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HYLE Book Reviews

Maureen Christie: *The Ozone Layer. A Philosophy of Science Perspective*, Cambridge University Press, Cambridge, 2000, xii + 215 pp., £45.00 [ISBN 0-521-65072-0]

*by Joachim Schummer**

It is like an irony of the history of science that philosophy of chemistry emerged at a time when disciplinary research became increasingly replaced with transdisciplinary problem-orientated research. From bio-medical research via materials science to nanotechnology, chemists and chemical approaches are strongly involved in these areas. If the boundaries of the philosophies of science were to be defined by the boundaries of classical disciplines, we would not only get into demarcation troubles but also miss some of the most fascinating recent research fields. One such field is the study of the dynamics of the stratosphere, which in the 1970s, by the calculations of two chemists, turned from marginality to the greatest importance to securing future conditions of life.

Maureen Christie, in her doctoral thesis in the History and Philosophy of Science at the University of Melbourne, now published by Cambridge University Press, has taken up the challenge of transdisciplinary research in the atmospheric sciences. Quite a classic philosophy of science approach, her interest is in how evidence is provided for scientific theories – however, not in ideal science but in the actual scientific practice, and not in any field but in one of "strong relevance to today" (p. xi). Thus, she came to the recent history of scientific views of stratospheric ozone depletion.

Based on primary sources and interviews, the first part of the book knowledgeably narrates the story. Christie starts with early ideas about stratospheric ozone that were rather neglected by environmental chemists who then focused on tropospheric pollution. The stratosphere came on the environmental agenda only with debates over the impact of supersonic aircraft in the 1960s. After a brief introduction to the industrial development and various applications of CFCs, she relates in greater detail how Mario Molina and Sherwood Rowland in the early 1970s arrived at their theory of global stratospheric ozone depletion by CFCs and how their public warning was received. With a critical view on the atmospheric monitoring systems, she discusses the surprisingly late discovery of the seasonal phenomena of grave local ozone depletion, known as the Antarctic ozone hole, as well as the competing theories and their evidence which were advanced to explain the phenomena up to 1994.

Part II discusses "philosophical issues arising from the history", centered on the methodological question of the evidence for theoretical ideas in science. Due to its multi-step development, the case study calls for discussion of different aspects. First, there were initial ideas about the relative harmlessness of CFCs, based on toxicological and chemical experiments. Second, there appeared a model of global stratospheric ozone depletion by CFCs, before any stratospheric measurements were performed. Third, there was surprising delay in discovering the Antarctic ozone hole within the huge sets of data, partly because theoretical ideas did not suggest a corresponding data analysis. And forth, there were several competing theories around to account for the Antarctic ozone hole, out of which a selection was made based on a large measurement program.

Christie's methodological studies focus on prediction, as exemplified by Molina's and Rowland's model in step two; on crucial experiments and other evidence for theory selection, with particular attention to the forth step; and on the general way the scientific community finds consensus, which allows her to analyze all four steps. Her approach is critical of idealized and normative methodologies in philosophy of science, of which she has particularly that of Popper in mind. Thus, she makes great efforts to show, for instance, that in the actual scientific practice negative evidence for one theory is taken as positive evidence for a competing theory, or that the role of predictions in science is not restricted to theory testing. For readers familiar with the various criticism of Popper's ideas of science since the 1960s, Christie's extensive discussion is sometimes slow-reading – before she has that wonderful idea to insert a fictional dialogue on these issues between herself and a critic (partly composed of her husband, the chemist John Christie).

Despite her critical attitude to idealized and normative methodologies, to which she opposes her detailed and informed historical narrative, Christie does not completely escape the classical confusion of normative and descriptive views about scientific method. Although she has formally divided her book into a historical and a philosophical part, that division is not so clear, as she repeats much of and expands on the historical narrative in the philosophical part. Moreover, as so many prominent philosophers of science did before, she uses the ambiguity to infer from what is to what should be. Thus, she collects historical evidence to argue that "models like Popper's are too narrow and rigid to provide a realistic description of science" (p. 203) in order to reject any normative claim of these models. In addition, she uses the same historical evidence to support her own normative view that "the corpus of scientific knowledge should ultimately be grounded and justified in a reasonable interpretation of observational or experimental evidence" (p. 5) and then concludes that her case study provides an example of "good science". I would not object to her results, nor to her sophisticated arguments in detail, but only to the overall argumentation that follows received lines of flawed reasoning in philosophy of science.

Christie proves true originality in philosophical analysis, however, whenever she leaves that tradition behind, particularly in two chapters on interdisciplinarity and on issues of computational science, respectively. In chapter 12, she shows that the case of competing theories of the Antarctic ozone hole was also a case of different disciplinary perspectives within the atmospheric sciences, as there were chemists, meteorologists, and physicists involved. Each had their own model approaches to the dynamics of the atmosphere, each formulated the ozone hole problem slightly differently, and each sought solutions within their particular theoretical framework. In the face of that, the theory selection, which was finally achieved in broad agreement, suggests indeed a common methodological basis beyond such things as incommensurability.

The surprisingly long delay of the discovery of the Antarctic ozone hole let Christie, in chapter 13, reflect on philosophical issues of data processing and computational meteorology. If a global monitoring system produces millions of data, classical observation turns into data processing and analysis that require pre-shaped expectations which in turn depend on theoretical ideas. Although she avoids discussing the related theory/observation issue, she provides illuminating analysis. With regard to computational meteorology, she points out the difference between the goal of prediction (e.g. weather forecasting) and the goal of understanding and concludes that the latter requires qualitative understanding of cause-effect-relations, which pure computational approaches do not provide. Chemists will find that these issues of meteorology are not so different from what has been discussed in quantum chemistry since the 1960s.

Overall, the book provides a scientifically informed and well-researched history of the scientific views of stratospheric ozone depletion, and a wealth of analyses of methodological issues involved. Although philosophers of science might sometimes miss references to more recent discussions, they may take it as model for studies of science beyond disciplinary boundaries.

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