LETTERS TO THE EDITOR.

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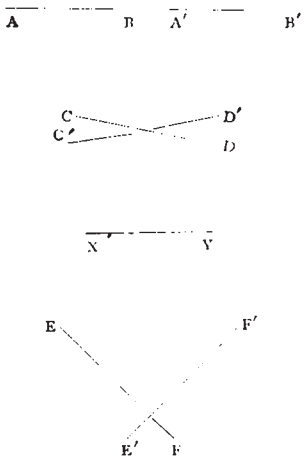
Relative Motion of the Earth and the Ether.

IN recent issues of NATURE and the *Philosophical Magazine*, Profs. Larmor and Fitzgerald and Lord Kelvin have expressed themselves as if satisfied that the negative result of the celebrated Michelson and Morley experiment as to a relative motion of earth and ether is genuinely decisive, and as if the only present escape from the dilemma between this experiment and the bulk of the evidence which necessitates a relative motion of earth and ether is to be found in a possible change of the dimensions of bodies caused by changes in their motion through ether.

I should like to point out that a much less heroic alternative is offered in an article of mine on relative motion of earth and ether in the *Phil. Mag.*, January, 1898. It is there shown that the optical apparatus used by Michelson and Morley was probably in a less sensitive condition than was assumed, and, therefore, failed to determine the very minute distance which was the subject of measurement in their experiment. The argument of my paper can be illustrated by the following considerations. Let AB be a source of light, and let A′B′ be a duplicate of it, for example AB and A′B′ may be the two images in Fresnel's production of interference fringes by a biprism. The distance apart of the fringes at any place is inversely proportional to the distance between AB and A′B′.



But if, instead of a duplication such as AB and A′B′, we have one such as CD and C′D′, then an eye at XY can see fringes whose width depends on the angle at which CD is inclined to C′D′. These are two simple limiting cases with correspondingly simple laws. Michelson and Morley assume that their apparatus gives them the case of CD and C′D′, but there is nothing in the arrangement of their apparatus to ensure that the case shall not be like that of EF and E′F′, where the two images have suffered both the angular displacement of CD and C′D′, and the lateral displacement of AB and A′B′. The law of the width of the fringes due to EF and E′F′ must be such as will include the laws of AB and A′B′, and of CD and C′D′ as limiting cases. I hold, therefore, that the Michelson and Morley experiment is vitiated by the assumption that their apparatus gave them the full sensitiveness of the CDC′D′ position, whereas it really gave the unknown smaller sensitiveness of the EFE′F′ position.

They found that the displacement which they measured was probably less than a fortieth of what might be expected as due to the earth's orbital motion. I maintain that a possible alternative to this conclusion is that the sensitiveness of their apparatus was probably less than a fortieth of what they assumed it to be.

On account of the great importance of the subject it is very desirable that this experiment should be repeated with a definite experimental measurement of the actual sensitiveness of the apparatus employed. It would be indeed a great help in astronomy if we could have Michelson and Morley apparatus of known adequate sensitiveness in our observatories furnishing continuous record of the earth's motion relative to the ether, from which we could calculate the drift of the solar system, and ultimately express all stellar movements with reference to the ether.

WILLIAM SUTHERLAND.

Melbourne, November 6.

Virgil as a Physicist.

IT seems to have escaped observation that, just as Homer appears to have known of, and even given names to, the two attendants or satellites of Mars, so Virgil is the earliest to mention that now familiar substance, "liquid air." In proof of this I may cite the following passages:—

(*a*) Georg. i. 404 (a meteorological passage, describing various signs of fine weather).

Apparet liquido sublimis in aëre Nisus.

"Nisus (the hawk) is seen high up in the liquid air."

(*b*) Æneid vi. 202 (where the author is speaking of the sacred doves which conducted Æneas to the golden branch which was to be his "open sesame" to the infernal regions).

Tollunt se celeres, liquidumque per aëra lapsæ
Sedibus optatis geminæ super arbore sidunt.

"Swiftly they soar aloft; then, dropping through the liquid air, together settle on the wished-for tree."

Virgil does not seem to have made any scientific examination of the substance he terms "liquid air"; but he must have noted its transparency since he makes a point of the visibility of birds through a thick stratum of it, and in the second passage he evidently considers (whether from actual experiment or not must be uncertain) that immersion in it had no effect on the "conducting power" of Venus's doves.

H. G. M.

The Sentinel Milk Steriliser.

A RECORD of certain observations upon the action of the "Sentinel" steriliser is given in your issue of December 13 (p. 166).

The results of the temperature determinations are there stated as follows:—

		Bell Form.	Cut-off Form.
Water	Half pint	94° and 95° C.	95° and 93° C.
	One pint	87·5° ,, 89°	86° ,, 87°
	Two pints	87° ,, 86°	84° ,, 85°
Milk	Half pint	98° (frothing)	95°
	Two pints	87°	84°

and your reviewer adds: "It will thus be seen that there is considerable variation in the temperature."

We trust that you will allow us to point out that the instrument used was of the size designed for the sterilisation of *two* pints of milk. An inspection of the above table proves that the apparatus worked in a satisfactory manner even when *one* pint only was placed in the vessel (the temperature readings being 87° to 89° in the bell form and 86° to 87° in the cut-off apparatus), and also that when the proper volume of liquid was inserted, the variations in temperature were still further reduced.

As the apparatus is purposely made in different sizes, and as it was at no time supposed that any one size would be used with but one-quarter of the correct volume of liquid, the conclusion that "there is considerable variation in temperature" certainly conveys a wrong impression to the reader.

Your reviewer appears to doubt the wisdom of selecting temperatures in the neighbourhood of 85° C. Now it is generally acknowledged that Prof. Bang, of Copenhagen, is one of the leading authorities on this subject, and therefore we give the following passage from Scurfield's translation of Nocard's "Animal Tuberculosis" (p. 73).

"The extremely well-conducted experiments of Bang have established the fact that the bacilli of tuberculous milk are destroyed with certainty when the milk is heated to 85° C. for five minutes; between 75° and 80° they are sometimes killed, but not always; they resist a temperature of 70°, and are afterwards able to render guinea-pigs and rabbits tuberculous when inoculated into the peritoneum; but their vitality is lowered, and they are no longer able to resist the action of the digestive juices of those animals. At 60° their virulence does not seem to be modified. Galtier has obtained results almost identical with those of Bang."

It is worthy of remark that one practical application of these investigations is to be found in Denmark, where the law compels all dairies that return unconsumed milk to "heat this milk to 85° C. for a short time, and then rapidly cool the same."

(For the Cambridge Sentinel Manufacturing Co., Ltd.),
D. BERRY (manager).

IN the directions for use issued with the "Sentinel" steriliser, it is not stated that the apparatus should be filled or thereabouts; in consequence the variations in temperature with different volumes were tested. It may not always be convenient or

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