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Since the early 1970s, the structuralists have been developing a detailed programme of interpretation of science. From the seminal works of J. Sneed and W. Stegmüller, in which a distinctive set-theoretical representation of scientific theories was articulated, several analyses of foundational problems in the philosophy of science have been advanced. The earliest developments of the programme have been dominated by two interrelated concerns: (i) the construction of a formal framework in which a number of scientific theories (from physics to economics) could be represented; (ii) the employment of this framework to formally represent Thomas Kuhn's notion of a paradigm (see, for instance, Sneed 1971, and Stegmüller 1976, 1979). In this way, a unified approach to the philosophy of science was articulated. This approach accommodates, in terms of the interplay of models—the mathematical structures which characterize particular scientific theories—issues in the statics and dynamics of science, involving the structure of scientific theories and the development of science. The culmination of this effort, and the most systematic and detailed formulation of structuralism—including applications of its framework to several scientific theories—was presented in Bälzer, Moulines and Sneed 1987. This book, published more than ten years ago, is still the reference-work on structuralism.

Throughout this development, a remarkable feature is that, with the exception perhaps of the problems of theoretical terms and the dynamics of science, most work by the structuralists has been concentrated on the analysis of particular scientific theories, rather than on the examination of general problems in the philosophy of science. To some extent, this is true even of Bälzer et al. 1987. One may wonder, given the amount of work which has already been accomplished by structuralists, how the programme fares with regard to general problems which are on the agenda of most interpretations of science, such as theory confirmation, explanation in science, the relationship between theory and phenomena, the dynamics of scientific theories, the structure of science, the theoretical/non-theoretical demarcation and so on.

The book under review has been especially written to bridge this gap. It is a collection of essays presented in a conference organized by the structuralists to come to grips with these issues. In its 13 chapters, the volume addresses a varied amount of problems in general philosophy of science. We shall briefly summarize some of them.

After a general presentation of the basic ideas of structuralism, spelled out in chapter 1 by Moulines, W. Diederich discusses the relationship between structuralism and the model-theoretic approach to the philosophy of science. In the following chapter, T. Bartelborth examines a model of scientific explanation articulated in terms of embedding. The main idea is that 'explanations are essentially unifications of our knowledge'. Thus, Bartelborth argues, 'we should conceive them as embeddings of an explanandum E in a model M' (p. 30). Models of inquiry in terms of questions are the main topic of chapter 4, where M. Sintonen argues that a question-answer perspective to scientific research can be accommodated, at least in part, within the structuralist framework. In chapter 5, pragmatic and diachronic aspects of structuralism are woven together by W. Diederich in order to spell out how Kuhn's ideas on the development
of science have been reconstructed by the structuralists. In chapter 6, T. Kuipers argues that the rejection of the hypothetico-deductive method has been premature, and that it provides an efficient way for approaching the truth in a given domain of inquiry.

Theory confirmation and test is the main subject of chapter 7, where B. Lauth puts forward a structuralist account of both. In chapter 8, Balzer presents recent developments, within structuralism, of the issue of theoretical terms, and also answers criticism that the programme has received in this regard. Holism and empirical claims are the main topics of U. Gähde’s contribution (chapter 9). According to Gähde, the crucial features of holism can be expressed in terms of the structuralist framework. Thus, an important aspect of our understanding of science is accommodated. In chapter 10, F. Mühlhölder introduces symmetry groups, and with them the concept of invariance, into the structuralist machinery. As is well known, these notions play a crucial role in classical and quantum mechanics; Mühlhölder examines, in particular, the notion of a physical symmetry (roughly speaking, a transformation that leaves the physical structure invariant).

In chapter 11, Moulines and M. Polanski discuss the basic components in the structuralist framework that allow it to represent intertheoretical relations (relations between models of a given scientific theory), namely bridges, constraints and links. The authors are concerned, in particular, with the formal relationships between the main types of links. The last two papers address formal reformulations of the structuralist framework. In chapter 12, P. Hinst provides a purely set-theoretical formulation of the fundamental parts of structuralism. In this way, the criticism that by using ‘informal’ set-theoretical devices structuralism may run into trouble is accommodated. In the final chapter 13, T. Mormann puts forward a categorial structuralism, which consists of the use of concepts of category theory in the structuralist approach. Since category theory provides a useful framework to elucidate the global structure of mathematics, Mormann argues, it may well become an insightful setting to examine the global structure of empirical science. He then provides category-theoretical formulations of the structuralist concepts of constraints and links. Moreover, in the last section, he introduces a category of linked theory cores, in which the global structure of empirical theories can be represented.

As this brief summary of the papers should make clear, the issues examined in the volume are varied and important. There is no doubt that, as an overall contribution to the development of structuralism, this book was certainly needed. But if we are to examine these problems systematically, it is important to consider, in structuralist terms, some further issues. We shall mention just one. In recent years, a great deal of attention has been given to the role of inconsistencies in science: from heuristic considerations to their ubiquity and the ultimate difficulties in getting rid of them. Now, as currently presented, all set-theoretical structures articulated in the structuralist framework are classical. Thus, it seems difficult to see how inconsistencies can be properly accommodated within this setting. And without an analysis of this issue, something will always be missing from a typically structuralist picture of science.

A final word. With the exception of the papers by Lauth, Balzer, Moulines and Polanski, logic and set-theoretic machinery have at best a ‘representational’ role in the analyses presented. In other words, they are used mostly to represent the basic components of the structuralist framework (such as core, theory-element, theory-net, etc.), and are not taken as a source of results that could be readily used to support the structuralist stance. Given the importance assigned by structuralists to formal analyses
of science, one would expect to find more detailed use of logic and set-theoretic results in a project such as the one articulated in the present book.¹

References
Stegmüller, W. 1976. The Structure and Dynamics of Theories, New York: Springer-Verlag. [The original German edition was published in 1973.]


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This revision of Prakken's impressive 1993 doctoral dissertation provides an entertaining and very readable introduction to the new, widely-recognized field of nonmonotonic logic. In the early days of computer programming, there were many, such as Marvin Minsky, who discounted the usefulness of logic in the development of AI, arguing that for computers to duplicate genuine human reasoning the programs must be constructed more like common-sense knowledge, allowing for defeasible inferences and exceptions to general rules, even for drawing nontrivial inferences from inconsistent information. Minsky, for one, favoured the complete dismissal of logic from any role in the development of AI, while others scrambled to weaken the classic, Tarski-style consequence operations that appeared to make logic too rigid for simulating the ordinary reasoning seemingly called for by the computer programs. The problem of course was exactly how to weaken the consequence operation without abandoning all semblance of correct inference; as Pat Hayes, an early AI theorist, remarked, lacking this standard consequence notion, we are left without 'any positive ideas for handling the inferences correctly'. The most likely candidate for elimination from the classic conditions for proper inference was usually voted to be monotony (p. 43), the principle that for all formulas

$$\phi_1, \ldots, \phi_{n+1}, \psi, \text{ if } \phi_1, \ldots, \phi_n \models \psi, \text{ then also } \phi_1, \ldots, \phi_n, \phi_{n+1} \models \psi$$

In other words, monotony is the condition that assures that no valid argument may be ruined by adding premises, with the obvious justification being that even should the added premise $\phi_{n+1}$ prove inconsistent with the original set, the conclusion nevertheless follows by virtue of the logical maxim that everything follows from a contradiction. But if this principle of additivity is jettisoned, the result is a nonmonotonic logic where enriching a set of premises may dispel the validity of an argument. Likewise, in a nonmonotonic system, modus ponens fails whenever the antecedent of the conditional premise is enriched, thus ravaging the foundations of the inference structure of classical logic. Despite the apparently dire consequences of abandoning the principle of monotony, many felt that the weakened system seemed to capture better some of the aspects of everyday reasoning, e.g. reasoning in the legal profession, and a surprising number of logicians came forward to study the properties of this new, nonmonotonic 'logic'.

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