

Narrating the Unobservable: On the historical-philosophical study of the relation between experiments and entities

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Scientific realism, as the philosophical issue concerning the interpretation of theoretical entities in science, has always been in a certain productive tension with the history of science. One recent attempt to make the two fields responsive to each other is Theodore Arabatzis' plea that a historicist account of these entities – Arabatzis calls it writing their biography – should underly the philosophical debate. Through the elaboration of a biography of the electron [1], Arabatzis shows how such a historicization of a theoretical entity can inform and constrain their philosophical interpretation. This historicization shows, he claims, that the different conflicting theoretical representation constructed between 1896 and the late 1920's all coalesce around a certain core of experimental claims that remains stable or cumulates over time. On the basis of this continuity over time, it is then possible, according to Arabatzis, to ascribe to the electron a particular kind of identity, which in turn allows him to evaluate particular positions within the realism-debate. Proceeding in this way, according to Arabatzis, thus allows for a close interaction between history and philosophy of science.

My aim in this talk is to challenge Arabatzis' conception of the identity of theoretical entities in terms of a biography of the stability of an experimental situation over time. I will argue, more in particular, that the identity of a theoretical entity over time should rather be understood in terms of a process of continual contestation of the entity's identity, history and its experimental-empirical domain. In order to accomplish this, I will discuss one particular part of the history of the electron, namely the relativistic response to the Kaufmann experiments (1901 – 1906), which at the time were taken to provide experimental evidence for Abraham's rigid electron and against the theory of relativity. Arabatzis does not spend much attention to this episode, because the experiments, according to him, only involved the further refinement of earlier experiments [1, p. 108], and because the episode provides merely an example of how experiments can provide a middle ground where different, incompatible theoretical representations can meet [2, p. 387]. As such, for Arabatzis this experimental episode provides another illustration of his more general claim that the identity of theoretical entities has to be understood in terms of the stability and cumulative expansion of the experimental core underlying them.

By means of a discussion of how some adherents of both the theory of relativity and the electromagnetic program (Abraham, Ehrenfest, Einstein, Laue, Minkowski, Planck) addressed the issues raised by the Kaufmann experiments, I will show, however, that we should not read the episode as just an example of experimental stability underlying conflicting theoretical representations. Rather, the theory of relativity was only able to overcome the challenge by co-opting and transforming both the experimental and theoretical study of the electron. This process took place on many different levels: it involved, among other things, casting doubts on Kaufmann's experimental method, proposing alternative experiments, re-writing the history of the study of the electron, and conceptualizing the electron as a generic relativistic object of study. This will then show that we are rather dealing with the imposition of a relativistic conception of experiment and theory on the study of the electron, which had as a consequence that the experimental significance of the Kaufmann experiments was seriously transformed: from posing an existential threat to the theory of relativity, they now came to be seen as providing evidence for the relativistic account of the electron's velocity-dependent mass. As such, the Kaufmann episode should not be seen as an instantiation of an experimental stability underlying the theoretical study of the electron, but rather as involving a radical

transformation of what it means to study the electron experimentally and theoretically.

On the basis of this historical discussion, I will then return to the more general claims that Arabatzis makes about his historicized approach to theoretical entities and about the interaction between history and philosophy of science. My claim here will be that the formulation of historical narratives concerning theoretical entities should not be concerned primarily with the search for continuity that is supposed to underly the practice of science. Such narratives should rather concern the way in which scientists, in response to theoretical and experimental challenges, try to endow their theoretical entities with a certain continuity, by giving them, for example, a certain history, by re-interpreting existing experiments in terms of these entities, or by incorporating them within a more general account. In this way, I will try to cast some light on the way in which historical-philosophical notions such as continuity, locality and generality are dynamically constituted through a process of contestation within scientific practice. Elaborating this point will then allow me to suggest, as a kind of concluding remark, that the interaction between history and philosophy of science with regards to the issue of theoretical entities should not be conceptualized primarily in terms of biographical narratives, but rather in terms of narratives of contestation and the crafting of relationships.

Sources:

[1] Arabatzis, T. (2006). *Representing Electrons: A Biographical Approach to Theoretical Entities*. University of Chicago Press.

[2] Arabatzis, T. (2011). On the Historicity of Scientific Objects. *Erkenntnis* 75: 377 – 390.