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On the Ehrenfest Paradox. Comment on V. Varičak's Paper

by A. Einstein

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Recently V. Varičak published in this journal some comments[1] that should not go unanswered because they may cause confusion.

The author unjustifiably perceived a difference between Lorentz's conception and mine with *regard to the physical facts*. The question of whether the Lorentz contraction does or does not exist *in reality* is misleading. It does not exist "in reality" inasmuch as it does not exist for a moving observer; but it does exist "in reality," i.e., in such a way that, in principle, it could be detected by physical means, for a noncomoving observer. This is just what Ehrenfest made clear in such an elegant way.

We obtain the shape of a body moving relative to the system K with respect to K by finding the points of K with which the material points of the moving body coincide *at a specific time* t of K. Since the concept of simultaneity with respect to K that is being used in this determination is completely defined, i.e., is defined in such a way that, on the basis of this definition, the simultaneity can, in principle, be established by experiment, the Lorentz contraction as well is observable in principle.

Perhaps Mr. Varičak might admit—and thus in a way retract his assertion—that the Lorentz contraction is a "subjective phenomenon." But perhaps he might cling to the view that the Lorentz contraction has its roots solely in the arbitrary stipulations about the "manner of our clock regulation and length measurement." The following thought experiment shows to what extent this view cannot be maintained.

Consider two equally long rods (when compared at rest) $A'B'$ and $A''B''$, which can slide along the X-axis of a nonaccelerated coordinate system in the same direction as and parallel to the X-axis. Let $A'B'$ and $A''B''$ glide past each other with an arbitrarily large, constant velocity, with $A'B'$ moving in the positive, and $A''B''$ in the negative direction of the X-axis. Let the endpoints A' and A'' meet at a point A^* on the X-axis, while the endpoints B' and B'' meet at a point B^*. According to the theory of relativity, the distance A^*B^* will then be smaller than the length of either of the two rods $A'B'$ and $A''B''$, which fact can be established with the aid of one of the rods, by laying it along the stretch A^*B^* while it is in the state of rest.

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[1] This jour. 12 (1911): 169.