BOOK REVIEWS

David Stump. *Conceptual Change and the Philosophy of Science: Alternative Interpretations of the A Priori*. New York: Routledge, 2015. Pp. 176. $116.00 (cloth).

David Stump's book *Conceptual Change and the Philosophy of Science: Alternative Interpretations of the A Priori* defends a pragmatic account of constitutive principles in science by analyzing their historical evolution and contemporary significance. The book divides naturally into two main parts. First, it gives a novel introduction to the philosophical development of the pragmatic a priori starting from Poincaré's conventionalism, continuing with the logical empiricist's take on a priori principles, and finishing with the pragmatic theories of a priori developed by Arthur Pap and C. I. Lewis. In the second part of the book the author illustrates the constitutive status of Newton's laws of motion and furthermore deals with two philosophical problems: (1) conceptual change and the role of constitutive elements in theory transitions and (2) the role of mathematics in physics. The book makes original contributions in both domains, offering original scholarly analysis of the development of the pragmatic a priori and interesting contemporary discussion of theory change and the relationship between mathematics and physics.

The book starts with the fascinating history of the emergence of non-Euclidean geometries, the debate that followed regarding geometry's epistemic status and Poincaré's conventionalism. Poincaré's introduction of the notion of convention can be seen as the initial step toward relativizing the Kantian synthetic a priori and introducing the pragmatic element in fixing the principles in a theoretical framework. While the interpretations surrounding Poincaré's conventionalism are diverse and often conflicting, the book aims to offer a coherent reading of Poincaré's positions, highlighting his contribution to the development of the pragmatic a priori. Stump gives a detailed analysis of Poincaré's arguments for the conventional understanding of mechanics and geometry and argues that Poincaré should be taken to develop two types of conventionalism. The motivation for this reading is twofold. First, the scope and applicability of conventions are different. Poincaré defends a hierarchical understanding of scientific theories, according to which geometry needs to be in place for the formulation of mechan-

ics and further empirical laws that presuppose mechanics. Second, Poincaré takes a different attitude toward the truth-value of mechanics and geometry. Stump claims that while geometry lacks truth-value and is evaluated merely in terms of its convenience, the laws of motion are truth apt. By taking Poincaré to be defending a two-type conventionalism, Stump highlights an important aspect of Poincaré's epistemology of science. He shows the important difference between geometry and mechanics with regard to their function and how Poincaré's epistemology makes a first step into the development of the pragmatic a priori. The book follows Hans Reichenbach's further development of Poincaré's insights and advancement of a relativized notion of a priori principles. Reichenbach's insight is that principles that play the role of a priori presuppositions in a specific theory cannot be regarded as fixed across theoretical frameworks but are dynamic and change in theory transition.

The book discusses accounts of constitutive principles developed by the positivists, for example, in the early work of Moritz Schlick and the later of Rudolph Carnap and the parallel development of alternative accounts in the work of Ernst Cassirer, C. I. Lewis, and Arthur Pap. Stump goes into particular detail when discussing Lewis's theory of pragmatic a priori principles and Pap's theory of functional a priori, two theories that have not received much attention in the contemporary literature and that offer alternative ways to account for the special role that physical principles, as well as mathematics and logic, play in scientific theories. These accounts of a priori principles motivate Stump's own position, which he defends with a discussion of Newton's laws.

The pragmatic account of a priori principles defended in the book shares important elements with Quinean holism, insofar as the principles that act as a priori presuppositions are ultimately revisable by experience. The difference between the account developed in the book and epistemic holism is the focus on the role the a priori elements play in the theoretical framework—they function as constitutive presuppositions making empirical inquiry possible. Stump claims that the Quinean notion of entrenchment does not capture the essential epistemic difference between constitutive principles and empirical claims. Technically speaking, the existence of a priori knowledge is denied and the functional a priori is understood in a very narrow sense—as a constitutive precondition of empirical investigation. The functional a priori elements originate in experience and are not fixed across theoretical frameworks; they are dynamic. What elements will be fixed as constitutive a priori is ultimately down to a pragmatic choice.

The conception of constitutive elements in science developed in this book comes very close to Michel Friedman's development of the relativized a priori in his *Dynamics of Reason* (Stanford, CA: CSLI, 2001). Stump agrees with

Friedman's main ideas on the nature of constitutive principles, his objection to Quine's epistemic holism, and the idea that constitutive principles should be seen as relativized a priori principles and not necessary truths. The disagreement with Friedman's position concerns the role of philosophy in securing the rational transition from one theoretical framework to another. Contrary to Friedman, the author opposes seeing philosophy as a metaframework establishing the rationality of theory change and adopts a position much closer to Ian Hacking's "styles of reasoning," which does not commit him to foundationalism.

Apart from the problem of theory change, the book also engages with a widely discussed debate in philosophy of science, the role of mathematics in physics, and offers a pragmatist solution to the problem of the applicability of mathematics. Contrary to many contemporary philosophers who use the indispensability argument to argue for Platonism, Stump argues that his account of constitutive principles can explain how mathematics gains its special role in science, without the unnecessary commitments to abstract entities. This solution is sensitive both to practices in mathematics and to the question of how abstract mathematics can be used for the representation of concrete physical phenomena. I think the author could have defended the advantages of his account even further, for example, by pointing out that the theory of constitutive principles can accommodate for the plurality of mathematical formalisms that an empirically successful theory can employ. While I found the author's resistance to a holistic approach to scientific theories and appeal to indispensability arguments to explain the usefulness of mathematics very well founded, the book had the potential to go into more depth to explain where the proposed account stands in the recent debates on the representational role of mathematics.

This book illustrates excellently that the questions regarding the status and role of constitutive principles in science continue to preoccupy philosophers of science today as much as they did a century ago. Stump shows that there are still many interesting questions in the debate to be addressed, both regarding the historical developments and contemporary issues in the foundations of science. Furthermore, whereas the role of functional a priori principles in science was originally developed in the context of space-time theories, it is clear that these principles figure much more broadly across the disciplines, leaving the development of a more interdisciplinary and pluralistic account open for future development.

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