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*Of Minds and Molecules: New Philosophical Perspectives on Chemistry*. EDITED BY NALINI BHUSHAN AND STUART ROSENFELD. (Oxford UP, 2000. Pp. xvi + 299. Price £55.00.)

Since the early 1990s, the philosophy of chemistry has been a rapidly growing field, now with two journals (*Hyle: International Journal for Philosophy of Chemistry* and *Foundations of Chemistry*), an international society, several conferences a year, and an annual output of over 50 publications. As with the philosophy of biology two decades earlier, both philosophers and chemists have recognized the need of philosophical reflection beyond the traditionally physics-focused philosophy of science. In a sense, they followed the ramification of the sciences two centuries earlier, and they did so, in the beginning quite independently from one another, in numerous countries. The book under review, delivered in early 2001, roughly represents the state of the art in the USA in about 1997, with two guest contributions from abroad. As publication delay in exploding fields is a big problem, though a common practice of big publishing houses, it may be mentioned that one of the editors (the chemist Stuart Rosenfeld) died in January 1999 during the final phase of the editorial work, so that his wife, a philosopher, had to finish the common enterprise alone. It comes as a surprise, however, that the blurb calls the book ‘the first anthology of its kind devoted exclusively to work in the philosophy of chemistry’, because more than ten anthologies had been published in various countries during the previous decade.

The fourteen papers of the collection, by both chemists and philosophers, are of mixed quality, and frequently draw on previous work of the authors. Some are outside the scope of, or only loosely related to, the philosophy of chemistry, albeit worth reading on 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 Morton and William Lycan. Some attempts at combining philosophy and chemistry are less successful, such as when the editors in their own contribution try to challenge natural-kind essentialism and realism on the ground that some natural kinds in chemistry are synthetic, rather than naturally occurring. Realism, though hardly defined here 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 serves to defend the autonomy of chemical concepts, theories and entities against reduction to physics. There seems to be agreement among many authors that in order to establish an autonomous

philosophy of chemistry, autonomy with respect to physics must first be established: see also P. Janich and N. Psarros (eds), *The Autonomy of Chemistry* (Würzburg: Königshausen & Neumann, 1998). This, however, places some papers in between the philosophies of physics and chemistry, with reduction as the central topic.

Although opinions and justifications differ, kinds of what in the philosophy of mind has been called non-eliminative reductionism prevail. For instance, Eric Scerri, with regard to chemical elements and the theoretical concepts of chemistry, defends 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 Ramsey, following up a debate raised by the British quantum chemist Guy Woolley in 1978, argues that classical chemical structures, though not 'real' and 'essential' properties given the authoritative quantum mechanics, bear a 'contextual reality', depending on the kind of measurement context and intervention. Others, particularly chemists, take some sort of 'realism' for granted, since anything else would undermine the seriousness of their work. Barry Carpenter even goes as far as to claim that the issue of metaphysical realism *versus* anti-realism is in principle decidable by scientific means. Against such naturalistic (or better, scientific) views the Belgian philosopher Jaap van Brakel takes a refreshing counterposition. With reference to what Wilfrid Sellars has called 'the manifest image' and 'the scientific image', he develops a radical but sophisticated anti-reductionist view about inter-theoretic relations and world views in general, where the relationship between chemistry and quantum mechanics serves as a prominent example: see also his *Philosophy of Chemistry* (Leuven UP, 2000).

Two papers push the debate on the relation between physics and chemistry further towards chemistry proper. Maureen and John Christie compare laws and theories of physics with those of chemistry, in order to point out the epistemological peculiarities of the latter. Andrea Woody and Clark Glymour first provide a programmatic sketch of the peculiarities of chemistry regarding inter-theoretic relations, explanation, representation and instrumentation, and then convincingly argue that if philosophers of science had focused on chemistry, instead of physics, a completely different picture of science would have emerged. Their programme can indeed be read as a framework for the remaining papers. Interestingly, it is the philosophers who deal with instrumentation and the chemists who focus on representation.

Philosopher Davis Baird, whose father founded a spectrometer company in the 1930s, provides a historical outline of the development of these instruments for analytical chemistry, and investigates how that has affected the notion of objectivity in chemistry. Daniel Rothbart carefully analyses the interaction between specimens and spectrometers in the course of the measurement process, and draws 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, is further elaborated in one of the best papers of the collection. Stephen Weininger discusses how different measurement time-scales result in different representations of molecular structure in chemistry. Contrasting an

architectural and a temporal view of chemical phenomena, he detects a grave underdevelopment of the latter throughout the history of chemistry. The most provocative 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 Janich and Psarros (eds), *Die Sprache der Chemie*, Würzburg: Königshausen & Neumann, 1996), these authors argue 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 are combined and applied to the relation between physics and chemistry, a certain tension arises, 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, can become subject to detailed epistemological investigations (Baird, Rothbart). Furthermore, a pluralism of methods and representations appears to be a methodological characteristic of chemistry (M. and J. Christie, Woody and Glymour, Weininger, Grosholz and Hoffmann, and to some extent Carpenter). Interestingly, nearly all who worked on the philosophy of chemistry from the 1950s to the 1970s (e.g., Bachelard, Caldin, Ströker, Lévy and Theobald), as well as the majority of those who began to establish the field in the early 1990s, have come 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 neatly pictures different phases of that obviously recurrent process, and fortunately many of its papers are from 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, discourses are now more international and cross-linked, with electronic access to a comprehensive bibliographic database ([www.hyle.org](http://www.hyle.org)). On the other, many further anthologies and monographs have appeared, as well as special issues of the two journals, guiding research towards more specific topics, such as 'Models in Chemistry', *Hyle*, 5–6 (1999–2000), 'The Periodic System of Elements', *Foundations of Chemistry*, 2 (2001), and 'Ethics of Chemistry', *Hyle*, 7–8 (2001–2). Like philosophers of biology two decades earlier, philosophers of chemistry now increasingly explore fields that no longer have a model in the philosophy of physics.

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*Uneasy Virtue*. BY JULIA DRIVER. (Cambridge UP, 2001. Pp. vii + 134. Price £35.00.)

Julia Driver is uneasy about recent accounts of virtue offered by Aristotelian virtue ethicists because of serious internal deficiencies within their theories, and she also wants to show that virtue has an unsatisfactorily narrow scope within Kantian ethics. Her response to these criticisms is to give an account of consequentialism which can accommodate virtue evaluations.