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**Edited by Diana Kormos Buchwald, Tilman Sauer, Ze'ev Rosenkranz, Josef Illy  
& Virginia Iris Holmes: The Collected Papers of Albert Einstein, Volume 10:  
The Berlin Years (English translation of selected texts)**

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Vol. 5, 161a. To Vladimir Varićak<sup>[1]</sup>

Bern, 19 May 1909

[Not selected for translation.]

Vol. 5, 197a. To Vladimir Varićak

Zurich, 15 February 1910

[Not selected for translation.]

Vol. 5, 197b. To Vladimir Varićak

Bern [Zurich], 28 February 1909 [1910]<sup>[1]</sup>

[Not selected for translation.]

Vol. 5, 202a. To Vladimir Varićak

Zurich, 5 April 1910

[Not selected for translation.]

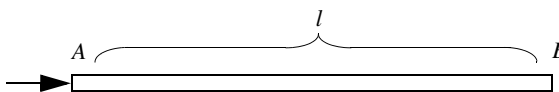
Vol. 5, 202b. To Vladimir Varićak

Zurich, 11 April 1910

Highly esteemed Colleague!

Your two letters have given me great joy, as has your interesting treatise on the transformation.<sup>[1]</sup> As regards the rotating rigid body, my view of the matter is about as follows.

First of all, it cannot be excluded that the abstraction of the freely moving rigid body does not fit at all into the theory of relativity.<sup>[2]</sup> Take, e.g., the case that a rigid rod which at first hovers freely at rest in space suddenly receives a momentum during an infinitely short time. The end in  $B$  can experience a change in position, or acquire a velocity, as a consequence



of relativity.<sup>[2]</sup> Take, e.g., the case that a rigid rod which at first hovers freely at rest in space suddenly receives a momentum during an infinitely short time. The end in  $B$  can experience a change in position, or acquire a velocity, as a consequence



of the epistemological foundations of the theory of relativity, to which I obligated myself by giving an uncautious promise. I did not do a good job with the thing by the way.<sup>[8]</sup>

With best greetings your devoted

A. Einstein

My wife sends best greetings, too.

## Vol. 5, 203a. To Vladimir Varičák

[Zurich, 23 April 1910]

[Not selected for translation.]

## Vol. 5, 235a. To [Otto Lehmann]<sup>[1]</sup>

Zurich, 1 December 1910

Highly esteemed Colleague,

First of all, many thanks for your kind letter, your paper, and above all for the papers you sent me earlier.<sup>[2]</sup> Now to your example!

1) Your consideration must still take into account that the lines of force emanating from a rod become denser as a result of the Lorentz contraction. The electric

field strength is thus increased by the ratio  $\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$   $\left( = 1 + \frac{1}{2} \frac{v^2}{c^2} \right)$ , whereby the

electrostatic energy is increased by this ratio.

2) The relative lessening of the repulsion through electrodynamic forces that you observed has the value  $\frac{v^2}{c^2}$ ; it is therefore only halfway compensated by the increased repulsion mentioned under (1). The energy is therefore in fact (larger) smaller than if the rods were at rest.

3) This does not indicate a violation of the principle of relativity, however, because with moving rods one must distinguish between the force  $K$ , acting between them, from the standpoint a frame of reference not moving along with them, and the force  $K'$ , from the standpoint of a frame of reference moving along with the rods. If  $K'$  differed from the force between the rods at the same distance while they were at rest, there would be a contradiction with the principle of relativity. But the force  $K$  between the rods from the point of view of the non-moving system can

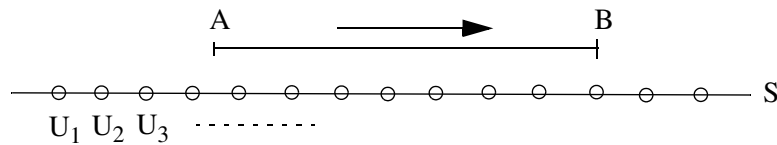


## Vol. 5, 257a. To Vladimir Varićak

Zurich, 3 March 1911

Highly esteemed Colleague!

I thank you very much for your letter and the paper.<sup>[1]</sup> I have now read the beautiful study by Lewis and Tolman,<sup>[2]</sup> but I cannot understand how you can draw from this an (support) endorsement of your opinion. I want to justify my opposite opinion explicitly.<sup>[3]</sup>



Let  $S$  be a nonaccelerated frame of reference, in which there are clocks of the same kind at rest with it. Let these be synchronized, e.g. by means of light rays, so that they show the time of  $S$ . Let the rod  $AB$  be in uniform motion relative to  $S$ . Its “real” length, i.e., the length measured by itself, be  $l$ . Then it follows from the rel.

theory in the well-known way that its length with respect to  $S$  is  $l \sqrt{1 - \frac{v^2}{c^2}}$ . This

means: if one determines those clocks in  $S$ , which show the same state of hands, when the points  $A$  and  $B$  are passing by them, then the distance of these points measured in  $S$  is  $l \sqrt{1 - \frac{v^2}{c^2}}$ . The contraction is observable by measurement, hence

“real.” In order that you see that the contraction is not simply affected by the definition of simultaneity in  $S$ , i.e. of a purely conventional nature, I add: it is impossible, to reset the clocks in such a way, that even after this resetting the rod always has the length  $l$  with respect to  $S$ , if it has the velocity  $\pm v$  measured by means of the clocks. From this one can conclude with Ehrenfest that a rotation without *elastic* deformation is excluded in the theory of relativity, if you assume in addition that a transversal contraction does not take place.<sup>[4]</sup> One cannot ask whether one has to conceive of the contraction as a consequence of the modification of the molecular forces or as a kinematic consequence from the foundations of the theory of relativity.<sup>[5]</sup> Both points of view are justified side by side. The latter point of view corresponds roughly to the one of Boltzmann, who treats the dissociation of gases *in a molecular-theoretic manner*; this is completely justified, although one can derive the laws of dissociation from the second law without kinetics.<sup>[6]</sup> A (principal)



























