

### Letters to the Editor.

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#### On Prof. Miller's Ether Drift Experiment.

SOME time ago I was told (I think by Prof. R. W. Wood) that the late Prof. Morley had expressed himself as anxious about the immense superstructure that had been built on the null result obtained by Prof. Michelson and himself during a comparatively few very careful experiments. He was anxious that the experiment should be repeated under different conditions and the result confirmed. We now know that such repetition has been undertaken, at first in connexion with Prof. Morley, by Prof. D. C. Miller of Cleveland, for whose zeal, enthusiasm, and enterprise we must feel high admiration. Not six or a dozen repetitions, but thousands of them, have now been made, on the tops of mountains, on plains, with frames of different materials, and with a sufficient length of light path to give a result of 1 part in 1000 million. The undoubted result of these repetitions has been to confirm the null result of Michelson and Morley, so far as regards the orbital motion of the earth, and thereby establish one of the foundations on which the theory of relativity was at first based, up to what at that date had seemed to be the probable errors of experiment.

Whether there is anything more to be deduced from Prof. Miller's results (he clearly thinks there is) is a matter which is manifestly *sub judice*. His first reported claim, that the result on the top of a mountain was much greater than on a plain, could scarcely be accepted. If that had been true, the ideas involved would have been extremely difficult and revolutionary. It is a relief to know that that, at any rate, is no longer urged. The place at which the experiment is performed seems to matter not at all; and that is a great simplification, for it enables us to open our minds to see whether there is anything that can be admitted in his present claim. Prof. Miller has studied and plotted all his results in an admirable manner; and the only question is whether the outcome should be considered as practically zero, or whether (as he believes) there is a real residual effect which has to be accounted for.

What Prof. Miller now claims to have detected is a drift of the solar system in a direction approximately normal to the plane of the ecliptic, a drift which could not have been observed under the conditions of the early experiments. But the pressing question is whether such a drift has been observed now. That it is contrary to the main postulate of the theory of relativity, namely, that no effect due to motion through the ether can ever be observed, or, in other words, that everything goes on as if the ether did not exist, cannot be cited in opposition. For that is just the postulate which is under examination, and it has never been finally proven; though it has been made plausible by the verification of deductions made by its aid.

The argument of Prof. Miller, as I understand it, is that there is a slight residual effect due even to the earth's orbital motion, but so small that it comes within the limits of what is possible to observe. The effect is by no means of the full magnitude, but is, as it were, diluted down to (say) one-fifth of its theoretical value by some unknown cause, which he conjectures

may be the FitzGerald-Lorentz contraction. It seems just possible that the FitzGerald contraction, though shown by Lorentz to compensate, does not compensate completely. Whether the compensation is complete or not, however, is a theoretical matter of some difficulty, which has not yet been thoroughly gone into, so far as I know, though reference may be made to a short paper by Sir Joseph Larmor in the *Phil. Mag.* for June 1904. If any good reason can be adduced for an outstanding discrepancy, that would strengthen Prof. Miller's position enormously; but until such reason is forthcoming the discrepancy must be doubted.

Assuming for the moment that the orbital motion does show a very slight and imperceptible or barely perceptible residual effect, Prof. Miller claims a larger effect, even ten times as large, which, plotted in accordance with sidereal time, could be accounted for by a cosmic drift of considerable magnitude if that too were diluted down by the same unknown cause and in the same ratio. He does not claim that the main drift of the solar system is observed, but only a residual fraction of it; and unless some reason can be given why there should be this residual fraction, and why the compensation should not be complete, it is dangerous to accept the result as certain, in spite of the skill with which Prof. Miller disentangles it from his multitude of observations and presents it as a small but recognisable and definite result.

The great importance of such a result, if it can be established, must make us very wary in accepting evidence for it, especially in view of the many disturbing causes. Hitherto the observations have been plotted with the view of displaying the reality of this supposed ether drift. But suppose they were plotted with some other object in view. For example, suppose they were plotted on the hypothesis that the south side of the housing of the instrument was slightly warmer than the north side. How would the average curve agree with that? An interferometer with so long a length of light path is a terribly sensitive instrument. The heat of the source of light, the warmth of the body of the observer, the exposure to radiation from the sun on one side and into space on the other, have all to be carefully considered. It is rather surprising that the readings were made by a peripatetic observer, with the instrument in constant and not very slow rotation. Under those conditions even the rotation of the earth might have a gyrostatic influence, and one would have thought that a stoppage of the frame and a reading of the fringes by a seated observer in many azimuths, would have been more satisfactory. It must be admitted as unlikely that an ether drift has been discovered by optical means; but the unlikely is not the impossible.

Assuming that the operations have been made with the cold-blooded and skilled accuracy of a Greenwich observer without regard to any theory whatever, and that the residual effect is genuine, then some result ought to be deduced; whether it be the important one claimed by Prof. Miller, or some more commonplace explanation. Meanwhile, one undoubted result does emerge from all this labour, namely, that the certain motion of the earth in its orbit fails to give any but a minute residual and doubtful effect—which is just the conclusion put forward by Michelson and Morley, a conclusion hitherto accepted by the scientific world. Beyond that there remains a residual effect to be discussed, and either established or negated. The history of science has constantly shown that small residual effects may contain the germ of important discoveries. I hope that it may turn out so in the present instance, though I cannot say that I hope it with any confidence. OLIVER LODGE.