Although no one acquainted with the care bestowed upon this description of work at Greenwich would for one moment think of impugning the accuracy of these estimations, they show precisely the excess of whole seconds that is taken in the before-mentioned article as indisputably proving the carelessness of the tabulations at the Kew Observatory.

As regards these averages, it is to be remarked that with one slight exception all the numbers that are above or below the theoretical average in one example are above or below in all, and that there is only one case in which the range of difference exceeds 3 per cent. The partiality shown for the figures 0 and 4 is also most marked, and of itself would be enough to show that the same person had made all the estimations.

There is another light in which we may regard these results, which still more plainly indicates my meaning. The decimals ·1, ·2, &c., ought to include all possible positions of the puncture between ·05 and ·15, between ·15 and ·25, and so on; but according to the reader of the chronographic sheets, ·1 includes only those positions of the puncture between ·081 and ·151; ·2 includes those between ·151 and ·230; ·3 those between ·230 and ·319; ·4 those between ·319 and ·481, and so on. Thus the error of any single determination is very small indeed, a remark that will apply equally to the tabulations Meteorological Office.

To show that different observers have very different idiosyncrasies, I may append the following averages similarly determined, this time from the purely astronomical estimations of the time of transit of stars across the well-defined spider lines of the telescope by the method known as eye and ear observation, these estimations being made on a precisely similar principle. From the Greenwich observations of 1864 I find 206 such estimations by Mr. Dunkin, the standard observer at that time; 259 by Mr. Ellis; and lastly, 500 by myself in the present year, made at this observatory, yield the following:—

	1.	2.	3.	4.	5.	6.	7.	8.	9.	0.
D., 1864 ...	7·8	16·5	11·7	12·1	13·6	7·8	9·2	13·6	6·8	1·0
E., 1864 ...	5·4	8·5	7·7	9·7	8·5	11·2	12·4	13·5	12·4	10·8
P., 1875 ...	13·4	13·0	10·6	10·8	7·8	8·6	8·8	13·6	4·8	8·4

Although founded on rather too few estimations, there is little doubt that the salient features would be preserved in a more extended discussion. Thus D's avoidance of whole seconds and the adjacent numbers 1 and 9, E's avoidance of the former of these, and my own of the latter, may be expected confidently, however large a number of estimations are taken into account. The universal fondness for 8 is also noteworthy.

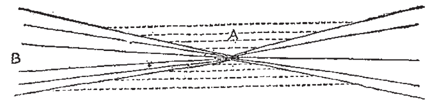
Orwell Park Observatory, near Ipswich — JOHN J. PLUMMER

Source of Volcanic Energy

IN your report of the meeting of the Geological Society in NATURE, vol. xii. p. 79, I find notes of a communication submitted by the Rev. O. Fisher, F.G.S., on Mr. Mallet's theory of volcanic energy, and as I consider Mr. Mallet's paper to be one of surpassing value, I wish to make a few remarks on the criticism of it by Mr. Fisher. Mr. Fisher objects to the possibility of assuming high *local* temperatures to be produced by the transformation of tangential forces into heat, within the earth's crust.

If the strata of which the earth's crust is composed could be represented in a diagram by so many concentric circles of perfect regularity, the crushing force resulting from tangential pressures caused by the regular contraction of the mass would of course be equal all through the mass; but, as a matter of fact, such a diagram would not be a faithful representation of the lie of strata in the earth's crust. These strata occur at all sorts of angles, and are broken in upon by faults of great extent; so the pressures produced upon various parts of the earth's crust are far from equal. These inequalities are also increased by the differences in density of strata as also by the thinning out of strata of the same density.

For instance, a strain may occur somewhat in the manner of the annexed diagram. A set of strata may bear upon a point A, considering the forces to act in the direction BA, CA, and so cause the pressure upon a square foot at A to be a hundredfold greater than on a square foot at B. The work done, therefore, may not be equally distributed over certain areas; but forces may *converge* upon various points, and if the work is thus intensified in certain points, the heat developed in such points must be greater than where the forces are not so concentrated. It seems to me, then, that the rocks at A may be crushed to *fusing-point* by converging forces, while at the same time the rocks of the same set of strata at B may be at a much lower temperature.



If what I have attempted to point out contains no "untenable assumption," the possibility of the developed heat being localised remains intact; and this is certainly the main feature of Mr. Mallet's theory.

Mr. Fisher's objection to the primeval formation of our present existing ocean beds and continents seems a fair one, notwithstanding the fact of the remarkable steepness of the western coasts of all continents remarked upon by Mr. Mallet, but this remarkable similarity of formation may be no more remarkable than the fact of all the great promontories of the world pointing to the south and none to the north. Still, however, Mr. Mallet's paper may help us, for if the tangential pressures produced in the earth's crust be sufficient in some cases to produce long lines of volcanic activity, may they not in other cases be resolved into motions acting in various directions and causing the upheaval of continents and depression of ocean beds?

In conclusion I may remark that if *mere* cooling is not considered sufficient to account for the development of such forces, may not forces produced by gravitation acting in the very same direction be well acknowledged? Not mere gravitation of the surface upon a retreating nucleus, which of course is part of Mr. Mallet's theory, but gravitation of the *whole* mass to itself, which enormous source of energy must also express itself in tangential pressures in the more resisting crust of the earth?

Kenmare — W. S. GREEN

Sanitary State of Bristol and Portsmouth

IN reference to the peculiar low mortality of some large towns in Great Britain, stated in the abstract of a communication to the Scottish Meteorological Society in NATURE, vol. xii. p. 281, as Portsmouth and Bristol, in contradistinction to others apparently in similar circumstances, having a high death-rate, I beg leave to point out that each of these towns is differentiated from the others mentioned in the paper in a *social* point of view more than in physical conditions. There is a large district in each of them, inhabited chiefly by visitors, tourists, retired professionals, and mercantile people, who take up their quarters in Southsea and Clifton, for the period of the regular seasons in each, or for limited tenure of occupation, either with reference to health, pleasure, or education of their families.

These divisions or quarters of Portsmouth and Bristol are under different physical conditions from the parent cities they are attached to, in that they are of separate growth, of later date of construction, better built, and inhabited by a wealthier class of people.

They might be compared to the apple-grafting on a crab-tree, on the old stem of which they flourish, but bear more showy flowers and more luxuriant fruit, and they thus tend to ameliorate the inherent deficiencies of the original tree by adding a higher and more cultivated life.

Topographically speaking, again, these two districts are entirely different from each other, though equally healthy, as above stated, Southsea being built upon a plain near the sea, and Clifton being built upon a hill above a river: the one lies on gravel and the other on limestone, so that these and other material circumstances, oddly enough, can scarcely be thought likely to produce a common result on their sanitary state.

The original towns of Portsmouth and Bristol, however, are nearly alike in some points, but not in others. Both are shipping ports, both are on tidal harbours, both are built along the banks on each side, and are therefore low in altitude above the sea; but the former lies on gravel, while the latter is built on alluvium and red sandstone. Most other large towns are of a homogeneous constitution, as Manchester in manufactures, Liverpool in shipping, Scarborough as a seaside resort, and Cheltenham as an inland watering-place; but Portsmouth and Bristol are peculiar in having this double social composition of a shipping