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Mechanisms, principles, and Lorentz's cautious realism

Mathias Frisch

Department of Philosophy, University of Maryland, College Park, MD 20742, USA

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Abstract

I show that Albert Einstein's distinction between principle and constructive theories was predated by Hendrik A. Lorentz's equivalent distinction between mechanism- and principle-theories. I further argue that Lorentz's views toward realism similarly prefigure what Arthur Fine identified as Einstein's "motivational realism."

Keywords: Lorentz; Einstein; Realism; Mechanisms; Principle theories

> With all his devotion to scientific study,
> he nevertheless was perfectly aware that
> the human intellect cannot penetrate very deeply
> into the essential core of things. It was not until
> my later years that I was able fully to appreciate
> this half skeptical, half humble disposition.
> (Einstein, 1957, pp. 8–9)

1. Introduction

In a letter to *The London Times* in 1919 Albert Einstein famously distinguished what he called "principle-theories" from "constructive theories," explaining that the new theory of relativity is an example of the former kind (Einstein, 1954, p. 228). Einstein's distinction has received, especially in recent years, a fair amount of attention in the philosophical

E-mail address: mfrisch@umd.edu.

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literature and it has become common, following Einstein, to characterize the difference between Einstein's theory and Hendrik A. Lorentz's pre-relativistic theory of the electron by appealing to this distinction. One of my main aims in this paper is to show that a distinction equivalent to Einstein's was drawn at least as early as 1900 by Lorentz himself, who distinguished theories positing principles generalized from experience from theories positing mechanisms (Lorentz, 1900b, c). As we will see, despite Lorentz's and Einstein's disagreement about the correct approach to the electrodynamics of moving bodies, both agreed in fact rather closely on the merits of the two kinds of approaches to physical theorizing in general.

A second aim of this paper is to locate Lorentz's claims concerning the respective roles of principle- and mechanism-theories within Lorentz's broader methodological and philosophical views on science—in particular with respect to what I take to be Lorentz's view on the issue scientific realism.[1] In the lecture in which Lorentz drew his distinction between the two types of theory he maintained that the ultimate goal of physics, pursued by all "great researchers," is to realize the Faustian dream of discovering "deep under the surface"

> how everything is woven together,
> one thing acts and lives through another.[2]
> (quoted in Lorentz 1900c, p. 348)

Lorentz consequently preferred mechanism-theories, for these theories embody the hope of uncovering hidden, underlying realities in a way that principle-theories do not. And this hope, of course, is the hope of scientific realism. Both mechanism- and principle-theories could, on a realist construal, be true, but the former promise to reveal the hidden springs of nature in ways the latter do not. Lorentz's characterization of the ultimate aim of science and his preference for mechanism theories seem to suggest a strong commitment to scientific realism.[3] Despite its initial plausibility, however, I will argue that this interpretation of Lorentz is mistaken or at least over-simplified. To the extent that it is correct to see Lorentz as a scientific realist at all, his realism is another instance of Lorentz's views prefiguring those of Einstein. According to Lorentz, our confidence that our best scientific theories in some sense correctly represent features of the natural world can ultimately be based on nothing but an inner urge of ours to trust these theories—an idea we find echoed in Einstein's notion of a "religious trust" at the foundation of all scientific theorizing.[4]

I will proceed as follows. In the next section I will present some of the physical background for Lorentz's methodological views and will sketch certain aspects of Lorentz's theory of the electron and its problems. In Section 3 I will discuss Lorentz's

[1] Lorentz nowhere presents a fully developed methodology of science and, in comparison even to Einstein, discussed philosophical questions only rarely in his writings. Yet there are enough *meta*-physical remarks interspersed in Lorentz's published works to suggest a substantive and interesting—even if not fully developed and argued for—'philosophy of science.'

[2] All translations from the German in this paper are my own. For the translations of this passage from *Faust* and the passages that I cite below I have consulted the translation by Martin Greenberg (Goethe, 1992).

[3] One might believe that mechanism theories ought to be interpreted instrumentally, but unless they are intended to uncover real underlying structures it becomes harder to understand what the general advantage of mechanism theories over principle theories may be.

[4] For a discussion of Einstein's realism see (Fine, 1996).