The Autonomy of Chemistry. 3rd Erlenmeyer-Colloquy for the Philosophy of Chemistry, ed. by PETER JANICH & NIKOLAOS PSARROS, Würzburg, Königshausen & Neumann, 1998, 173 pp. (ISBN 3-8260-1486-3)

This volume consists of thirteen short papers in English that were presented at the third Erlenmeyer Colloquium in Marburg (Germany) in September 1996. It contains a longish introduction in German by Peter Janich, giving a detailed and fair overview of the contents of the contributions and a useful discussion of the various ways the question of the autonomy of chemistry can be taken. First and foremost the organisers should be complemented on their initiative – the first Erlenmeyer Colloquium was organised in 1993, before the philosophy of chemistry 'took off'. The aim of these colloquia is to bring chemists and philosophers together, this time to discuss the autonomy of chemistry as a '*Wozu-Frage*' (a what-for or a for-what-purpose question). While this is an extremely laudable goal, there are nonetheless some inherent problems involved in publishing the papers from such a gathering, most essentially because the editors have little control over the contents of contributions or which contributions will be published – I assume all papers are published here. Of the thirteen papers, there were only three I found really worthwhile from the perspective of the philosophy of chemistry. There are interesting comments in some of the other papers, but either they dive at once into the history of chemistry, present personal views, or aim to cram many years of research published elsewhere into ten pages.

There is an excellent paper by Nikos Psarros on the difference between physical, chemical, and biochemical molecules and on the question whether molecules are the bricks of the world. (Answer: Yes, if you need them to explain phenomena you have created in your laboratory. No, if you don't.) Then there is a very well-researched paper by Joachim Schummer on the 'situatedness' of physical chemistry, and Theodore Arabatzis reviews the conflict between chemists and physicists about electrons in the time of C.N. Lewis, combining historical research with pertinent philosophical observations. The book is well worth its (modest) price for these three papers alone for anybody interested in the philosophy of chemistry.

Of the contributions that are least satisfactory the paper of Klaus Mainzer stands out. It reads like a glossary of his many publications on the subjects he reviews, moving all over the place; from 'mathematical *graph* theory' to GUT (*i.e.* 'the *big* unification of electromagnetic, weak and strong forces'); from explaining what nucleic acids are to discussing DENDRAL and CAMD. He even finds space to remind the reader that "1 nm = 10^{-9} m = 10 Å" (p. 45). (I return to the substantial point of this paper below.) Pierre Laszlo says there is "a deep analogy between chemistry and linguistics, that can be elaborated quite far" (p. 76), but in his paper this intriguing suggestion is only very indirectly supported by long digressions, from children mixing paints to quotes of Baumé (1773) to support that chemistry was a combinatorial art from the beginning. Laszlo also says: "What sociologists may gain in objectivity, they lack in competence, being unable for instance to distinguish between a passing scientific fad (such as use of NMR shift reagents in the 1970s) and a genuine breakthrough (such as the discovery of fullerenes in 1987)." This is at the same level as when the physicist Herbert Dingle says: "The whole of chemistry may therefore, so far as final results go, be regarded as a superfluous study".[1] No need for this mud throwing to fuel local culture wars. Like Mainzer and Laszlo, Gerd Hanekamp has done interesting work in the philosophy of chemistry, but he spends most of his ten pages reviewing what, in general, methodological constructivism and culturalism is about. When he finally comes to chemistry there is room left

only for a list of tantalising definitions and a couple of brief comments. Valeria Mosini reviews the pitfalls of the old question whether living organisms violate the second law of thermodynamics. From a philosophy of chemistry perspective one would have liked to have seen more on the notions of disorder and dissipated energy and what this means for the relation of thermodynamics and statistical mechanics, instead of historical digressions on Delbrück, vitalists, and Bohr.

In his introduction, Janich deftly brings all papers under the theme of the conference, *viz.* the autonomy of chemistry, and he concludes that there is a surprisingly broad consensus about a reduction-critical attitude. He says: "It is obvious that none of the contributions represents a form of reductionism, neither a crude, nor a subtle-careful one" (p. 29). But such a conclusion by-passes the hard philosophical issues. As Janich himself points out, one can distinguish between two foundational issues. Without putting weight on the use of these terms, I will call the first issue that of methodological (historical, genealogical) autonomy, and the second, ontological (metaphysical, closed system, natural laws) autonomy (corresponding to Janich's "*abschließende Form theoretischer Darstellung*" and "*Abhängigkeiten im Zugang zu einem Wissen*" – also compare his useful list of different criteria for tackling the *Wozu-Frage*). At a higher level of abstraction I would oppose this dichotomy, but given this way of speaking, it serves a useful purpose in the following way. Janich is surely right to say that chemistry is and will remain autonomous in its development (relative to other natural sciences), and there is no clear-cut methodological hierarchy between chemistry and physics (pp. 29, 65). Nobody would expect it to be otherwise, given the long-standing and well-entrenched institutional separation of physics and chemistry, fuelled by the 'imagined communities' of identity formation, as well as the constant interactions between the two (amply illustrated in the contributions in the book under review). With historical examples (Faraday, Mayer and Liebig), Peter Buck nicely illustrates that, notwithstanding all interaction, physics and chemistry *are* different: physical comprehension just is (psychologically) different from chemical comprehension. However this observation has little bearing on discussions about the ontological autonomy of chemistry (Janich's "*abschließende Form theoretischer Darstellung*"). The latter question is a much more tricky one, only addressed, and then only indirectly, in the contributions of Psarros, Schummer, and Hanekamp. The other contributions are either neutral or display a soft or crude reductionism (as this term is normally understood in the philosophy of science). For example, Gernot Frenking's paper is entitled "Heretical thoughts of a theoretical chemist about the autonomy of chemistry as a science in the past and the present". But in this paper we find him saying (pp. 105-7):

- "chemistry as true science is still in a developing stage […] because quantum chemical research of the many chemical phenomena is still in an infant stage;"
- "the very basis of all chemical phenomena, *i.e.* the chemical bonding, was understood for the first time [...] in 1927."

These statements are supported with the obligatory quote from Dirac[2] on which views such as that of Dingle (already quoted above) are based. Similarly, Arabatzis suggests that the conflict between physicists and chemists over the electron was "fully resolved" with "the advent of the exclusion principle, spin, and eventually quantum mechanics" (p. 155). The crudest form of reductionism can be found in the paper of Mainzer. He argues that chemistry has become a *science* in the sense of Kant, because it is using more and more mathematics. In saying this he takes for granted the non-autonomy of chemistry. For example he says:

- A physical justification of molecular models is suggested in quantum chemistry.
- The emergence of a chemical phenomenon is reduced to a physical symmetry breaking.

What Mainzer is saying is (to paraphrase Kant's terms): to the extent that chemistry can be reduced to quantum mechanics it is a proper science.[3] Of course, chemistry as a practice is autonomous, but it is not an autonomous *science*. Hence, as Dingle puts it:[4] "Chemistry rightly figures prominently in the history of science; in the philosophy of science it should not figure at all." Presumably, it was not the purpose of the 3rd Erlenmeyer Colloquy to support this view.

Notes

[1] Herbert Dingle in *The James Scott Lecture* delivered July 5, 1948 to the Royal Society of Edinburgh.

[2] "The underlying laws necessary for the mathematical theory of a large part of physics and the whole of chemistry are thus completely known, and the difficulty is only that exact applications of these laws lead to equations which are too complicated to be soluble."

[3] I. Kant, *Schriften*, 4:470; *cf.* 4:471, 14:470, 29:173, 31:288, 31:316.

[4] Dingle, *op. cit.*

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Chemical Research – 2000 and Beyond: Challenges and Visions, ed. by PAUL BARKAN, Oxford Univ. Pr., New York-Oxford, 1998, xiii + 218 pp. [ISBN: 0-8412-3575-9]

In many fields, the millenium makes people reflecting upon past achievements, future objectives, and the basic principles of their own field. Such a reflection presupposes both the willingness and capacity to question former habits, to comprehend the field at a more general level detached from everyday business, and to try unconventional lines of thought, or even visions. In a sense, the millenium makes people 'more philosophical' for a while.

Chemical Research – 2000 and Beyond arose from a symposium at the Rockefeller University, NY, October 18, 1997 that was sponsored by the ACS and an impressive list of chemical companies. (p. xiii). The editor and organizer, P. BARKAN, was able to win over a lot of 'big names' from the U.S.A., "five Nobel laureates in chemistry, prominent chemists from academia and industry, and a U.S. congressman", as the blurb reads. Rather than taking the opportunity of a more relaxed and open-minded reflection, the Introductions already rings the alarm bell (p. ix): "global political, economic and social changes […] are threatening the pace of progress through scientific research". It stresses "the urgency for the chemical community to assume an active role in convincing policy makers and the public that the quality of life in the 21st century will depend on a strong national science agenda that fosters basic scientific research." And more clearly, it promises "perspectives on the conditions necessary for our nation to maintain a leadership research environment".

In his introductory essay, P. BARKAN goes into details (p. 7): "Our leadership in science and technology is being threatened by the rapidly emerging global industrial competition", "trade deficit", "the loss of dominance in some critical technologies", "short-sighted poli-