

ejectamenta of volcanos. These and other phenomena, such as that which I shall shortly mention, have been too much ignored by mathematicians in treating of the subject. To suit the exigencies of the calculus, they assume the earth to be homogeneous throughout, and either fluid, viscous, or elastic, and take no account of any greater rigidity existing in the surface than in the parts beneath it. Mr. Darwin, for example, in his paper on the Stresses of Continents and Mountains, assumes that the earth must be strong enough to bear the stress arising from their weight. But it is a fact well known to geologists that the parts of the earth's surface which have a tendency to sink are not the mountains, but the sedimented areas, the river plains, and the bottoms of shallow seas. The tendency of the mountains, on the other hand, is to rise, so as partially to compensate for what they lose by denudation. In short, the crust of the earth bears a close analogy to a floating field of ice, broken up, crushed together, and refrozen; and no one would argue that there could be no fluid stratum beneath it, because some blocks of ice stood higher than others; for he would know they would receive sufficient support from their under sides sinking deeper into the water.

The above facts show that the substratum must have a less viscosity than the crust. But if the substratum be as rigid as glass or steel, then the crust must be much *more* rigid than glass or steel, which is a *reductio ad absurdum*. For my own part I believe it to be what may without impropriety be called liquid. And if it be asked how it can remain liquid under the pressure of between 20 and 30 miles of superincumbent solid rock, I answer, that recent experiments have tended to show that igneous rocks are denser when melted than when solid at the melting temperature. Consequently we may expect their melting-point to be lowered rather than raised by pressure. If that be the case, solidity would not be induced in such molten rocks by the pressure of the superincumbent crust.

HARLTON, CAMBRIDGE,  
5th January.

O. FISHER.

#### PERMIAN AND TRIAS OF SOUTH-WEST LANCASHIRE.

SIR,—Having read the recent articles on the Permian and Trias by the Rev. A. Irving, F.G.S., and the letters referring to the Permian strata of South-west Lancashire, I beg to offer some further information more recent than that available to Prof. Hull, Mr. De Rance, or Mr. Strahan. During the last week I visited St. Helen's Junction, and in consequence of a fall of *débris* at the side of a pit, found an exposure of ten feet of red marl, containing a layer, a few inches thick, of a greenish colour which effervesces strongly in acid. I and Mr. Strahan saw the sandstone at the base of this section in 1881, but at that time only one foot of the overlying marl was visible. No fossils have been found, or searched for, it being dangerous to approach the spot for fear of falling into the pit. The marl must belong to the beds described in the wells of the brewery many years ago, and most likely represents the Permian.

However, a section of much more importance has just been

obtained from a boring now in progress at Hunt's Cross, Wootton, much nearer Liverpool than St. Helen's Junction, for the particulars of which I am indebted to Mr. A. Timmins, C.E., who is conducting the operation. The spot is near a doubtful boundary-line between the Pebble-beds and the Upper Mottled Sandstone, on the Geological Survey Map. After passing through 137 feet of drift a bed of marl was found, which has been penetrated to the thickness of 200 feet—337 feet from the surface—without reaching the bottom of it. It would be absurd to call this marl Lower Mottled Sandstone, and most likely it is Permian, just below the Pebble-beds, which is the usual succession in the country to the east of the boring. Before the age of this marl is finally decided, it is very desirable that fossils should be obtained, if any occur in it, but the stuff comes up the bore-hole in the condition of powdered dust, so that there is little chance of finding any at present. Now that attention has been directed to the importance of finding fossils, it is to be hoped that they will soon be found in some of the localities where the marl occurs. Meantime it seems probable that the marl occurs between the Pebble-beds and the Lower Mottled Sandstone, and that all the strata below the former belong to the Permian in the country around Liverpool, as I understand to be the case about Manchester.

G. H. MORTON.

P.S.—From the great thickness of the marl at Hunt's Cross, it is just possible that the boring may be in the Keuper Marl, but even that would be very extraordinary.

#### THE PERMIAN QUESTION.

SIR,—May I be permitted to point out an ambiguity which has crept into the discussion of the Permian-Trias question in this MAGAZINE? The term "Upper Permian" has been used by me consistently to indicate beds (marls and sandstones) which occur *above* the Magnesian Limestone series, which Murchison designated "Bunter Schiefer." Such a use of the term implies that the Magnesian Limestone series would, in a threefold classification, fall into the place of Middle Permian, as in the "Student's Elements." The sense in which I have used the term "Upper Permian" is that in which it was formerly and recently used by Prof. Hull, and by Mr. De Rance in the table of the Lancashire Permian Strata which appeared in my paper of last month. The latter gentleman, in last month's Number, uses "Upper Permian" for what (in the classification I originally ventured to criticize) would be called Middle Permian. Of course, if the threefold division be given up, these become the upper member of a dual series, the existence of which I have not called in question. All therefore that Mr. De Rance has recently urged, as well as the evidence put forward quite recently by Prof. Hull, is beside the point at issue.

WELLINGTON COLLEGE,  
Dec. 9th, 1882.

A. IRVING.

WE regret to record the death of one of our contributors to this MAGAZINE, Mr. Edward B. Tawney, M.A., F.G.S., Conservator of the Woodwardian Museum, Cambridge. We shall give a full notice of his work next month.