Letters to the Editor.

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The Effect of the Earth's Rotation on the Velocity of Light.

IN the *Philosophical Magazine* (6), 8, 716, 1904, an experiment was described, designed to test the effect of the earth's rotation on the velocity of light. In consequence of atmospheric disturbances, it was quite impossible to measure the interference fringes in the open air. Accordingly a twelve-inch water-pipe was laid on the surface of the ground in the form of a rectangle, 2010 ft. by 1113 ft. The residual pressure was reduced to about one-half an inch by means of a fifty horse-power pump. One of the ends was double, as shown in Fig. 1. At *A*, light from a carbon arc

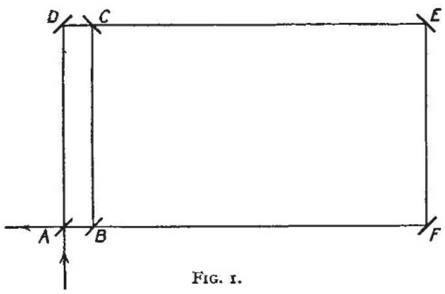

FIG. 1.

was divided by a plane parallel plate, thinly covered with gold, into two beams, one traversing the circuit in a clockwise, the other in a counter-clockwise direction.

Observations showed that the beam going in the counter-clockwise direction was retarded with respect to the other by 0·230 of a fringe.

TABLE I.

	Displacement in Fringes.	Number of Observations.	Deviation from Mean.
1	0·252	20	0·022
2	·255	20	·025
3	·193	20	·037
4	·246	20	·016
5	·235	20	·005
6	·207	26	·023
7	·232	20	·002
8	·230	20	·000
9	·217	20	·013
10	·198	20	·032
11	·252	20	·022
12	·237	20	·007
13	0·230	23	0·000
	Mean 0·230	Total 269	Av. dev. from mean 0·016

Observations 1-6 inclusive, without collimator; 7-13 inclusive, with collimator.

	Obs.	Calc.
Displacement . .	0·230 ± 0·005	0·236 ± 0·002

The theoretical value,[1] on the assumption of a stagnant ether, is given by the formula $\Delta = \frac{4A\omega \sin \theta}{\lambda c}$.

[1] This is twice the value given in the original article. Attention was directed to this correction by L. Silberstein in the Journal of the Optical Society of America, 5, 291, 1921.

With the actual dimensions of the apparatus, the calculated displacement is 0·236 of a fringe. In this formula the latitude, θ, is 41° 46′, and the wave-length, ω, as measured by comparison with sodium light, is 5700 Å.U.; ω is the angular velocity of the earth's rotation, and c the velocity of light.

Two hundred and sixty-nine observations were made, and averaged, usually in groups of twenty, in the order taken. Thirteen such means are given in Table I.

The results are interpreted to mean that the calculated and observed displacements agree to within the limits of observational error.

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March 21.

Atmospheric Electric Transmission.

IT appears to be of interest and value, in relation to current investigations on the circumstances of wireless transmission at short ranges, to note the intensity of reflection of electric waves that might be expected at the sharp boundary of an ionised layer, high in the atmosphere. The term sharp here implies practically that the transition is completed in, say, not less than one-tenth or, for nearly direct incidence, one-fifth of a wave-length. The relative amplitudes in the reflected waves are then, for the two polarised components, given sufficiently by the Fresnel expressions

$$-\frac{\sin (i-r)}{\sin (i+r)} \text{ and } \frac{\tan (i-r)}{\tan (i+r)}.$$

When the index of refraction μ is $1-\nu$ where ν is small, they become

$$-\frac{\nu}{2 \cos^2 i} \text{ and } \frac{\nu \cos 2i}{2 \cos^2 i};$$

e.g. for rays inclined at 30° to the horizontal they are -2ν and $-\nu$.

For the most favourable case (NATURE, November 1, 1924, p. 650,[1] or *Phil. Mag.*, December, p. 1031), that of free ions, N per cubic cm., unhampered by collisions, therefore high up, the value of ν is

$$\tfrac{1}{2}N\lambda^2 \frac{e^2}{\pi m},$$

which is $\frac{1}{2} \times 10^{-3}N$ for free electrons and for wave-length of one kilometre. To ensure a reflection of 10 per cent. in amplitude (or 1 per cent. in energy) of rays inclined at 30° as above, N would have to be about 300 electrons or else 5×10^5 hydrogen ions per cubic cm. If the wave-length is 10 times smaller, namely, 100 metres, these numbers have to be multiplied by 10^2.

At the other extreme, if a gradual transition is to bend round the complete ray through the same angle of 60° in traversing a curve of whatever length, the difference of the values of N at the top and bottom of this curved path figures out (*cf. loc. cit.*) of the order of 300 electrons per cubic cm. when λ is one kilometre, much the same density of ions being thus necessary in the two cases.

For the first case, however, that of transition practically sharp, a layer a few wave-lengths in thickness would play the part of Newton's thin plate in optics, by reflecting from both its faces: thus as the wave-length is gradually changed, there would be regular fluctuations at the receiver. Ionic clouds drifting across the sky might cause irregularity of

[1] At top of column 2 read $\frac{1}{3} \times 10^{-3}$ watts per square cm.