

K. Brad Wray, *Kuhn's Intellectual Path: Charting The Structure of Scientific Revolutions*, Cambridge: Cambridge University Press, 2021, xii + 233 pages

Thomas Kuhn's extraordinarily successful book, *The Structure of Scientific Revolutions*, was one of the most significant works in the history and philosophy of science of the latter half of the twentieth century. Sixty years after its original publication in 1962, *Structure* continues to attract attention. It was once commonplace for commentators to focus narrowly on the details of Kuhn's model of science as presented in *Structure*. It is now widely recognized that *Structure* constituted a particular stage in the overall evolution of Kuhn's thought. It was the outcome of years of prior reflection on the nature of science. And Kuhn continued to actively develop his ideas for more than three decades following the publication of the first edition of the book.

In this extensively researched book, Brad Wray takes *Structure* as his central point of focus. It is, in a sense, a book about a book. More exactly, it is about a book, the book's author, the author's influences, the book's reception, and the author's career as it relates to the book. Wray considers aspects of Kuhn's education and early career in order to shed light on the formative influences that shaped the ideas about science presented in *Structure*. He explores the impact of these ideas within the disciplines of the history, philosophy, and sociology of science, as well as in the social sciences more broadly. The result of Wray's analysis is a deeper understanding of the significance of *Structure* as well as of the overall intellectual project from which it stemmed.

Kuhn studied physics at Harvard at both the undergraduate and graduate level. While completing his PhD, he was invited by James B. Conant to participate in the teaching of Harvard's General Education Natural Science program. During preparation of lectures for this program a formative experience occurred. Kuhn was reading Aristotle for background to the development of seventeenth-century mechanics. At first, Aristotle appeared to Kuhn to have had a profoundly mistaken conception of mechanics. But, while reading Aristotle, Kuhn experienced a sudden flash of insight into the alternative worldview of Aristotle. It was this experience of initial failure to understand followed by profound shift in understanding that opened Kuhn's thinking to the idea of a scientific revolution. As Wray notes, "the Aristotle experience was the source of Kuhn's initial discovery of scientific revolutions, that is, those disruptive changes in science that undermine the strictly cumulative account of scientific progress that he reacted against in *Structure*" (p. 11).

It was not just the "Aristotle epiphany" that led to Kuhn's account of revolutionary scientific change. Wray makes a compelling case that Kuhn was deeply influenced both by Conant's own approach to science and by his exposure to case studies in the history of chemistry which formed part of the program that Conant had designed. Wray points to several familiar Kuhnian themes that were already present in Conant's approach. Conant favoured a historical approach to understanding science, he saw scientists as attempting to reconcile facts with conceptual schemes and believed that scientific revolutions played an important role in scientific progress. Conant was critical of the idea of a fixed scientific method, as well as of the idea of a unified science. Perhaps most strikingly, he held that theory appraisal is comparative and that a theory is only ever rejected when an alternative is available to replace it. As for the history of chemistry, we might suppose, in light of his earlier work and training, that Kuhn thought primarily about the Copernican revolution and twentieth-century physics when he developed the ideas for *Structure*. But Wray notes that Kuhn devotes considerable attention to chemistry. Indeed, "Every single chapter of *Structure* includes a discussion or remark about a chemist or a development in chemistry" (p. 51). Part of the explanation, Wray suggests, is that this is due to the emphasis of Conant, himself trained as a chemist, in the

General Education course, as well as the role of Leonard Nash, also a chemist, with whom Kuhn at one stage co-taught the course.

*Structure* opens with the suggestion that the study of history might lead to a transformation of our “image of science”. It has been an enduring question what exactly the image was that Kuhn sought to challenge and replace. Was it the popular image of science, the text-book image, or, perhaps, the logical positivist image? With respect to the latter possibility, Kuhn does not deal at length with logical positivism in the pages of *Structure*. The lack of detailed engagement with positivism has raised doubts about the level of Kuhn’s knowledge of positivist philosophy of science. Moreover, Rudolf Carnap commented favourably on the manuscript of *Structure* when he wrote to Kuhn in his capacity as editor of the *Encyclopedia of Unified Science*. Rather than a challenge to positivism, this suggests that *Structure* was not seen as inimical to positivism at all. But Wray attempts to show that Kuhn was more deeply engaged with positivism than appeared to be the case. His main evidence for this is the text of the Lowell Lectures, which Kuhn delivered in 1951. Kuhn regarded these lectures as an early attempt to work out the account of science ultimately presented in *Structure*. He devoted a lecture to the positivist project of formalizing the language of science. He had concerns that the project was an impossible task. He also expressed reservations as to its desirability, since formalizing the language of science would impose constraints on the formation of new concepts. This material did not find its way into *Structure*. Instead, Wray suggests, Kuhn proposed his account of paradigms as a way of allowing for the kind of conceptual innovation that, in his earlier lecture, he had argued was not possible within the formalist framework.

Turning to the reception of *Structure*, Wray considers its impact within the social sciences before addressing the appropriation of Kuhn by the sociology of science. The model of science that Kuhn proposed in *Structure* was intended solely as an account of natural science. Despite this, social scientists took a keen interest in Kuhn’s account and often drew on the account in reflecting upon the nature of their own disciplines. Wray provides examples of discussion among social scientists of whether their fields possess paradigms, as well as the implications of having or failing to have a paradigm for the scientific status of their disciplines. Apart from possession or otherwise of paradigms, there was also the question of whether social sciences undergo revolutionary transition between phases of normal science. As for the sociology of science, Kuhn was sympathetic to functionalist sociology of science and interacted positively with sociologists such as Robert Merton. Moreover, Kuhn placed considerable emphasis on social factors in his account of science, since he regarded scientific knowledge as the product of groups of scientists. But the situation began to change with the emergence of the Strong Programme in the Sociology of Scientific Knowledge, which derived significant inspiration from Kuhn. Wray emphasizes the finitist approach of Barry Barnes, which he characterizes as an “extreme form of nominalism” (p. 110). He canvasses several objections that Kuhn raised against the Strong Programme. But perhaps the most important point is that Kuhn rejected the extreme externalism of the Strong Programme: “It is Kuhn’s internalism that both distinguishes his view from that of the Strong Programme and makes his account a contribution to the *epistemology* of science, rather than to the sociology of science” (p. 117).

No doubt, many philosophers of science regard Kuhn as primarily a historian of science, albeit one with aspirations that were philosophical in nature. But Wray brings out some of the complexities of the situation by considering the reception of *Structure* by historians of science. First, though, he points out that after the completion of *Structure* Kuhn did indeed undertake several purely historical projects. For example, in the 1962-63 academic year, Kuhn participated in a large-scale project on the history of quantum physics based in Copenhagen. This project produced a large store of valuable historical materials relating to the development of quantum physics. In the 1970’s, Kuhn pursued research on the origins of the quantum theory

which resulted in his 1978 book, *Black-Body Theory and the Quantum Discontinuity, 1894-1912*. That book was met with some puzzlement, since Kuhn did not employ the theoretical framework and terminology of *Structure* in his analysis of the historical episode. As for Kuhn's standing within the history of science, Wray suggests that Kuhn's historiographical approach put him out of step with contemporary tendencies in the discipline. By contrast with the increasingly externalist orientation of his contemporaries, Kuhn's approach to the history of science was internalist. As for the reception of *Structure* among historians of science, Wray provides evidence of resistance to the theoretical approach that Kuhn presented in *Structure*. Historians of science, Wray suggests, tend to focus on the particularities of a historical episode rather than seek to identify underlying patterns. Hence, they resisted the idea that the history of science might have a structure or develop in cyclical fashion. Thus, though Kuhn did undertake work that was primarily historical in nature, that was not the case with *Structure*. Wray argues that Kuhn's project in *Structure* was not primarily historical, but philosophical: "those historians who have seen *Structure* as an example of poor historical scholarship are mistaken. It is not poor historical scholarship, because it was not historical scholarship at all" (p. 141).

Philosophers of science reacted strongly to *Structure*. It was subject to widespread philosophical criticism. Wray divides the philosophical criticism into four main themes. First, the notion of a paradigm is vague and ambiguous. Second, the choice between paradigms may not be made on a rational basis. Third, Kuhn's view gives rise to relativism since it accords no place to objective considerations such as neutral observation. Fourth, Kuhn blurred the distinction between the normative and descriptive in such a way that it was unclear whether his descriptive account of science should be taken to have normative implications. Wray notes that Kuhn modified some of his views in response to criticism, for example, by introducing distinctions to clarify the notion of a paradigm. In other areas, Wray takes the criticism to have been due to misunderstanding, which has not always been resolved. Some philosophers have picked up on Kuhn's suggestion that scientific rationality has a social dimension. There has also been debate among philosophers about the nature of Kuhn's relativism. As for the relation between the descriptive and the normative, Wray points out that the widespread naturalism of contemporary philosophy of science makes this less of a problem. Apart from the critical reaction to *Structure*, Wray also discusses Kuhn's influence on a debate to which he did not directly contribute. He argues that Kuhn's emphasis on scientific theory change exerts an influence on the contemporary debate about scientific realism in a way that is distinct from the emergence of scientific realism out of the breakdown of the positivist account of the meaning of theoretical terms.

The book makes for an interesting read. Those who have been engaged in the debates may find some of the critical analysis superficial or overly charitable to Kuhn. But that would be to miss the book's purpose. Wray does not attempt to resolve the philosophical disputes to which Kuhn's work in *Structure* gave rise. He provides context and background for that work. He shows where and how it fits into Kuhn's trajectory. He draws on a broad range of research, including archival materials, such as texts of lectures and correspondence, to trace Kuhn's intellectual journey before, up to and after the publication of *Structure*. He provides details about Kuhn's education and subsequent career that shed light on his interests, projects and shifts in orientation. The result is a deeper understanding of Kuhn, *Structure*, and the place of *Structure* in Kuhn's intellectual development. In my own case, I come away from reading Wray's book with an enhanced sense of Kuhn's philosophical aspirations, though still unpersuaded of their merits.

## References

Kuhn, Thomas S. (2012), *The Structure of Scientific Revolutions*, 4<sup>th</sup> ed., Chicago: University of Chicago Press

Kuhn, Thomas S. (1978), *Black-Body Theory and the Quantum Discontinuity, 1894-1912*, Chicago: University of Chicago Press