Session of 22 December 1913, pp. 1410–1413.

In the *Comptes Rendus* of 27 October, I have demonstrated that an interferograph in which the optical circuit surrounds a certain area and which rotates in the plane of the circuit, registers its movement as a whole in relation to the ether of empty space.

I. *The interferograph*, already described, is shown from above in the drawing: a rotating horizontal platform carrying all the optical pieces and also the luminous source O, which is a small electric lamp with a horizontal metal filament. The objective lens of the microscope C_0 projects the image of this filament through the Nicol prism N, upon the horizontal slit in the focal plane of the objective collimator C; *m* is a return mirror. The polarized parallel beam, with vertical Fresnel vibration, divides at the separator (the thin layer of air *J*) as in the interferometer habitually used in my researches.[6] I have applied this interferometer to the optical study of the movement of the earth.[7] The beam T that is transmitted by the thin layer of air *J* is reflected successively by four mirrors M and travels around the closed circuit *J*, A_1, a_2, a_3, a_4, *J*, of area S. The beam R that is reflected by the same layer of air travels through the same circuit in the inverse direction. At its return to *J*, the beam T, again transmitted, and the beam R, again reflected, become superimposed in the same direction, following path T_2 and R_2, and interfering at the prime focus of the telescope L on a fine-grained photographic plate *pp'*.

II. *Mode of operation.* I recall that the perfect superimposition of the two inverse beams T and R is characterized by the general extinction of the field of view of the telescope for the radiation used, which here borders on the indigo radiation of the mercury arc. From the beginning of the experiments onward, a slight rotation ϵ of the separator *J* (that is, of the two central prisms) around a vertical axis clockwise (swung in direction CW) or counter-clockwise (swung in direction CCW) contracts the dark field into a central vertical fringe that borders on the lateral parallel fringes.

With the fringes adjusted, and the plate *pp'* wedged into its frame and uncovered to the surrounding red light, I progressively speed up an electric motor, the vertical spindle of which carries a horizontal disc D with a tire of hide, which rolls against the thick rim of the platform. The desired frequency of rotation N being attained, I make the photographic exposure by turning on the electric current for the small lamp O, by means of a sliding contact on the spindle of the revolving platform.

3. *Direction and amount of the optical whirling effect.* In the ether hypothesis of Fresnel, the luminous waves T and R are propagated through the ether of empty space with a velocity of V_0 independently of the movement of the assemblage of the interferograph. The phase of the waves T of a clockwise direction of propagation is altered as though the luminiferous ether were animated with a counter-clockwise whirling when the circuit revolves in the sense *cw*. The value $4\pi NS$ of this whirling, or relative circulation C of the ether within the optical circuit, gives, by the formula $C/\lambda V_0$, the degree of retarding of the phase of the waves T and the equal advancing of the waves R of inverse propagation; the fringes on one exposure must be displaced $2x$ rings. The absolute direction of this displacement y of the fringes should be p to p'—that is to say, *cw*, like the rotation of the interferograph when the swing adjustment ϵ of the central prisms is also in the direction CW (this direction is defined as the *positive* direction). The displacement z (equal to $2y$ or $4x$), measured in going from a photo *ccw* to a photo *cw*, should in that case be in the direction *cw*. If the adjustment ϵ is in the direction CCW, the displacements y and z must change direction.

Through numerous tests, I have constantly observed the direction thus anticipated. The displacement z reverses itself when I swing the separator *J* (i.e., the central prisms) through an angle ϵ of only a fraction of a degree. This fact identifies the effect as due to a difference of phase associated with the movement of the interferograph, rather than to dynamic deformations of the optical pieces.

Here are some examples of measurements of z compared with values calculated by the formula $16\pi NS/\lambda V_0$. I have determined the wavelength λ by the interfringe distance obtained with the

6. See note 1.
7. See note 2.

small lamp O as compared to the slightly different interfringe distance obtained with radiation of 436 millimicrons from a mercury arc. The measurements are made by one of the two methods indicated in my note of 27 October. The central fringe *c*, which is transparent on the examined negative, and the dark lateral fringes *f*, are bordered by penumbras of sufficient narrowness to permit (even at a weak magnification) the accurate framing of the sighted fringe between the two threads of an ocular micrometer.

	Swing ϵ of prisms	N/ sec	*z* by *c*	*z* by *f*	*z calc.*
Method 1 ($S = 863\ cm^2$)	CCW	0.86	−0.026		−0.029
	CW	1.88	+0.070		+0.065
Method 2 ($S = 866\ cm^2$)	CCW	2.21	−0.072	−0.078	−0.075
	CCW	2.35	−0.077	−0.080	−0.079

While rotating in one direction, the interferograph measures, as $1/2\ z$, the effect of its unified whirling movement. The measurement is first order, and it resorts to no exterior datum.

The result of the measurements demonstrates that, in the ambient space, light is propagated with a velocity V_0, independent of the movement as a whole of the luminous source O and the optical system. That is a property of space which experimentally characterizes the luminiferous ether. The interferograph measures, as $1/4\ z\lambda V_0$, the relative circulation of the ether within the closed optical circuit.[8]

8. *Editors' note*: Translated from the French by Richard Hazelett. The translation is not at every point literal, in the interest of needed clarity.