

Mechanism and modernity

Gregor Schiemann: Hermann von Helmholtz's mechanism: The loss of certainty. Dordrecht: Springer, 2009, x+282 pp, €106.95 HB

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Gregor Schiemann's *Wahrheitsgewissheitsverlust: Hermann von Helmholtz' Mechanismus im Anbruch der Moderne* (1997) is a mighty endeavor. Part intellectual history, part history of philosophy of science and nature, it has an ambitious, twofold aim: to chart mechanistic philosophy of nature and to trace the transformation from the "classical" to the "modern" concept of science. In doing so, it seeks to provide a new periodization of the history of modern science.

The abridged English version, *Hermann von Helmholtz's Mechanism: The Loss of Certainty*, still advances a number of big claims. Commonly, the Early Modern period is regarded as a period of major changes of the structure, content, and organization as well as of the conception of science. Schiemann, however, advocates a different periodization. While he agrees that the seventeenth century was a time of profound transformation of mechanics, he argues that the transformation from the classical to the modern conception of *science* took place in the second half of the nineteenth century (and, according to Schiemann, is still going on). One of the main features of this transformation is the shift from the claim to absolute, valid knowledge or truth to the insight into the hypothetical character of scientific knowledge. The loss of confidence in the certainty of knowledge—*Wahrheitsgewissheitsverlust*, as it is so exquisitely put in the original title—is a distinctive feature of modernity.

Schiemann takes his cue from German philosopher Alwin Diemer and historian and sociologist Wolf Lepenies as well as from Bachelard and Foucault. In his introduction, he reminds us that these thinkers highlight transitions and ruptures in the long-term development of science and that they see the dawn of modernity occurring in the nineteenth century. Schiemann utilizes the works of one of the most eminent nineteenth-century scientists, Hermann von Helmholtz, to illustrate and

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explore conceptions of mechanics and mechanism and the shift from the classical to the modern conception of science. In brief, Helmholtz's early philosophy of nature exemplifies "classical" mechanism together with a "classical" conception of science. While never abandoning mechanism and never fully converting to modernism, from the 1870s onward Helmholtz approached the "modern" concept of science. The book analyzes Helmholtz's mechanism and traces this shift in Helmholtz's writings, focusing on his public lectures and speeches.

The book has two parts. Part I offers a characterization of the classical and the modern conceptions of science along with an analysis of the science of mechanics and of the philosophical program that is based on it: mechanism. According to Schieman, mechanism has been the dominant philosophy of nature since the seventeenth century. Broadly conceived, mechanism implies that matter and motion are the exclusive causes of all natural phenomena. In the narrow sense, the kinds of forces and motions mechanism permits are specified by the theory of mechanics. Schieman then identifies three traditions within classical mechanism: materialist (Descartes, Boyle), dynamic (Leibniz, Kant), and dual mechanism (Newton). These traditions differ in their conceptualizations of matter and force: materialist mechanism rejects an independent notion of force, dynamic mechanism explains all properties of matter from effects of force, while for dual mechanism matter and force are irreducible fundamental ideas.

Schieman also reconstructs the concept of science that was tied to classical mechanism. In particular, he is interested in the kind and conditions of validity for scientific knowledge (*Geltungscharakter* and *Geltungsbedingungen*) expounded by mechanists. He distinguishes two ways of legitimating the claim to truth of the sciences: "metaphysical" and "scientific". The metaphysical strategy appeals to pure thought alone (Descartes), the scientific one to practical research (Galileo). From the perspective of legitimating strategies, Schieman sees an important continuity between medieval-scholastic and early modern science. In both periods, and indeed until the mid-nineteenth century, the claim to truth of the sciences (*Wahrheitsanspruch*) was never questioned. Only in the second half of the nineteenth century did the absolute validity of scientific knowledge become a problem, and it is precisely this development that yields the modern conception of science.

In a nutshell, "hypotheticity" is a distinguishing mark of modernity. Of course, Schieman does not claim that hypotheses did not play any role in classical science. That would obviously be absurd. Rather, the claim is that from the late nineteenth century on, hypotheses were regarded as an essential part of scientific knowledge and indeed the "epitome of science proper" (45). Modern science is inescapably hypothetical in three respects: Laws of nature are regarded as hypotheses; logical statements are not deemed valid a priori; and empirical facts are no longer considered to be the ultimate universally valid touchstone for knowledge. As a consequence, modern science substitutes a plurality of possible theories for the "classical monopoly of truth" (48). Schieman notes that the rise of "hypotheticity" came together with fundamental changes of the social organization of science (which Helmholtz helped initiate).

Part II presents a subtle and original analysis of some of Helmholtz's key writings about science. The two main chapters on Helmholtz's "classical mechanism" and its "hypothetization" in the 1870s are flanked by a brief intellectual biography and some concluding reflections about the conditions and causes of the change in Helmholtz's concept of science. The first of the two main exegetic chapters analyzes Helmholtz's mechanistic program as it was elaborated in the introduction to *Conservation of Force* (1847). Helmholtz's mechanism can be characterized as "dual", as he introduced matter and force as irreducible concepts. For him, absolute truth—in particular, the discovery of the central forces as ultimate causes—appeared attainable. And Helmholtz sought to establish the validity of his mechanism in a "scientistic" fashion, referring to the concepts of elements and mechanical forces that were being employed in physical research.

The second chapter traces the "hypothetization" of Helmholtz's concept of science: the period of transition in the 1860s and the abandonment of absolute truth as an attainable aim for science. Schiemann exposes in tandem Helmholtz's philosophy of nature and his conception of science. Here, the point is that Helmholtz never gave up his philosophy of nature (his mechanism); to hold onto it, he had to relax his concept of science (the demand for absolute validity). Helmholtz's mature conception of science, as expressed in the two speeches *On Thought in Medicine* and *The Facts of Perception* from the 1870s, placed science on a new foundation: sense perception. But this foundation was no longer completely secure. Helmholtz's own work on perception had shown that the facts of perception (and thus the laws grounded in them) were fallible. Yet Helmholtz never fully embraced the modern understanding of science. He remained "spellbound by the classical myth of truth" and accepted the "hypotheticity" of science because he could thus rescue mechanism from its demise (209–210). The last chapter of the second part considers the conditions and causes of the change in Helmholtz's conception of science. Schiemann's conclusions are cautious. He highlights the impact on Helmholtz's notion of science of his work on perception as well as more general political and cultural conditions that might have contributed to the loss of confidence that ultimate truth was attainable in science, but he does not offer a definitive explanation of Helmholtz's change of mind.

Schiemann touches upon a number of big issues: the development of Helmholtz's philosophical and scientific thinking, the structure of mechanistic philosophy of nature, long-term transformations of the history of science, and the concept of modernity. A book that deals with big themes invites big questions: Is Schiemann's analysis of mechanism appropriate? How compelling is the concept of modernity Schiemann expounds? Above all, how convincing are the periodization, the claim that the late nineteenth century witnessed the "loss of trust in the certainty of scientific knowledge", and the suggestion that the process of formation of modern science is still continuing? Both the German original and the English translation raise these issues. However, the translation is much abridged, and as a result, the emphasis of Schiemann's account has shifted. In the original, the discussions of the classical conception of mechanism and of the classical and modern concepts of science take up about a third of the book; in the English version, a fifth. As indicated by the two titles, the German original emphasizes long-term developments in

philosophy of nature and science, while the English version has become, by and large, an interpretation of Helmholtz's writings about science.

As an in-depth interpretation of Helmholtz's intellectual trajectory, *Hermann von Helmholtz's Mechanism* has many merits. But in my opinion, the abridgement was not always beneficial. For instance, illustrations of past mechanist philosophies of nature are omitted from the English version. Schiemann's reconstruction of mechanism, schematic and idealized to begin with, has now become even more detached from historical context. Thus condensed, the complex dual analysis of mechanism from the entwined perspectives of history of philosophy of nature and history of philosophy of science is hard to unravel, and the at times heavy-going translation does not facilitate this task.

Moreover, the proposition about late nineteenth-century *Wahrheitsgewissheitsverlust* strikes me as the most fascinating and thought-provoking feature of Schiemann's study, so I would have liked to see it more in the foreground. Schiemann's overall proposition invites further research and elaboration in light of recent studies on Early Modern mechanism, mechanical philosophy, and mechanistic explanations. In particular, it would be worthwhile to consider if, pre-1850, the trust in the certainty of knowledge was as universal as Schiemann suggests, and to explore other aspects of the erosion of that trust. Newton famously distinguished between "moral" and "absolute" certainty, and only the former did he deem attainable. Condillac and other Enlightenment philosophers emphasized that erring was essential to the human condition. It would be interesting to ask whether, and if so, to what extent insights into the capriciousness and uncertainty of experimental knowledge have affected philosophical conceptions of science. Boyle, for instance, doubted that experimental knowledge could ever be completely secure as it was marred by contingencies and the "wantonness of nature". Late eighteenth-century practices of measurement suggested that the uncertainty of instrumentally gained knowledge was insurmountable. Also, we need to compare and contrast the idea of hypotheticity with conceptions of the general fallibility of knowledge, the appreciation of man's epistemic limitations, the ubiquity of error, and the fickleness of knowledge gained through experiments and instruments. My hunch is that ultimately the thesis Schiemann has laid out will have to be modified. But of course, this would not decrease the value of his provocative and inspiring study.