no doubt that a little knowledge of this kind would have infused the necessary caution, and have prevented anyone accepting as a fossil that which required the invention of a method of chemical deposition (excepting in these pages) hitherto unknown in nature. Serpentinous marble, as we may ascertain from all sources, is the typical *Eozoön* rock, and, though the minerals filling the so-called chambers and canals may be Loganite or pyroxene, in addition to the serpentine, they are intimately related in a pseudomorphic point of view. Loganite and serpentine, as I have before stated, are both products of alteration. The organic hypothesis demands that we should consider the infilling to be, as contended for by Dr. T. S. Hunt, the *same mineral originally supposed to be deposited therein*. If this be so, then what becomes of the meaning of metamorphism? This to me is a trial of faith greater even than the acceptance of King and Rowney's "constructive criticisms."

I await with interest the publication of the papers sent to the Royal Irish Academy by Dr. Dawson and his colleague, Dr. Hunt, and trust they may contain new matter for consideration, as my only object has been to elicit further evidence, if there be any, in favour of the organic hypothesis.

Feb. 17

T. MELLARD READE

Ocean Currents

IN reference to Mr. Laughton's letter in *NATURE* of the 23rd of February, I must admit that the question of the movement of barometric depressions was not introduced into my first letter, for the reason that I did not anticipate the objection of a state of equilibrium which he raised, since the average differences of pressure only were dealt with; but I do not see that it necessitates a change of ground to show how this difficulty is met by the variations which occur in the region of lower average pressure, and how these changes themselves, taking place in a certain line of movement, might affect the surface currents of the ocean; and I am not disposed to accept the sweeping rejection of the whole power of differences in the atmospheric pressure, permanent or moving, which is contained in the last paragraph of the letter referred to, until more extended observations shall show what directions the great movements of changing pressure take in passing over the parts of the ocean which lie outside of the trade wind regions.

The action of a barometric depression in moving over the sea differs entirely from that of the winds in this, that by the former the level of a large area of the ocean surface may be raised and carried along with the depression round which the winds blow, whilst by the force of the latter the waters can only be drifted at the same level before the wind.

I have been particularly careful to suggest difference of atmospheric pressure only as a supplementary power in the production of ocean streams, not as a chief one, and it was indeed the partiality of the various theories of the causes of currents which led me to open the subject at all.

That the trade winds have a very large share in originating the Gulf Stream is undoubted, but that they can account for the whole of the phenomena of ocean currents, as Mr. Laughton maintains, appears more than doubtful.

The existence of the under outflowing current of the Mediterranean, corresponding to the inflowing surface stream, has been abundantly proved by the recent Government expedition under Dr. Carpenter. If this current be due to the action of the winds alone we should expect to find the direction of the upper and under streams reversed with a change of wind to opposite points east or west in the Strait. But the observations on the direction of the winds for six years at Gibraltar show that westerly winds (from N.W., W. and S.W.) prevail there for 198 days in the year, and easterly winds (N.E., E., and S.E.) for 144 days; further it happens that in the months of July, August, and September, in one of which the observations on the outflowing under-current were made, east winds prevail in the ratio of two days to one day of west wind. Experiments similar to that used to determine the presence of an under-current in the Strait of Gibraltar, have been made in the open ocean, and Maury (at p. 206 of the 9th edition of his work) quotes an instance of an apparatus constructed of a block of wood, sunk by weights to 500 fathoms, and attached by a line to a small floating barrel, having moved off "against wind and sea, and surface current." The members of the late German Arctic expeditions have observed that where the warmer blue waters moving from south-westward meet the impure waters of the Spitzbergen and east Greenland current, there is a definite line of demarcation which would indicate that the Atlantic water here dips down beneath the specifically lighter water of the ice-bearing current, a conclusion which is supported by the increase of temperature with the depth beyond this point.

Such under-currents can in no way be primarily caused by the action of the winds, and if difference of temperature and density must be called in to account for them, it must be admitted that these causes have to do with the upper streams also.

I would take this opportunity to correct a statement made in my second letter, of a probable movement of a barometric depression across the British Isles at the rate of ninety miles an hour. The depression there referred to appears to have had an oblong form, the longer axis moving nearly parallel to the length of the British Isles from N. to S., so that the record of its passage took place at Valentia and at Aberdeen within a short interval of time, thus giving an apparently great rate of travelling. But I have the authority of the Secretary of the Meteorological Office for the facts given beneath, which prove that a rate of depression movement of upwards of seventy English miles an hour may take place. On the 16th of December, 1870, a minimum reading of the barometer was registered at Valentia at 2^h 45^m P.M.; at Kew, at 9^h 30^m P.M.; at Yarmouth, at 10^h P.M., where the mercury remained at the same level for four hours. The interval of time between the registrations at Valentia and Yarmouth is 7^h 15^m; the distance between these places is 520 miles. It seems probable also that the centre of the depression moved directly from Cork to Yarmouth, for the wind records prove that it passed north of Falmouth, and south of Holyhead and of Valentia.

KEITH JOHNSTON, JUN.

Perpetual Motion

PROBABLY your sense of justice will induce you to insert some very brief remarks on your review of my article in the *Quarterly Journal of Science*. The tone of the review is a penalty which all who venture to impugn commonly accepted theories must be prepared to submit to. Heresy in science meets with as little mercy as heresy in theology. I confess that in one sense of the word I am consciously a perpetual-motionist, but not in the sense of believing that any merely mechanical contrivance can produce