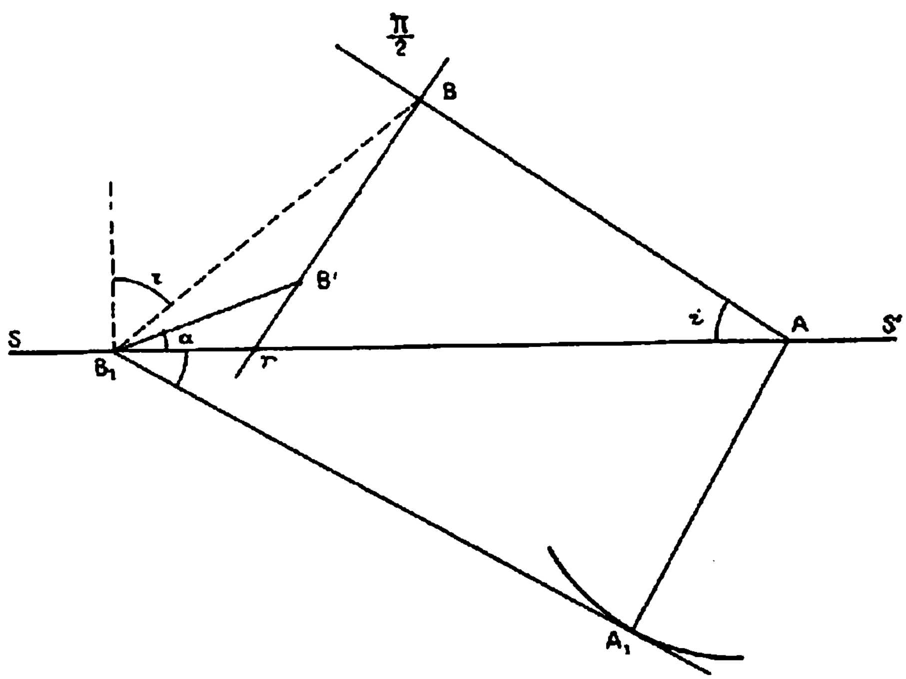
OPTICS – *The entraining of ether and aberration of stars.*
Note ([1]) By M. **E. BRYLINSKI,** presented by M. Daniel Berthelot.

I. We had an occasion to announce before ([2]) that it would seem natural to suppose that the ether located in the vicinity of the Earth should be drawn away, completely or partially, by the Earth in its displacement. It was argued that similar entraining would be incompatible with the aberration of stars, such as observation reveals it. This objection does not appear founded to us.

II. Let us suppose initially that the Earth is surrounded by a concentric ether bubble which it involves in its movement, this bubble being separated from motionless ether existing with beyond by a surface of discontinuity.



Let SS' trace this surface of separation, AB being an incidental plane wave forming angle i with this surface and α the angle of the direction of the translational motion of the Earth with the surface of discontinuity. Let us take on the axes related to the Earth (of which we will neglect rotation), the

([1]) Meeting of 10 November 1924.

([2]) See *Comptes Rendus*, v. **174**, 1922, p. 153, and the *Journal of General Electricity*, v. **11**, March 11th, 1922, p. 345-348.

point B of the wave which will arrive on SS' at B_1, at time t such that

$$BB' = ct, \qquad B_1B' = vt = \beta ct.$$

From B_1 we lead tangent B_1A_1 to the circle of ray ct with center at A, being at angle x with SS'. B_1A_1 will be the trace of the wave in the driven part of the ether (who is at rest relative with the chosen axes).

In triangle $BB'B_1$, we have

$$\frac{BB_1}{\cos(\alpha+i)} = \frac{\beta ct}{\sin(i'-i)} = \frac{ct}{\cos(\alpha+i')}.$$

In addition, in triangle ABB_1,

$$\frac{AB_1}{\cos(i'-i)} = \frac{BB_1}{\sin i}$$

and finally

$$AA_1 = ct = AB_1 \sin r.$$

From where one draws

$$\sin r = \frac{\cos(\alpha+i')}{\cos(\alpha+i)} \frac{\sin i}{\cos(i'-i)} = \frac{\sin i' - \beta \cos i' \cos(\alpha+i')}{1+\beta \sin(\alpha+i')} = \sin i' - \beta \cos\alpha,$$

by limiting us to the first order of approximation.

The deviation Δ' of the luminous ray will equal $i' - r$, from where

$$2\sin\frac{\Delta'}{2} \cos\left(i' + \frac{\Delta'}{2}\right) = \beta \cos\alpha,$$

One would obtain the same result by making calculation by means of motionless axes in which ether not entrained.

III. In the ordinary theory, where the ether is supposed absolutely motionless, the deviation has as a value

$$\Delta = \beta \cos(\alpha+i),$$

then Δ' can be expressed as

$$\Delta' = \beta\left[\cos(\alpha+i) + \tan i \sin(\alpha+i)\right].$$

The difference between the two values is equal to

$$\Delta' - \Delta + \beta \tan i \sin(\alpha+i).$$

Taking into account that the observer can only see stars located above the horizon and we denote by *h* and R the thickness of the entrained ether bubble and the radius of the earth, one sees easily that

$$\sin i \leq \frac{R}{R+h},$$

where the real limit is still lower than this value because the observation of low stars on the horizon is difficult.

It seems natural to assume that the thickness of the ether bubble is large compared to the Earth's radius; if *h* is on the order of at least 100R, the value of $\Delta' - \Delta$ will remain below $10^{-2}\beta$ and will be inappreciable.

IV. One may feel reluctant with the idea that the ether bubble is entrained as a block, and so we assume that the ether is involved gradually, with speeds decreasing up to zero as one moves away sufficiently, and, in this case especially, it seems natural to consider that the layer where the speed of ether vanishes is extremely far away from the Earth.

Between two infinitely close layers, one will still have

$$d\Delta' = \frac{\cos\alpha}{c\cos i}dv$$

However *i* has only first order variations, therefore cos*i* can be regarded as constant for integration and one finds, while limiting oneself to the first order of approximation, the preceding formula

$$\Delta' = \beta\frac{\cos\alpha}{\cos i}.$$

V. It follows from this that the aberration of stars, so much at least that we have not significantly increased the precision of observations for stars relatively low on the horizon, does not settle the question of the entraining or the not-entraining of ether by the Earth, and it seems likely in the event of entraining, this entraining extends to long distances from the Earth.

[translator's note: Reader is advised to see:
Metz_CR[trans]_v180n7(1925)495-497
available at: http://www.wbabin.net/pprhst.htm#Metz]