A Note on Poincaré's Contribution to Relativity

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IN the history of special relativity, Henri Poincaré's place has, on the whole, been either unrecognized or else exaggerated[1]—in either case, a disservice to the memory of this illustrious mathematician. A recent paper in this journal by Charles Scribner, Jr. goes far towards correcting this historical wrong.[2] On two points however, amplifying comments are called for. On the one hand, it needs to be explained how in his St. Louis address,[3] Poincaré could start by referring to the "principle of relativity" in words (quoted in Scribner's paper) that could be taken for those used by Einstein a year later, and yet end by looking towards ways of explaining the Lorentz-FitzGerald contraction (for instance, by some perturbation of the ether); on the other hand, attention needs to be called to Poincaré's substantial mathematical contributions to relativity theory as developed in his extensive article of 1906.[4]

On the first point it should be noted that when Poincaré speaks in his St. Louis address of the *relativistic principle*, he has apparently in mind essentially what now goes by the name of Galilean relativity. It is the overhanging threats to this principle as well as to the other general *classical* principles, and ways of overcoming them, that is the main theme of his eloquent address. True, he refers to the "laws of physical phenomena" and not just to the laws of mechanics in this reference to the principle of relativity, but the two, it must be remembered, were in the minds of most leading theoreticians of the era then closing, largely coextensive—did not Maxwell seek to explain electrical and, hence, also optical phenomena in terms of mechanical actions? Indeed, let us listen to what Poincaré himself has to say on this subject later in the address (Ref. 3, p. 9). "We come now to the principle of relativity: this not only is confirmed by daily experience, not only is it a necessary consequence of the hypothesis of central forces, but it is imposed in an irresistible way upon our good sense, and yet it also is battered."[5] Does not this statement speak for itself? Whatever our admiration for his keen scientific perceptions and high epistemological sophistication—and such admiration is fully justified—it must be nevertheless recognized that Poincaré apparently never actually came to anticipate Einstein's revolutionary idea concerning physical time, or to have gone a step beyond what he called Lorentz's "most ingenious idea. . . of local time."[6] His other statements in the St. Louis address as well as his later discussions bearing on relativity can therefore be considered as fully consistent—consistent with the then all but universally-held pre-Einsteinian kinematic notions.

Where Poincaré's contributions to relativity physics are most noteworthy is in its mathematical development.[4] Not only did he make important corrections to Lorentz's transformation equations, but he also sketched out fully the group-theoretic approach and defined the complete Lorentz group of transformations in space-time. This article contains also a number of other significant contributions to relativistic theory, that must be passed over in a short note. Suffice it here to offer the following suggestion. It would be both interesting and instructive to have available an outline, employing modern notation, of Poincaré's Rendiconti paper. This would serve, moreover, to do justice to Poincaré's part in the development of the theory of relativity. The part played by Lorentz, by Einstein, and by Minkowski in this development is documented in the well-known collection of their original publications.[7] Would it not be just, as well as useful, that at least a concise summary of Poincaré's contribution to relativity is also made easily accessible to the student of the subject?

[1] A notable exception in this regard among books on relativity is W. Pauli's *Theory of Relativity* (Pergamon Press, Inc., New York, 1958), a translation with supplementary notes by the author, of an extensive and brilliant survey article on relativity which appeared originally in Encyclopädie der Math. Wiss., 1921.

[2] C. Scribner, Jr., Am. J. Phys. **32**, 672 (1964).

[3] Translation published in Monist, **15**, 1 (1905).

[4] H. Poincaré, Rend. Circ. Matem. Palermo **21**, 129 (1906).

[5] Moreover, in one of his last essays on the subject: *Last Essays* (a translation of *Dernières Pensées*) (Dover Publications, Inc., New York, 1963), he states explicitly (p. 23) "the principle of relativity, in its former aspect, has had to be abandoned: it is replaced by the principle of relativity according to Lorentz."

[6] This, incidently, may well be an explanation of the highly curious fact that Poincaré never mentioned Einstein's work on relativity in any of his publications.

[7] H. A. Lorentz, A. Einstein, H. Minkowski, and H. Weyl, *The Principle of Relativity*, translated by W. Perrett and G. B. Jeffery (Dover Publications, Inc., New York) (republication of 1923 edition by Methuen and Company, Ltd., London).

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LETTERS TO THE EDITOR

A Compromise Giorgi System of Units

THE main objection of some physicists to the Giorgi (or mks) system of units is that **E** and **D** have different dimensions; similarly **H** and **B**. They usually consider **D** and **P** as partial fields and **E** as the total field, and would prefer to write

$$\mathbf{E}=\mathbf{D}-\mathbf{P}.$$

Similarly,

$$\mathbf{B}=\mathbf{H}+\mathbf{M}.$$

However they do appreciate the convenience of using the practical units of electricity and magnetism. Can a compromise be sought?

One may either (a) redefine **E** so that it is of the same dimensions as **D** and **P**, and measured in coulombs/meter^2 or (b) redefine **D** and **P** to be of the same dimensions as