The magnifying power of the eye-pieces of the collimators is 100, and the same for each instrument.

Observations for the latitude of the observatory have already begun and the work on twenty stars, on different nights, is yet unreduced. The work for the Meridian Circle in the near future, besides the study of the errors of the instrument, will be, observations for latitude, time, azimuth; comparison stars for comets; comparison stars used by Professor Stone, of Leander McCormack Observatory, in his work on the places of nebulæ, and a select list of stars from 4th to 8th magnitude for geodetic purposes.

Dr. H. C. Wilson is in charge of the Meridian Circle, and he is making good progress, as the preceding record shows, for a period of less than four weeks' time.

ON THE RELATIVE MOTION OF THE EARTH AND OF THE LUMINIFEROUS ETHER.

ALBERT A. MICHELSON AND EDWARD W. MORLEY.

(Abstract.)

To explain astronomical aberration according to the undulatory theory of light, Fresnel made two suppositions: First, that the ether is at rest except in the interior of transparent media; and secondly, that in such media it is moving with a velocity less than that of the medium in the ratio $\frac{n^2-1}{n^2}$ where n is the index of refraction. The second hypothesis is already established; the authors have now submitted the first to the test of experiment, by the method proposed and executed by Michelson in 1881, so modifying the scale of the experiment and the mounting of the apparatus as to obtain decisive results.

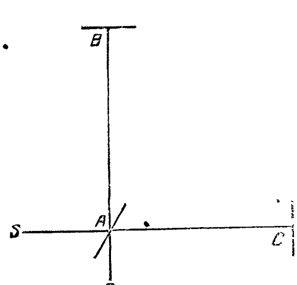

Fig. 1.

Let light from s be partly reflected to b and partly transmitted to c, and be returned by mirrors at b and c; part of the returning light will unite along ad, and, if the two paths are equal, will produce interference. If now, the ether being at rest, the apparatus moves in the direction *sc* with the orbital velocity of the earth, the directions and distances described by the rays will be altered; if we put D for the distance *ab*, and v and V for the velocities of the earth and of light, we shall find the difference of path to be $D\frac{v^2}{V^2}$ If the apparatus be now rotated so that *ab* is in the direction of the orbital motion of the earth, the difference will be in the opposite direction, and the displacement to be observed will therefore be $2D\frac{v^2}{V^2}$

In the experiment of 1881, D was such that the displacement according to theory would be 0.04 wave length; in the present case, D was, by repeated reflections, made about ten times as large. The former apparatus was extremely sensitive to vibrations and suffered distortion during the rotation; these difficulties have now been entirely overcome by mounting the apparatus on a massive stone floating on mercury.

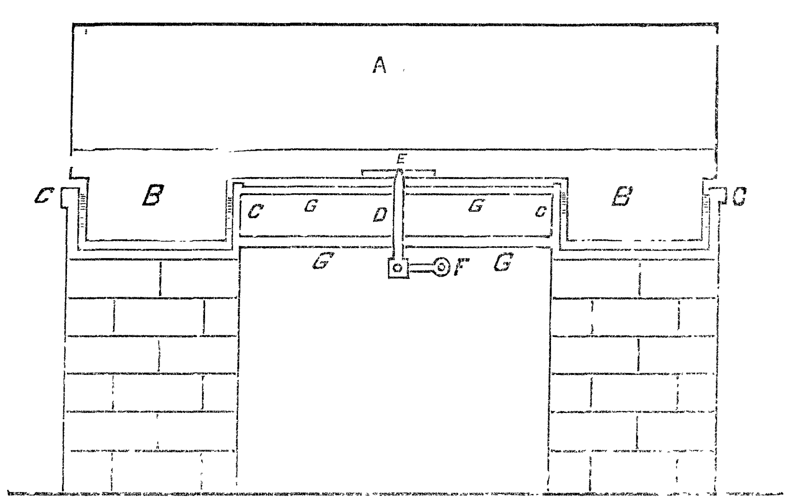

Fig. 2.

a is a stone 1.5 metres square, and 3 decimetres thick. *bb* is an annular wooden float. *cc* is an annular trough containing mercury; between the float and the trough is a clearance of one centimetre. A pin *d* can be pushed into a socket *e* so as to keep the float concentric with the trough; the pin bears no part of the weight.

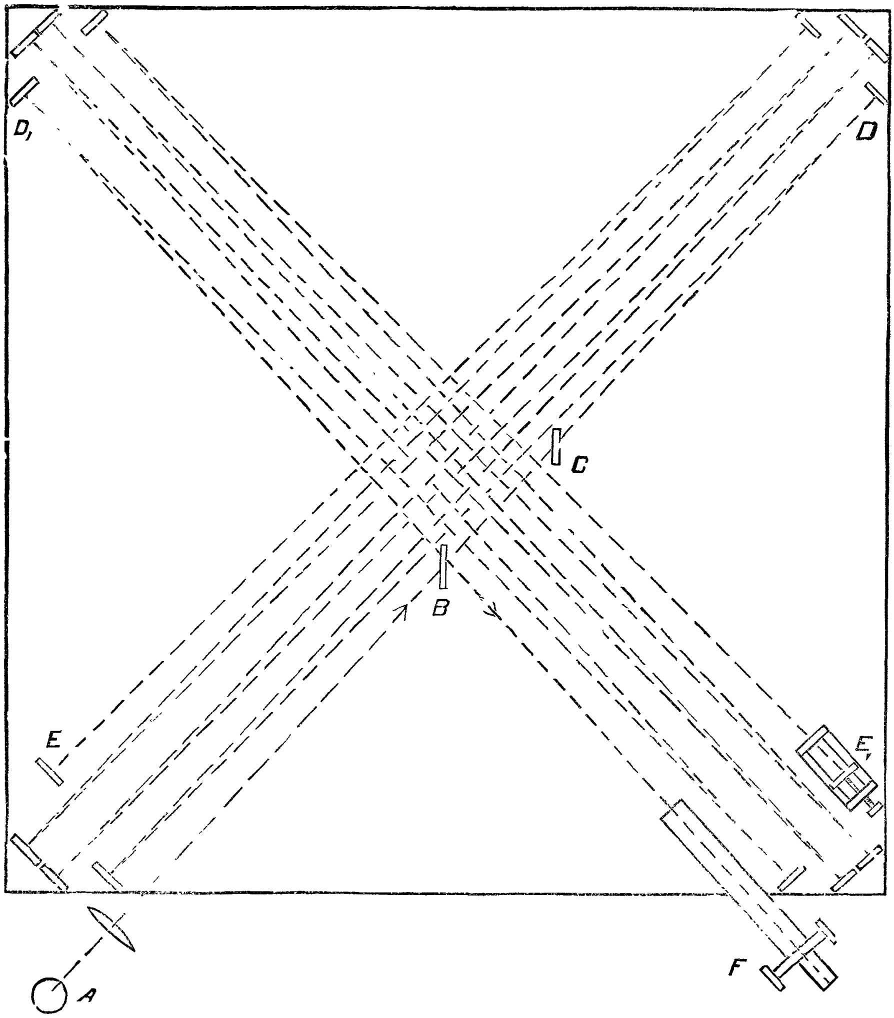

Fig. 3.

At each corner of the stone are four plane mirrors, *e*, *d*, of speculum metal. *b* and *c* are plane parallel glasses. Light from an Argand burner at *a* divides at *b*, follows the paths indicated, and reaches the observing telescope *f*.

The mirrors having been adjusted so that both rays entered the telescope, the lengths of the two paths were made nearly equal by measurement and by moving the mirror *e* which could be moved in the direction of its normal, keeping very accurately parallel to its former plane. The telescope being adjusted to distinct vision of the source, the two images were made to coincide. Then the telescope being adjusted to distinct vision of the expected interference fringes, sodium light was substituted for white light, and the interference fringes were made as clear as possible by adjustment of the mirror *e*. White light being restored, *e* was slowly moved in the direction of its normal till the fringes reappeared in white light, when they were adjusted to a convenient width and position and the apparatus was ready for observation.

While the apparatus was revolving once in about six minutes, the wire of the micrometer was set on the clearest fringe at the moment of passing one of the sixteen equi-distant marks on the iron trough; the readings were continued for six revolutions.

The following are the means of three such sets of readings made at noon on three days and of three sets of readings made at six hours after noon on three days. The numbers are wave lengths, and are corrected for linear variations.

Marks.....	16	1	2	3	4	5	6	7	8
Noon.......	0.00	— 0.07	+ 0.02	0.00	— 0.01	+ 0.13	+ 0.23	+ 0.16	0.00
Evening...	0.00	+ 0.06	— 0.02	+ 0.07	+ 0.05	+ 0.16	+ 0.13	+ 0.03	0.00

These means are plotted in the following figure :

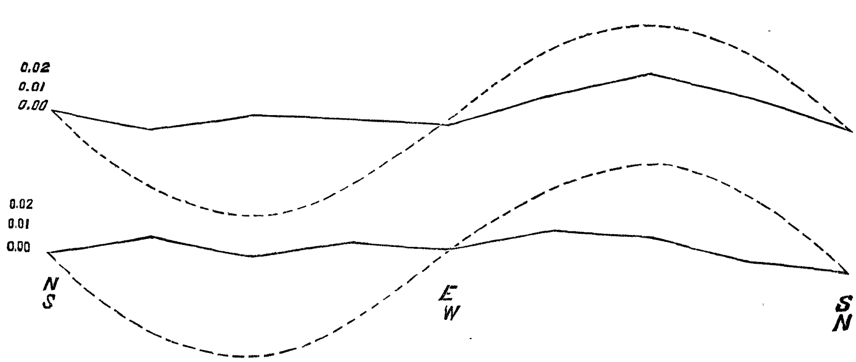

Fig. 4.

The upper curve represents the noon observations and the lower those at evening. The dotted curves represent *one-eighth* of the theoretical displacement. The actual displacement, it seems fair to conclude, was certainly not one-twentieth, and probably not one-fortieth, of the theoretical. The displacement varies as the square of the velocity; therefore the relative velocity of the earth and the luminiferous ether was certainly not one-fourth and probably not one-sixth of the orbital velocity of the earth.

It is of course possible that the orbital velocity of the earth at the time of the experiment was equal and opposite to that of the solar system through space. Measurements will therefore be repeated at proper intervals.

A NEW MODE OF DETERMINING THE CONSTANTS OF REFRACTION AND ABERRATION.

GEORGE C. COMSTOCK.*

In a series of papers published during the past two years in the *Comtes Rendus*, M. Loewy has suggested the introduction into practical astronomy of a new instrument and has worked out in detail its application to the solution of two important problems of spherical astronomy, the determination of the so-called constants of refraction and aberration.

The fundamental idea upon which the proposed methods of research are based is the superior accuracy of differential as compared with absolute measurements. The determination of the astronomical refraction by the methods hitherto in use furnishes an excellent example of the difficulties attending investigations of the latter class. We have here to determine the absolute declinations of a group of circumpolar stars from observations made at their upper transits over the meridian and the declinations of the same stars from observations made at their lower transits. The value of the refraction depends ultimately upon the difference of the declinations thus determined. Consecutive observations of the same star are thus separated by an interval of at least twelve hours, frequently by a much longer one, and the astronomer engaged in a research of this kind has to fear not only the instrumental sources of

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