Spring 2011

Review of Michael Heidelburger and Gregor Schiemann, eds. The Significance of the Hypothetical in the Natural Sciences

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BOOK REVIEWS

Michael Heidelberger and Gregor Schiemann, eds. *The Significance of the Hypothetical in the Natural Sciences*. Berlin: de Gruyter, 2009. Pp. viii+376. $109.00 (cloth).

The Significance of the Hypothetical in the Natural Sciences brings together a brief editorial introduction and 14 essays by authors who will be very well known to *HOPOS* readers. Most of the articles come from a 2005 conference at the University of Tübingen, and although four of the articles have been previously printed, only one appeared previously in English. The essays in the book fall squarely into the category of *HOPOS* scholarship, given the historical treatment that philosophers of science and philosophically minded scientists receive. Indeed, the general topic of the book is the genesis and interpretation of a philosophical idea, the hypothetical in the natural sciences. In part, this means the rise of the hypothetical-deductive method and abduction, rather than induction as the primary methodology of the sciences, but it also refers to fallibilism and to the provisional nature of scientific claims.

The central theme of the book is the change from an axiomatic to a hypothetical perspective, and Helmut Pulte and Ernan McMullin's chapters address this very directly, the latter coming close to defining modern science as that which has a self-conception as hypothetical. In any case, the conception of the sort of knowledge that can be gained through science changed dramatically in the early modern period, as McMullin documents, considering the views of Copernicus, Kepler, Bacon, Galileo, Descartes, Boyle, and Newton. Pulte analyzes the rise of hypothetical thinking by studying Carl Neumann's nineteenth-century analysis of the foundations of Newtonian Mechanics, finding that the development of pure mathematics was key to the shift to the hypothetical conception. Laura Synder shows that in nineteenth-century Britain the inductive and hypothetical-deductive methods were much closer together than might be expected. While focusing on Herschel, she shows how both he and Whewell put constraints on the discovery of hypotheses. Far from Popper's bold conjectures, these hypotheses are informed by induction, so Whewell could claim to be the progeny of Bacon.

It comes as no surprise, given the title of his major work on the philosophy of science—*Science and Hypothesis*—that Henri Poincaré's views make up a significant portion of the discussion in the book. The role of hypotheses and conventions in Poincaré's philosophy is studied by Gerhard Heinzmann and Scott Walter. Heinzmann analyzes Poincaré's classification of hypotheses and links his geometric conventionalism to hypothetical reasoning. In analyzing Poincaré's reasons for maintaining Galilei spacetime (and for his infamous prediction that Euclidean geometry will continue to be used in physics no matter what), Walter shows that Poincaré took the principle of relativity to be a convention, while Einstein and others did not. Christophe Bouriau rounds out this set of articles with a comparison between Vaihinger and Poincaré, finding that they both see science as hypothetical and can be usefully described as presenting a form of pragmatism, although they differ from William James and F. C. S. Schiller on truth and hence present a novel form of pragmatism. Of course, Peirce also vehemently rejected this theory of truth, so even within classic pragmatism there is considerable room for differing opinions.

The collection also contains many studies of individual philosophers or scientists on the issue of hypotheticity, several of which connect the issue to the realism versus empiricism (scientific antirealism) debate. Taking the studies of philosophers first, Andreas Bartels looks at the views of Duhem and Popper, noting that although they were on opposite sides of the realism debate, they both, but for different reasons, linked hypotheticity and antirealism, something that is no longer done in contemporary discussions of realism. The reason seems to be that the contemporary debate over realism centers around the narrow issue of the belief in the existence of unobservables, rather than a more general issue of the limits of human knowledge and the hypothetical character of science. Alfred Nordmann compares the views of Peirce and Popper, noting that while Peirce did not associate hypotheticity with fallibilism, Popper did. Popper is committed to a realism that accepts the skeptical challenge that we can never have access to the real world. Peirce, of course, dismisses such skepticism as misguided and meaningless. Nordmann ends by nicely connecting Peirce to philosophers who emphasize experimental practice, what he calls technoscience, whereas Popper analyzes science at the level of theory and thus misses the importance of experimental practice. In a chapter originally written for a different purpose, Gad Freudenthal studies instrumentalism and realism in the history of astronomy, pitting Duhem against Popper and Maimonides against Gersonides in these debates. He shows that the philosophers generalized the stances that they took in regard to scientific realism, while the historical actors in astronomy had a specific science in mind. He links his chapter to the topic of hypotheses in an afterword, in which he argues that the negotiated

clash of two sciences, mathematical astronomy and Aristotelian physics, gave rise to the notion that scientific claims are to be first accepted hypothetically in order to be examined later. Rainer Specht studies Locke's empiricism, finding that the gulf between rationalism and empiricism is not very wide in the seventeenth and eighteenth centuries. He considers the views of many important players in the rise of empiricism besides Locke, such as Gassendi and Boyle, painting a very nuanced picture of Locke and his influence, especially in Germany. Turning away from the realism debate but remaining with the studies of philosophers, Michael Heidelberger looks at Emile Boutroux's concept of contingency, finding another link to pragmatism—this time Peirce's Tychism—and also parallels with Nancy Cartwright's early work on laws of nature. He also finds a hypothetical, anti-Kantian view of mathematics in Boutroux, which helped prepare the way for Poincaré's conventionalism in geometry.

Turning to the case studies of scientists, Gregor Schiemann considers Werner Heisenberg's position on a hypothetical conception of science, finding a pluralism akin to that of William James. According to Heisenberg, some established theories in physics are "closed"; that is, they are no longer open to minor revision but at the same time have limited applicability. So while they contribute to the stability of science, such theories are not incompatible with understanding parts of scientific knowledge as hypothetical. Andreas Hüttemann looks at pluralism and the hypothetical in Heinrich Hertz's philosophy of science, arguing that the common view of Hertz as an antirealist and pluralist is overblown. Furthermore, while Hertz makes consistent appeal to the concept of hypothesis, he does not rule out the possibility of the discovery of correct scientific theories, so he cannot be said to have contributed to the continuing development of a hypothetical view of science, at least in a strong sense of the term. The collection is completed by a piece by Michael Esfeld on the hypothetical metaphysics of nature. He considers what metaphysics will look like if it is based on science and is therefore hypothetical and fallible. The result is a consideration of a tenseless theory of time and existence in which there is no objective "now," just as there is no absolute sense in which two events can be simultaneous in the special theory of relativity. Esfeld concludes with comments on the mutual dependence of science and philosophy, which is a very fitting conclusion to the volume and, of course, very fitting for a book being discussed in *HOPOS*.

The volume raises very interesting issues that should be the topic of further inquiry. For example, the role of pragmatism is raised many times here, and it would be beneficial to focus some studies on the relation of the pragmatists to the idea of hypotheticity. The role played by the formalization of mathematics

and logic is another area to investigate further, given the connections mentioned in several of the essays. There are also undoubtedly more philosophers and scientists who played a role in the development of the hypothetical conception of science, and these should be considered in future work. I strongly recommend the book, given that the quality of the chapters is uniformly high and that it offers much to learn about the history of the philosophy of science.

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Timothy McGrew, Marc Alspector-Kelly, and Fritz Allhoff, eds. *Philosophy of Science: An Historical Anthology.* Malden, MA: Wiley-Blackwell, 2009. Pp. xx+680. $104.95 (cloth); $57.95 (paper).

The editors of this collection write that "existing anthologies in the philosophy of science almost invariably present science as seen through the lens of twentieth-century developments" (1). The collection they present as an alternative is a creditable effort, and it will enrich many classrooms, yet the extent to which it succeeds in providing another lens or lenses is a matter that deserves careful thought. The first thing to say about an anthology, however, is what it includes and what it does not.

The present volume provides, through its selections and its substantial introductions, (1) a standard history of astronomy and dynamics through Newton; (2) a selection of methodological and epistemological texts from the atomists through the early twentieth century; (3) an introduction to the "received view" in philosophy of science; and (4) an introduction to subsequent Anglo-American debates concerning confirmation and observation, methodology, explanation, and realism. More specifically, part 1 includes units on (1) the ancient and medieval periods, with particular attention to atomism, Aristotle, and later challenges to Aristotle's dynamics (82 large pages); (2) the scientific revolution, especially Copernicus, Kepler, Galileo, and Newton (188 pages); (3) modern philosophers from Bacon to Kant (55 pages); and (4) methodology in the writings of scientists and a handful of philosophers from Lavoisier to Einstein (69 pages). Part 2 includes units on (5) the received view (Carnap, Hempel, Reichenbach, and Strawson; 72 pages), (6) confirmation and observation (Hempel, Quine, Goodman, Putnam, Hanson, and Maxwell; 80 pages),