

LETTERS TO THE EDITOR

The first theoretical prediction of the radiation discovered by Vavilov and Cerenkov

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It is generally believed that directed electron emission was first inferred in 1904 by A. Sommerfeld in a treatment of motion of an electron in vacuum at a velocity exceeding the velocity of light in a vacuum, something that does not occur in reality^[1]. Recently, however, while going through O. Heaviside's 1899 paper^[2] "On the Electromagnetic Effects Due to the Motion of Electrification Through a Dielectric"^[1], I came upon a section devoted specifically to treatment of the motion of a charge q through a dielectric at a velocity u exceeding the velocity v of light in the dielectric. At its very beginning, the author draws the following fundamental conclusion:

"Now the following question presents itself: what situation arises if $u > v$? First of all, it is clear that there can be no disturbances at all ahead of the moving charge (for simplicity, a point charge). Then, recognizing that the spherical waves emitted by the charge as it moves along the z axis propagate at the velocity v , we find that the geometrical locus of points on their fronts is a conical surface whose vertex is the charge itself, while its axis is the z axis and its semivertex angle θ is given by the relation

$$\sin\theta = \frac{v}{u}. \quad (38)$$

Thus, it must be acknowledged that the directed emission effect of a charge moving uniformly in a dielectric at a velocity exceeding the velocity of light was first theoretically predicted by Heaviside 45 years before the experimental discovery of this phenomenon by S. I. Vavilov and P. A. Cerenkov.

¹⁾This paper had been mentioned earlier in textbooks on the history of physics as one in which Heaviside, in a continuation of J. J. Thomson's theoretical study (1881) of the problem of the increase in the electromagnetic mass of a moving charge, first derived an indication that the inertial properties of the moving charge are independent of the direction of the acting force. Attention should also be drawn to another remarkable curiosity: the appearance of the relativistic root $\sqrt{1-(u^2/c^2)}$ in the electrodynamic relations derived by Heaviside in this 1889 paper.

¹A. Sommerfeld, *Göttingen Nachr.* 99, 363 (1904); 201 (1905); A. Sommerfeld, *Optics* (Russ. transl.), IL, 1953, Sec. 47.

²O. Heaviside, *On the Electromagnetic Effects Due to the Motion of Electrification Through a Dielectric*, *Phil. Mag.* 27, 324 (1889).

Translated by R. W. Bowers