

style, we can follow him on an interesting and alluring journey through the centuries in which many people lived for dreams that could never be fulfilled.

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*Of Minds and Molecules. New Philosophical Perspectives on Chemistry*, ed. by Nalini Bhushan & Stuart Rosenfeld, New York, Oxford University Press, 2000, xvi + 299 pp. (ISBN 0-19-512834-6)

It is a well-known fact that big publishing houses are very slow in recognizing new scholarly trends and even much slower in producing their books. In rapidly growing fields, such as philosophy of chemistry, this causes particular problems. Authors and editors are forced to make a decision between small and fast publishers, with the risk of reaching only a smaller audience, and big and slow publishers, with the risk that the book is already outdated at the time of publication. The editors of this anthology decided for the latter in the mid-1990s, for patiently awaiting the response of a wider readership. However, when their editorial work was virtually finished, one of the editors, the chemists Stuart Rosenfeld, died in January 1999, so that it was up to his wife, the philosopher Nalini Bhushan, to finish the common enterprise alone. She had to wait another two years, before the book was eventually delivered in early 2001, with publication date as of 2000. At that time, more than ten anthologies and several monographs on the philosophy of chemistry were already published in various countries. That did not prevent Oxford University Press, however, from calling their book in the blurb “the first anthology of its kind devoted exclusively to the work in the philosophy of chemistry”. So much about the policies of big publishing houses.

Since the early 1990s, philosophy of chemistry has emerged, at the beginning quite independently from each other, in numerous countries. Due to the publication delay, the book under review represents the state of philosophy of chemistry of about 1997 in the USA, with two guest contributions from abroad. Its fourteen papers, authored by both

chemists and philosophers, are of mixed quality and frequently draw on or repeat previous work of the authors. Some are outside the scope of, or only loosely related to, the philosophy of chemistry, albeit worth reading of their own. This includes Robin Le Poidevin's criticism of relationist philosophies of space and the psychological, physiological and philosophical analyses of smell by Thomas Hellman Morton and William G. Lycan. Some attempts at combining philosophy and chemistry are less successful. This is unfortunately true also of the editors' own contribution when they tried to challenge natural kind essentialism and realism on the ground that some natural kinds in chemistry are synthetic, instead of naturally occurring. Realism, though hardly defined and rarely related to pertinent debates in the philosophy of science nor to a 1996 monograph devoted to realism and chemistry, is a recurrent topic in many papers and largely served only to defend the autonomy of chemical concepts, theories, and entities against reduction to physics. There seemed to be agreement among many authors that, in order to establish an autonomous philosophy of chemistry, the autonomy of chemistry with regard to physics must first be established (see also *The Autonomy of Chemistry*, ed. P. Janich, N. Psarros, 1998). This, however, places some papers in-between the philosophies of physics and chemistry, with reduction as the central topic.

Although opinions and justifications differed, kinds of what in the philosophy of mind has been called noneliminative reductionism were prevailing. For instance, Eric Scerri, with regard to chemical elements and theoretical concepts of chemistry, defended an "intermediate position between realism and reduction" according to which the theories of physics tell us what is 'real' but cannot or should not eliminate chemical concepts because of their usefulness, even if the terms do not refer to 'real' entities. Jeffrey Ramsay, following-up a

debate raised by the British quantum chemists Guy Woolley in 1978, argued that classical chemical structures, though no "real" and "essential" properties in view of the authoritative quantum mechanics, bear a "contextual reality", depending on the kind of measurement context and intervention. Others, particularly chemists, took sort of "realism" for granted, since anything else would undermine the seriousness of their work. Barry Carpenter even went as far as to claim that the issue of metaphysical realism versus antirealism is in principle decidable by scientific means. Against such scientific views, Belgian philosopher Jaap van Brakel took a refreshing counter-position. With reference to what Wilfred Sellars had called "the manifest image" and "the scientific image", he developed a radical but sophisticated antireductionist view about intertheoretic relations and world views in general, where the relationship between chemistry and quantum mechanics served as a prominent example (see also his *Philosophy of Chemistry*, 2000).

Two papers pushed the debate on the relation between physics and chemistry further towards chemistry proper. Maureen and John Christie, from Australia, compared laws and theories of physics with those of chemistry, in order to point out epistemological peculiarities of the latter. Andrea Woody and Clark Glymour first provided a programmatic sketch of peculiarities of chemistry regarding intertheoretic relations, explanation, representation, and instrumentation, and then convincingly argued that if philosophers of science had focused on chemistry, instead of physics, a completely different picture of science would have emerged. Their program can indeed be read as a framework of the remaining papers. Interestingly, it is the philosophers who dealt with instrumentation and the chemists who focused on representation.

Philosopher Davis Baird, whose father had founded a spectrometer producing company in the 1930s, provided

an historical outline of the development of these instruments for analytical chemistry and investigated how that had affected the notion of objectivity in chemistry. Daniel Rothbart carefully analyzed the interaction between specimens and spectrometers in the course of the measurement process and drew epistemological and ontological conclusions as to the objectivity and reproducibility of measurements, the dynamic character of measurement properties, and the status of chemical substances. The idea of measurement dependence, also highlighted by Jeffrey Ramsey, was further elaborated on in one of the best papers of the collection. Stephen Weininger discussed how different measurement time scales resulted in different representations of molecular structure in chemistry. Contrasting an architectural and a temporal view on chemical phenomena, he detected a grave underdevelopment of the latter throughout the history of chemistry. The most provoking paper is certainly by Emily R. Grosholz and Roald Hoffmann. While philosophers usually work hard on the clarification of concepts in order to avoid ambiguities and equivocations (see also *Die Sprache der Chemie*, ed. P. Janich, N. Psarros, 1996), these authors argued that the well-known equivocations in chemistry (e.g. a term refers to both a substance and a molecule) advance the productivity of the field because they bridge the gap between experiments and theory.

Besides the aforementioned realism, there is another topic running through virtually all the papers, pluralism and perspectivism. If both topics were combined and applied to the relation between physics and chemistry, a certain tension arose resulting in such reconciling concepts as 'intermediate position' (Scerri) or 'contextual reality' (Ramsey). If not, epistemic perspectives of chemistry, such as those mediated through instruments, could become subject to detailed epistemological investigations (Baird, Rothbart). Furthermore, a plu-

ralism of methods and representations appeared to be a methodological characteristic of chemistry (M. & J. Christie, Woody & Glymour, Weininger, Grosholz & Hoffmann, and to some extent Carpenter). Interestingly, nearly all who had worked on the philosophy of chemistry from the 1950s to the 1970s (e.g. Bachelard, Caldin, Lévy, and Theobald) as well as many of those who began to establish the field in the early 90s came to similar conclusions. It is only when a philosophical field defines its own issues with respect to the peculiarities of its object that it reaches a state of maturity. The book nicely pictures different states of that obviously recurrent process and, fortunately, many of its papers are on the mature side.

Since 1997, when the papers of the collection were finished, much more has been done in that direction. On the one hand, the discourses have grown more international and cross-linked, for which the HYLE Collected Bibliography was originally created. On the other, many further anthologies and monographs on specific topics have been published, as well as special issues of the two journals in the field, guiding research towards more specific topics, such as 'Models in Chemistry' and 'Ethics of Chemistry' in *HYLE*, and 'The Periodic System' in *Foundations of Chemistry* (2, 2001). Like philosophers of biology two decades earlier, philosophers of chemistry now increasingly explore fields that have no longer a model in the philosophy of physics.

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