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ESSAY REVIEW

A systematic companion to "neoclassical" philosophy of science

Gerhard Schurz: Philosophy of science: A unified approach. New York: Routledge, 2013, xix+456pp, $39.99 PB.

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After the demise of logical empiricism in the late fifties of the past century, philosophy of science entered a sort of Kuhnian revolutionary phase. Both its central problems and the methods used to address them underwent a profound change; under the pressure of the "new" philosophy of science—and of the various historical, sociological, cultural, or feminist approaches—the way of doing philosophy championed by Carnap and Popper was progressively abandoned by many scholars interested in the study of science. Today, it is unclear whether this revolutionary phase is coming to an end, and if a new paradigm is in sight. That this may be the case is suggested by the appearance of some advanced introductions to the philosophy of science, which aim at replacing classical work like those by Carnap (1966) and Hempel (1966) as manuals for the present generation of scholars. These new contributions provide the (advanced) student, and the expert as well, with a firm grip of what, following Kuipers (2001), we may call the "neoclassical" approach to the philosophy of science: briefly, updating and revitalizing the traditional analytic account to tackle the hot problems of postpositivist philosophy of science.

With this book, Gerhard Schurz provides probably the most complete advanced introduction to neoclassical philosophy of science appeared so far. *Philosophy of science: An unified approach* is an impressive overview of the main issues in general philosophy of science, organized by topics and written in a extremely rigorous and systematic style. To be sure, Schurz's book is a deliberately biased one: To dispel any doubt, right at the beginning he declares himself "a follower of logically and empirically oriented philosophers of science such as Carnap, Hempel, Reichenbach, and Stegmüller in the German speaking area" (xvii). Thus, it is easy

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to predict that this book will leave two kinds of readers unsatisfied. First, because this is not an historical introduction to the field: The author addresses a (great!) number of selected philosophical problems, presents the most prominent solutions available, and discusses their relative merits before offering what he thinks is the best, often original, answer to the problem at hand. So the reader looking for a chronological introduction or for an historically balanced evaluation of different positions in the philosophy of science is advised to look at other books, like the now classical one by Loose (2001). Second, the book will disappoint those who believe that "general" philosophy of science is dead and should be replaced either by the history and the sociology of science or by highly specific philosophies of the special sciences. As Schurz's book lively demonstrates, that verdict is simply untenable.

The book is divided into six long chapters. Each chapter starts with introductory sections written for the beginner, followed by sections on "complementary and advanced topics." The advanced part is often as long as the basic one, and sometimes even longer (like in chapters 5 and 6). Thus, the book really contains two books of roughly 200 pages each. It is completed by a rich, 35 pages bibliography, a carefully compiled subject index, and short solutions to most of the exercises proposed at the end of each chapter. Schurz usefully keeps footnotes at a minimum, limiting himself to a few suggestions for further reading, which close each chapter. The use of formal notation is also reasonably limited, at least in the basic part, and all formulas are explained in informal terms; as a negative note, a more careful editing would have improved the formal apparatus, which is sometimes difficult to read (see, e.g., the symbol for the negation of the entailment relation on p. 314). Another strong point of the book is the constant use, to illustrate the main concepts and problems, of concrete examples taken from different scientific disciplines—including physics, psychology, economics, history, and especially chemistry, the subject of Schurz's master degree (cf. Schurz 2011).

The first three chapters (170 pages overall) mainly contain preparatory material of a general or meta-methodological nature. Chapter 1 (*Introduction: where do we stand?*) offers an introduction to the nature and history of philosophy of science and a brief but informative survey of the main contemporary positions in the field. Chapter 2 (*The question of unity: in search of common foundations of the sciences*) contains a discussion of the nature and aims of science, a deeply informed classification of the different special sciences (including humanities), and a well-argued defense of their fundamental methodological unity. Finally, chapter 3 (*The conceptual toolkit: language, logic and probability*) introduces the notion of a formal language, the idea of formalization, and the basic elements of deductive logic and probability theory. Here, the reader is offered a detailed and very useful taxonomy of all the different kinds of concepts (logical/non-logical, descriptive/prescriptive, empirical/theoretical, qualitative/quantitative, etc.), sentences (synthetic/analytic, observation/empirical/theoretical, general/non-general, etc.), and kinds of contents (logical/empirical/probabilistic) that are used in scientific languages; their methodological significance is explained in connection with issues of verification and falsification, confirmation and disconfirmation, and lawlikeness. The advanced part introduces Schurz's own account of relevant inference, which will be applied in the following chapters, and offers a critical discussion of statistical and subjective conceptions of probability (besides presenting additional technical material on binomial distributions and inductive learning). Schurz's own position in the debate is a *dualistic* one, vindicating a central and complementary methodological role for both notions: "In Kantian terms, statistical probabilities without a connection to subjective probability are *empty* (have no observable implications), and subjective probabilities without a connection to statistical probabilities are *blind* (have no relation to reality)" (168). This first part of the book contains a number of very insightful and thought-provoking discussions—like those of value neutrality, of the theory-ladenness of observation and of the justification of induction in the advanced sections of chapter 2. Given space limitations, I will focus, however, on the (basic sections of the) last three chapters of the book, where the author gets to the heart of the matter.

The three questions selected by Schurz as the leitmotiv of his book are the following: How do we test scientific laws? How do we evaluate full scientific theories? and How do we use laws and theories to explain and predict phenomena? The three core chapters of the book (240 pages overall) address in turn each of these problems.

Chapter 4 (*A question of fit: law hypotheses and their empirical testing*) is the most demanding, and probably also the most rewarding, chapter in the book. It offers an extremely valuable discussion of the testing of both strict and non-strict lawlike generalizations. Strict or deterministic laws have the form of universal statements like "All *A*s are *B*s"; non-strict laws include statistical generalizations ("*x* % of *A*s are *B*s"), normic generalizations ("*A*s are normally *B*s"), and *ceteris paribus* generalizations ("All *A*s are *B*s as long as preventing factors are either held constant or absent"). By focusing on two examples ("All solids expand when heated" and "80 % of all trees beside motorways are sick"), Schurz offers a highly original, *unified* treatment of both deterministic and statistical laws, interestingly based on John Stuart Mill's method of agreement and difference. The result is a detailed discussion of the confirmation and disconfirmation of deterministic and statistical hypothesis, including a crash course in test and inference statistics in section 4.3. Schurz carefully emphasizes the weak character of statistical inferences, highlighting the many possible sources of errors both in the interpretation of their results and in their practical application. Thus, at the end of the chapter, the reader is well advised not to conflate, e.g., the significance of a statistical correlation (probability that a correlation exists) with the strength of this correlation (196), nor a even strong correlation with a causal connection between the relevant variables (204 ff.). The advanced sections of the chapter contain a fairly technical discussion of normic and *ceteris paribus* generalizations, of continuous distributions, and a very interesting critical account of Bayesian statistics (where Schurz's dualistic view of probabilities is put to work).

The assessment of scientific theories, as opposed to simple generalizations, is the topic of chapter 5 (*Going beyond experience: theories and their empirical evaluation*). This is a dense chapter where Schurz addresses three main topics: (1) the role of theoretical concepts in science in light of the (Duhem) problem of holism in theory testing, (2) the statics of scientific theories, and (3) the dynamics of scientific research programs. Two theories are considered in detail: Newtonian mechanics and Piaget's account of cognitive development in children. Here, Schurz successfully illustrates his non-reductionist methodological monism at work, showing how both theories share essentially the same logical structure and can be similarly tested against experience. His approach to theory statics is based on the structuralist view of Sneed and Balzer, while the account of theory change and scientific progress is a refined Lakatosian one, based on a sophisticated comparison of the successes and failures of competing or subsequent theories. Against this background, the second part of the chapter on advanced topics is a full, 57-page-long chapter on his own. Besides going into the question of the dispensability of theoretical concepts in more detail, Schurz tackles here two of the hottest problems in current philosophy of science: the realism/antirealism debate, and the role of confirmation and of different theoretical virtues in assessing and accepting theories. In particular, section 5.11 on the *Non-confirmational accounts of theory evaluation* contains highly interesting insights on the notion of verisimilitude or truthlikeness, based on Schurz's own "relevant element" approach to this issue.

The final chapter 6 (*In search of causes: Explanation and all that goes with it*) is significantly shorter than the previous ones, especially in its basic part. Given the background of chapter 4, Schurz can straightforwardly proceed to present both the deductive-nomological and the inductive-statistical models of explanation and their crucial shortcomings as emerged in the philosophical literature since Hempel. The discussion of the conceptual asymmetry between explaining and predicting and the analysis of the issues troubling probabilistic models of explanation are clear, informed, and extremely useful. An acid test for every form of methodological monism is how it fares in accounting for the explanation of human actions. In section 6.4, Schurz smoothly accommodates this kind of explanation within his framework, by interpreting the principle of rationality—according to which an agent will choose those actions which he believes are suitable means to realize his subjective goals—as a normic law in the sense of chapter 4. In the end, Schurz isolates three defensible views of scientific explanation (367–369), according to which the *explanandum* is, respectively, (1) made "expectable" (in probabilistic terms) given the accepted background theories; (2) explained by reconstructing its underlying "causal story"; and (3) understood by unifying the relevant class of phenomena to which it belongs via a small number of principles. None of the three accounts are without problems and can convincingly overcome the other two; Schurz's final view is nonetheless optimistic, and pragmatically oriented to a pluralistic notion of explanation as a "prototype concept": "the three features (expectability, causation, and unification) which each of the three paradigms takes to be the "essence" of scientific explanations *normally go together*, and depart from each other only in *exceptional* cases. (… A)s there exist birds without wings and birds with wings that cannot fly, there exist predictive explanations that are neither causal nor unificatory, causal explanations that are not predictive nor unificatory, and unificatory explanation that are neither causal nor predictive" (370). The bulk of chapter 6 is contained in two advanced sections, devoted, respectively, to the notion of lawlikeness and to a detailed analysis of philosophical accounts of causality, which complete the book.

What is the intended audience of this book? On the one hand, this is clearly not an introduction for the absolute beginner looking for a self-study guide. On the other hand, the book's distinctive features—the technical rigor, the philosophical depth of the exposition, and the number of issues covered—make it suitable for any systematic course in the philosophy of science, at both an elementary and advanced level. With a careful choice of the topics, and by combining selected, basic, and advanced, sections, a teacher will be able to design the optimal course for any possible class, be it of graduates or undergraduates. Finally, to the philosopher of science outside the classroom, novice, or expert as well, Schurz offers an authoritative guide to all the central questions of the discipline. This makes his book a definite reference for anyone with a serious interest in the philosophical analysis of science.

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