all bodies experience the same acceleration in a gravitational field very strongly invites the assumption that an accelerated coordinate system and an acceleration-free coordinate system with a homogeneous gravitational field are to be viewed as totally equivalent things.[6] On the basis of this assumption one arrives at quite plausible consequences.[7] As soon as I receive the reprints of my paper dealing with this subject, I will send you a copy.

Yours very respectfully,

A. Einstein

73. To Arnold Sommerfeld

Bern, 14 January 1908

Highly esteemed Professor Sommerfeld:

Your letter made me uncommonly happy; never before has a physicist been so frank with me and at the same time so kind.[1] I therefore cannot help but start this letter with a remark of a personal nature. Thanks to my having hit upon the fortunate idea of introducing the relativity principle into physics, you (and others) enormously overestimate my scientific abilities, to the point where this makes me somewhat uncomfortable. I do not want to ply you with self-criticism; self-criticism is rarely good for anything, and is worthless to others too. But let me assure you that if I were in Munich and had the time, I would sit in on your lectures in order to perfect my knowledge of mathematical physics.—

So, first to the question of whether I consider the relativistic treatment of, e.g., the mechanics of electrons as definitive. No, certainly not. It seems to me too that a physical theory can be satisfactory only when it builds up its structures from *elementary* foundations. The theory of relativity is not more conclusively and absolutely satisfactory than, for example, classical thermodynamics was before Boltzmann had interpreted entropy as probability.[2] If the Michelson-Morley experiment had not put us in the worst predicament, no one would have perceived the relativity theory as a (half) salvation. Besides, I believe that we are still far from having satisfactory elementary foundations for electrical and mechanical processes. I have come to this pessimistic view mainly as a result of endless, vain efforts to interpret the second universal constant in Planck's radiation law in an intuitive way.[3] I even seriously doubt that it will be possible to maintain the general validity of Maxwell's equations for empty space.

I am very interested in your investigation on the propagation of signals.[4] But since I didn't know that you will publish this investigation, I did not consider it proper to ask you for further reports about it when I was writing my last letter,[5] because it could have cost you time to satisfy this request.

I am very glad that you want to persuade Dr. Koch,[6] the man mentioned by you, to do that experiment with canal rays. But I should tell you that Mr. J. Stark mentioned to me once (about half a year ago) that he wants to tackle this thing;[7] however, he has written to me several times since without mentioning the matter again. If, for whatever reason, Dr. Koch is not inclined to undertake this investigation, I can think of another experimental project for him that is close to my heart. It concerns an electrostatic machine for measurement purposes, by means of which far smaller amounts of electricity shall be made accessible to measurement than is the case with the electrometers of today.[8] If you or he are interested, I will gladly give you a detailed account about the matter.[9]

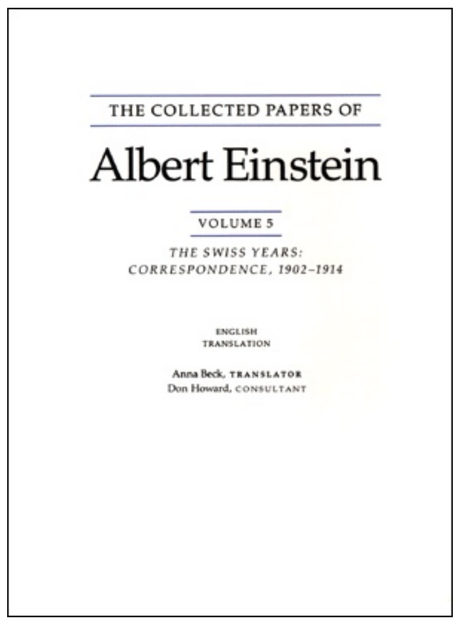
Do I think that the energy of an electron at rest can be exclusively electrostatic in nature? If one provides an electric charge to a rigid body that is itself massless, then, according to the theory of relativity, it acquires a mass equal to $\frac{\text{electrostatic energy}}{c^2}$. This holds independently of the shape of the body and the way the charge is distributed. But one cannot set the energy of the moving body equal to its electromagnetic energy; rather, the rigid body, which is itself massless, must be assigned an inertial mass (*Ann. d. Phys.* 23 (1907): 371–379)[10] because it is subjected to forces deriving from the electric masses. What is unsatisfactory is of course the fact that we do not know how to localize that portion of the kinetic energy, in fact, how to give it an intuitive interpretation. It is not yet quite clear to me whether the abstraction leading to the formulation of the concept of the rigid body is no longer appropriate, or whether we are facing here a puzzle of genuine significance.[11]

I am thus of the opinion that we can conceive the mass of the electron as exclusively a mass of an electrostatic energy if we want to, though in that case the nature of the kinetic energy remains partly obscure. But I do not like such a conception of the electron because, to begin with, the rigid framework with its electrical impregnation arouses my mistrust. In my opinion, a satisfactory theory should be constituted in such a way that the electron appears as the solution, that is, that no extraneous fictions are needed in order not to have to assume that its electric masses are moving apart. Besides the speed of light c, such a theory would have to feature yet another universal constant, owing to the value of which the elementary electric charge has such and such a particular value and no other value.[12]

I cannot justify this opinion for you here, but I hope I will be able to do this in person one day. If I am unable to go to the next *Naturforscherkongress*,[13] then I would gladly come to Munich some day to discuss physics with you.

Respectfully yours,

A. Einstein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