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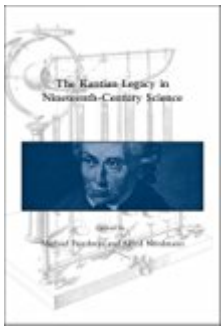

Michael Friedman, Alfred Nordmann, eds.. *The Kantian Legacy in Nineteenth-Century Science.* Cambridge: MIT Press, 2006. iv + 370 pp. $45.00, cloth, ISBN 978-0-262-06254-1.

Reviewed by Katherine Arens

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This exemplary collection represents work by philosophers on two continents who consider Immanuel Kant's legacy as seen in the history of mathematics, mathematical logic, and the physical sciences, and then explore his reception by major scientists/philosophers of science, starting with his contemporaries and moving up through Albert Einstein, Henri Poincaré, and the logical positivists. These fourteen impeccably documented essays originated in November 2000 at a conference at the Dibner Institute for the History of Science and Technology at MIT (p. 1). Taken together, these essays build a bridge between nineteenth-century science, philosophy, and the philosophy of science, addressing evolutionary biology, cognitive physiology, mathematics, physics, logical positivism, and pragmatism.

The trajectory sketched offers a new vision of Kant's work, based on his influence on the sciences. The projects are organized around five main areas of influence (p. 1): *Naturphilosophie*, Jakob Friedrich Fries, Hermann von Helmholtz, Neo-Kantianism, and Poincaré. The authors hope to correct many current assessments of Kant's scientific legacy, in order to reclaim him for more than mathematics. By tracing issues like the differentiation between regulative and constitutive rules, they argue for Kant's broader significance for all the fields mentioned above.

The first cluster of essays is on romantic biology and *Naturphilosophie*. The volume's overture is by Frederick Beiser with "Kant and *Naturphilosophie*." Beiser explains the Romantic concept of nature (vital materialism). Neo-Kantians established the stereotype that Kant's work was strictly opposed to vital materialism, but Beiser demonstrates how *Naturphilosophie* may actually be derivable from Kant's position--that there are grounds to consider Kant the father of Romantic science. Beiser offers an extraordinarily careful exposition of the differences between contemporary physiology and the more philosophical approach to science that was evolving at the time. When Kant argued that concepts like organism only have a regulative purpose in science (p. 14), Beiser notes, he was also willing to leave the question of constitutive rules undecided, which was

critical to the evolution of the position of the *Naturphilosophen*.

Robert J. Richards, in "Nature Is the Poetry of Mind, or How Schelling Solved Goethe's Kantian Problems," takes up another facet of Romantic science. He begins with Helmholtz's interest in the poet Johann Wolfgang von Goethe's reception of Kant, under the influence of Baruch Spinoza--Helmholtz discussed the case at an 1892 meeting of the Goethe Society (p. 27). Richards reconstructs the positions that came to fruition in Goethe's *Metamorphosis of Plants* (1790), in discussions with Friedrich Schiller. Karl Leonhard Reinhold had tutored Goethe in Kant, but then his interest took a new turn once Friedrich Wilhelm Schelling arrived as his interlocutor (p. 37). The result was that Goethe assumed the concept of life and worked toward a kind of model for evolution.

The third essay in this group, Michael Friedman's "Kant--Naturphilosophie--Electromagnetism," takes up contemporary discussions of Hans Christian Oersted's 1819 work on electricity and magnetism, which evolved under the influence of Schelling, and should be seen in contrast to works by contemporaries such as Johann Wilhelm Ritter. Friedman provides an excellent discussion of the role of regulative and constitutive rules in science (in this context, experience emerges as constitutive, while the scientific logics applied to that experience function as regulative).

The second group of essays focuses on Jakob Friedrich Fries, who received Kant early in the nineteenth century. Friedrick Gregory, in his "Extending Kant: The Origins and Nature of Jakob Friedrich Fries's Philosophy of Science," starts by outlining Fries's intellectual biography, and then adduces a network of other contemporaneous voices to trace his differences with Kant. Moving toward purer science, Helmut Pulte's "Kant, Fries, and the Expanding Universe of Science," examines Fries's systematic differences with Kant, comparing concepts at the boundaries between philosophy and science. Fries argues that in this era philosophy and science were not as far estranged from each other as they would be later. By reference to biology, chemistry, mathematical physics, and mathematics, Pulte argues for Fries's impact and originality in differentiating science.

The volume's third cluster of essays includes two important discussions of connections between Kant and Helmholtz. Robert DiSalle, in "Kant, Helmholtz, and the Meaning of Empiricism," turns to the foundations of geometry to ask how empirical experience has contributed to it. Helmholtz emerges as a very modern alternative to Kant's notion of pure intuition, as he challenges Euclidean geometry and preserves a model for constructivism based on experience, especially by questioning the status of experiential *a priori* as constitutive. DiSalle offers a kind of phenomenology of scientific disciplines, differentiating them based on the particular kind of experience and space each accounts for.

A magisterial presentation of Helmholtz in the context of experimental equipment and mental representations is offered by Timothy Lenoir, in "Operationalizing Kant: Manifolds, Models, and Mathematics in Helmholtz's Theories of Perception." Lenoir begins with the work of Johann Friedrich Herbart (who succeeded Kant at Königsberg) and pursues how sense perception depends on the eye and ear in establishing measures for quantity (such as space and magnitude). In pursing Helmholtz and the physiology of perception, he brings in contemporaries like Carl Friedrich Gauß and considers machines used for measurement, to show how they conceptualized the relationships between representations and external objects in terms of dimensions, color vision, and the like.

The next group of essays addresses the intellectual history of Marburg Neo-Kantianism in order to revise it. Alan Richardson, in "'The Fact of Science' and Critique of Knowledge: Exact Science as Problem and Resource in Marburg Neo-Kantianism," posits that epistemology was taken up

by two different disciplines at the time--philosophy and the philosophy of science. He addresses Ernst Cassirer, Jonas Cohn, and other members of the Marburg school, and then draws a line from Hermann Cohen and Paul Natorp up through Rudolf Carnap and logical empiricism, based on their different uses of logic--pure logic versus logics of experience.

In "Kantianism and Realism: Alois Riehl (and Moritz Schlick)," Michael Heidelberger addresses the impact of the Marburg School on Carnap and Moritz Schlick. He notes that most attention has been paid to Cassirer (p. 227), and then uses Riehl's "critical realism" as a vector for the Kantian roots for neopositivism. He reads Riehl as a Neo-Kantian anticipating logical positivism, offering a careful intellectual biography and exposition of his notion of sensation, concluding that Riehl's influence has been undervalued because Neo-Kantianism adopted a different model. Riehl's critical realism and Hermann Cohen's critical idealism (p. 253) are again taken up in Alfred Nordmann's "Critical Realism, Critical Idealism, and Critical Common-Sensism: The School and World Philosophies of Riehl, Cohen, and Peirce." Nordmann sketches the intellectual genealogy of Charles Sanders Peirce from Kant, in a very important tracing of echoes.

Poincaré is the focus of the last cluster of essays in the volume, tracing a different version of the debates pitting science against philosophy, in this case motivated by the relationship of pure math and logic. Janet Folina, in "Poincaré's Circularity Arguments for Mathematical Intuition," takes up a critique of Poincaré by Warren Goldfarb (1988), with the goal of redefining intuition to salvage Poincaré from charges of psychologism. Folina notes the *apriorist* inspiration of intuition and considers value/fact distinctions to redefine psychology. In "Poincaré--Between Physics and Philosophy," Jeremy Gray takes up Poincaré's various public statements on the uses of mathematics, to discuss how the philosopher sees the relations between mind and basic concepts of mathematics. Finally, a comparison between Hertz and Poincaré is evolved by Jesper Lützen, in "Images and Conventions: Kantianism, Empiricism, and Conventionalism in Hertz's and Poincaré's Philosophies of Space and Mechanics." Lützen examines Hertz's discussions of theories as "images" and attempts to distinguish the status of phenomena in terms of space, time, and conventions.

Overall, this collection of essays is a benchmark to be reckoned with in any future discussions of the roots of logical empiricism and the influence of Kant in the sciences. Readable, well-documented, and cogent, it should be required reading to span the intellectual history of the nineteenth and twentieth centuries and to disperse stereotypical understandings of Kant's influence in science.

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