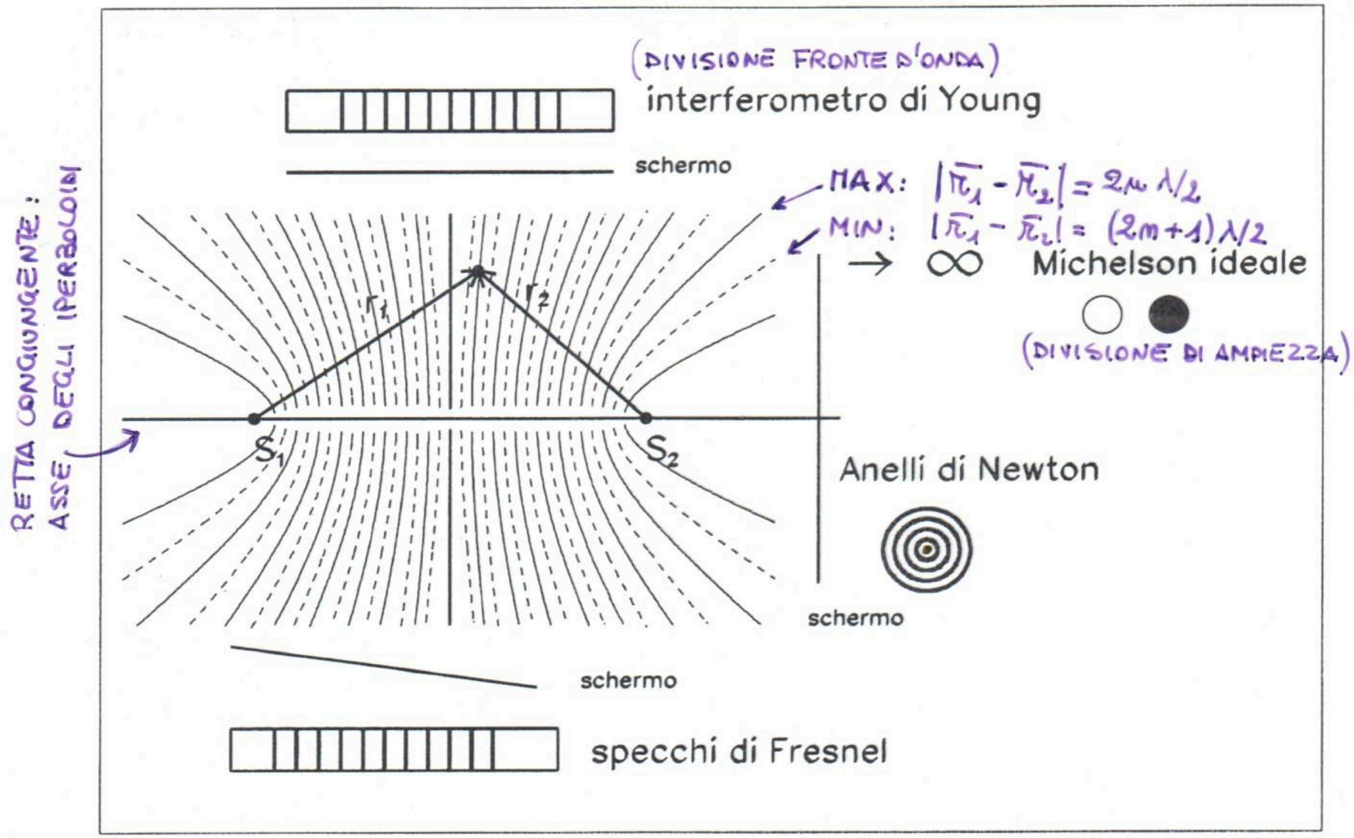
Interferenza

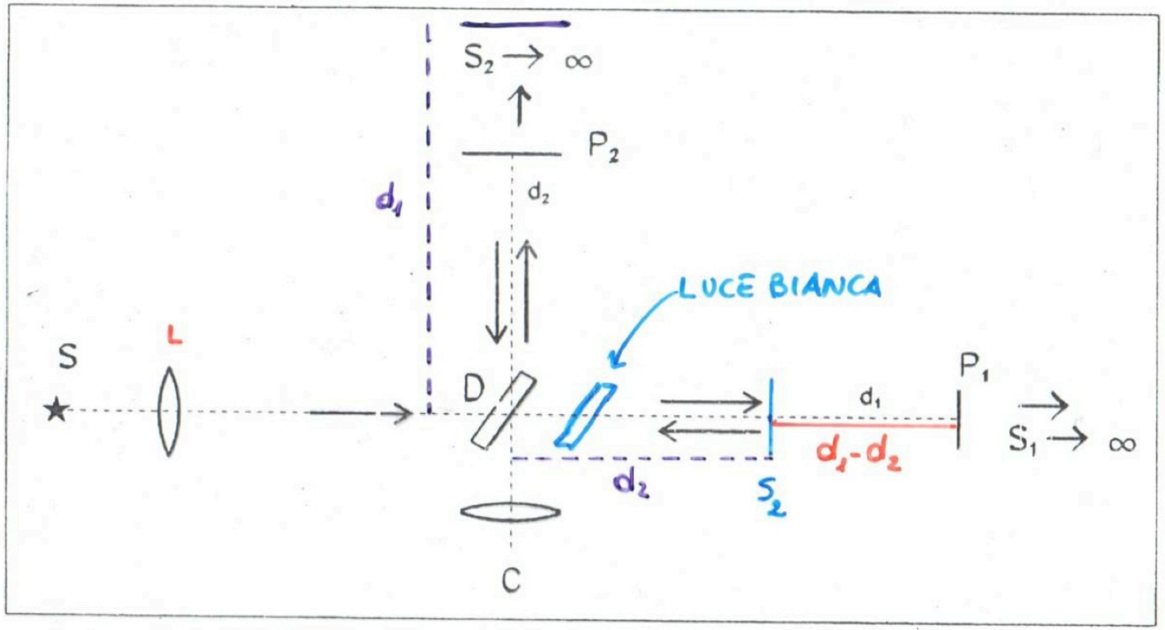
$$\left.\begin{aligned} E_1 &= E_{01}\cos(\omega t - \vec{k}\cdot\vec{r}_1 - \alpha_1) \\ E_2 &= E_{02}\cos(\omega t - \vec{k}\cdot\vec{r}_2 - \alpha_2) \end{aligned}\right\} \quad E = E_1 + E_2$$

$$I = 4 I_0 \cos^2 \frac{\delta}{2}$$

$$\delta = \frac{2\pi}{\lambda}(r_1 - r_2) - (\alpha_2 - \alpha_1)$$



INTERFEROMETRO DI MICHELSON



D FORNISCE 2 IMMAGINI VIRTUALI DI S IN S_1 E S_2

SE I RAGGI SONO PARALLELI È COME SE S_1 E S_2 FOSSERO ALL'INFINITO E DISTASSERO TRA DI LORO $d = (d_1 - d_2) \cdot 2$

$2(d1 - d2) = 2m\, \lambda/2$ MAX

$= (2m+1)\, \lambda/2$ MIN

sensibilita': MAX-MIN $\lambda/4$

- S NEL FUOCO DI L : 1 SOLO ϑ_i SU D (MICHELSON IDEALE) CASO 1-d
- S NON NEL FUOCO DI L : LAMINA DI SPESSORE $d = d_1 - d_2$ → FRANGE CIRCOLARI DI EGUALE INCLINAZIONE
- S_2 LEGGERMENTE INCLINATO: CUNEO SOTTILE (10^{-3} rad) → FRANGE RETTILINEE DI EGUALE SPESSORE

$|d1 - d2| < 3$ m luce naturale

< 1 km luce laser

No. 203. Vol. XXXIV. NOVEMBER, 1887.

Established by BENJAMIN SILLIMAN in 1818.

THE

AMERICAN JOURNAL OF SCIENCE.

THIRD SERIES.

VOL. XXXIV.—[WHOLE NUMBER, CXXXIV.]

WITH PLATES II TO IX.

No. 203—NOVEMBER, 1887.

NEW HAVEN, CONN.: J. D. & E. S. DANA.
1887.

TUTTLE, MOREHOUSE & TAYLOR, PRINTERS, 371 STATE STREET.

Six dollars per year (postage prepaid). $6.40 to foreign subscribers of countries in the Postal Union. Remittances should be made either by money orders, registered letters, or bank checks.

THE

AMERICAN JOURNAL OF SCIENCE.

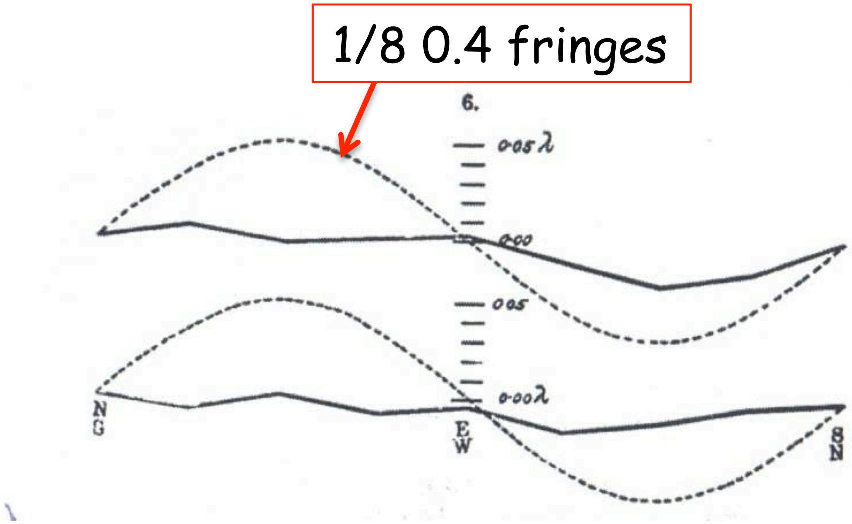
[THIRD SERIES.]

ART. XXXVI.—*On the Relative Motion of the Earth and the Luminiferous Ether;* by ALBERT A. MICHELSON and EDWARD W. MORLEY.*

THE discovery of the aberration of light was soon followed by an explanation according to the emission theory. The effect was attributed to a simple composition of the velocity of light with the velocity of the earth in its orbit. The difficulties in this apparently sufficient explanation were overlooked until after an explanation on the undulatory theory of light was proposed. This new explanation was at first almost as simple as the former. But it failed to account for the fact proved by experiment that the aberration was unchanged when observations were made with a telescope filled with water. For if the tangent of the angle of aberration is the ratio of the velocity of the earth to the velocity of light, then, since the latter velocity in water is three-fourths its velocity in a vacuum, the aberration observed with a water telescope should be four-thirds of its true value.†

* This research was carried out with the aid of the Bache Fund.

† It may be noticed that most writers admit the sufficiency of the explanation according to the emission theory of light; while in fact the difficulty is even greater than according to the undulatory theory. For on the emission theory the velocity of light must be greater in the water telescope, and therefore the angle of aberration should be less; hence, in order to reduce it to its true value, we must make the absurd hypothesis that the motion of the water in the telescope carries the ray of light in the opposite direction!



noon
(counterclockwise)

evening
(clockwise)

displacement should be $2D\frac{v^2}{V^2}=2D\times10^{-8}$. The distance D was about eleven meters, or 2×10^7 wave-lengths of yellow light; hence the displacement to be expected was 0·4 fringe. The actual displacement was certainly less than the twentieth part of this, and probably less than the fortieth part. But since the displacement is proportional to the square of the velocity, the relative velocity of the earth and the ether is probably less than one sixth the earth's orbital velocity, and certainly less than one-fourth.

$$\frac{\partial^2 f}{\partial x^2} - \frac{1}{c^2}\frac{\partial^2 f}{\partial t^2} = F(x,t)$$

Galileo

$$\begin{aligned} x' &= x - vt \\ y' &= y \\ z' &= z \\ t' &= t \end{aligned}$$

$$\frac{\partial}{\partial x} = \frac{\partial}{\partial x'}\frac{\partial x'}{\partial x} + \frac{\partial}{\partial t'}\frac{\partial t'}{\partial x}$$

$$\frac{\partial}{\partial t} = \frac{\partial}{\partial x'}\frac{\partial x'}{\partial t} + \frac{\partial}{\partial t'}\frac{\partial t'}{\partial t}$$

$$\frac{\partial^2 f}{\partial x^2} = \frac{\partial^2 f}{\partial x'^2}$$

$$\frac{\partial^2 f}{\partial t^2} = v^2\frac{\partial^2 f}{\partial x'^2} - 2v\frac{\partial^2 f}{\partial x'\partial t'} + \frac{\partial^2 f}{\partial t'^2}$$

$$\frac{\partial^2 f}{\partial x'^2} + \frac{1}{c^2}\left[2v\frac{\partial^2 f}{\partial x'\partial t'} - v^2\frac{\partial^2 f}{\partial x'^2}\right] - \frac{1}{c^2}\frac{\partial^2 f}{\partial t'^2} = F(x',t')$$

$$\begin{aligned} x' &= \gamma(x - vt) \\ y' &= y \\ z' &= z \\ t' &= \gamma(t - \frac{v}{c^2}x) \end{aligned}$$

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$\frac{\partial^2 f}{\partial x^2} = \gamma^2\frac{\partial^2 f}{\partial x'^2} - 2\frac{v\gamma^2}{c^2}\frac{\partial^2 f}{\partial x'\partial t'} + \frac{v^2\gamma^2}{c^4}\frac{\partial^2 f}{\partial t'^2}$$

$$\frac{\partial^2 f}{\partial t^2} = \gamma^2 v^2\frac{\partial^2 f}{\partial x'^2} - 2v\gamma^2\frac{\partial^2 f}{\partial x'\partial t'} + \gamma^2\frac{\partial^2 f}{\partial t'^2}$$

$$\frac{\partial^2 f}{\partial x'^2} - \frac{1}{c^2}\frac{\partial^2 f}{\partial t'^2} = F(x',t')$$

Lorentz