

HYLE Book Reviews

***Ars Mutandi: Issues in Philosophy and History of Chemistry,*
ed. by Nikos Psarros & Kostas Gavroglu, Leipziger
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by Shawn B. Allin *

Ars Mutandi is a compilation of papers presented at the International Conference on the Philosophy of Chemistry and Biochemistry and Adjacent Historical Problems held in Athens, Greece during April 1996. The proceedings are comprised of seventeen papers submitted by participants from eleven different countries and may be divided into seven different sections; Falsificationism and Chemistry (2 papers), Chemical Epistemology and History of Chemistry (2 papers), Shaping Chemistry (4 papers), Chemical Entities (3 papers), Chemistry and Quantum Mechanics (2 papers), Chemistry and Its Neighboring Sciences (3 papers) and Chemical Heritage of the Ancient Greek World (1 paper). This wide variety of topics provides the reader with a great deal to contemplate and ponder.

Ars Mutandi begins with a brief, four page, Introduction by the editors. Nikos Psarros and Kostas Gavroglu provide the rationale behind holding an international conference on the philosophy and history of chemistry and discuss the increased level of attention the field is deservedly receiving. My first reading of the Introduction caused significant concern because of the poor level of English. Fortunately, the papers are well written and highly polished. Hopefully, the Introduction will not scare any potential readers away, as it is not indicative of the proceedings as a whole.

The first section, Falsificationism and Chemistry, involves F. Michael Akeroyd (Bradford, UK) and Maureen Christie (Melbourne, Australia) taking opposite sides of Popper's idea of falsificationism. Akeroyd argues in support of falsificationism in his paper "Popper and Biochemical Sciences" with support from examples involving cell-free fermentation, pneumococcal transformation, thermophilic bacteria and the isolation of enzymatic RNA. Akeroyd concludes his argument that "a large portion of the history of biochemistry supports the position of Karl Popper" (p. 4).

Christie take the opposite view and argues against Popper's "asymmetry between confirmation and falsification" (p. 7) in "Falsification and Direct Confirmation in Scientific Theory Adoptions". She bases her argument on an analysis of the Antarctic ozone hole and three competing explanations; the presence of chlorinated compounds, a major climatic change, or increased solar activity. Analysis of data resulted in the first hypothesis being adapted because of the strong negative correlation between the ClO and O₃ mixing ratios. To Christie, this example refutes Popper's ideas because the first hypothesis was adopted through positive reaffirmation and not falsification. The problem with her argument is that while valid for the initial comparison of competing hypotheses, the strong negative correlation does not prove the first hypothesis to be correct: it simple makes it more tenable than the competing hypotheses. With the limited

resources available for studying the source of ozone depletion, focusing on the strongest hypothesis was the only viable path to follow.

The second section, Chemical Epistemology and History of Chemistry, includes contributions from Ursula Klein (Berlin, Germany), "Do We Need a Philosophy of Chemistry?" and Michael Engel (Berlin, Germany), "Naturphilosophische Überzeugungen als forschungsleitendes Motiv – Die asymmetrische Synthese von Pasteur bis Bredig". Klein's analysis of chemistry's progress from focusing on a material's physical properties "into a coherent system embracing chemical substances and their transformation" (p. 25) nicely outlines chemistry's growth from a descriptive, into a synthetic, endeavor.

In an effort to see German re-introduced as a language used in international conferences, Engel's contribution to the proceedings are in his mother tongue, German. While this is a noble cause, he has done his scholarship a disservice by limiting its audience to those who read German, or those willing to find someone to translate. The consequences of his actions are quite severe for young scholars in North America, as many doctoral programs have eliminated their foreign language requirements. As a result, many readers will simply skip Engel's contribution. As the editors state in their Introduction, "English is in fact the contemporary *lingua franca*, which means that it is no more the possession of only a single nation, but of the humanity as a whole" (p. ii).

The section on Shaping Chemistry contains the greatest number of contributed articles and also incorporates the greatest variety of topics. Gennadiy Kopylov (Moscow, Russia) discusses development and structure of the natural sciences in "The Engineering World and Chemistry: An Outline of the Research Programme"; Daniel Rothbart (Fairfax, USA) discusses the convolution of experiment and theory in his "The 'Design' of Nature through Chemical Instrumentation"; Joseph Earley, Sr. (Washington, USA) comments on "the question of compound individuals" (p. 75) in "How Do Chemists Know When 'Many' Become 'One'? Can Others Do It Too?"; and Rein Vihalemm (Tartu, Estonia) argues that chemistry is distinct from both physics and biology in "Can Chemistry Be Handled as its Own Type of Science?"

Rothbart's article provides an excellent example of how philosophical issues can be explored in the chemistry curriculum. For example, his statement, "When data are acquired, abstract theoretical judgements are not all removed from the experiment; rather, such judgements are channeled through the instrument to solidify the formulation of the specimen's universal character. Through the mediation of the instrument, the physical real is united with the conceptual real." makes a great discussion topic for an undergraduate instrumental analysis course.

The fourth section, Chemical Entities, includes "A Conceptual Profile for Molecule and Molecular Structure" by Eduardo Mortimer and Luiz Otávio Amaral (Belo Horizonte, Brazil); "Fullerenes: The Philosophical Aspects of their Discovery" by Danuta Sobczynska (Poznań, Poland) and "Are there Laws of Nature in Chemistry?" by Nikos Psarros (Marburg, Germany). The first of these contributions explores the interesting question of what is meant by 'molecule' or 'molecular'. Specifically, the example of PF_5 – a compound without a unique structure – and physical properties such as melting point, dielectric constant and dilation are discussed. Again, this is a rich source of material for discussion in undergraduate chemistry classes.

Sobczynska's article on the transformation of fullerenes from a theoretical entity to an experimental one is a wonderful example of history in the making. Finally, Psarros' piece provides a wonderful comparison between the results and consequences of an experiment.

The contributions of Vincenzo Aquilanti (Perugia, Italia) and Valeria Mosini (Rome, Italia), respectively entitled "Sceptical Chemists in a World of Atoms and Quanta" and "Wheland, Pauling and the Resonance Structures", constitute the section on Chemistry and Quantum Mechanics. Both authors have done an excellent job of dealing with chemistry issues and not falling into the philosophy of physics paradigm. If the reader were still undecided with respect to the need of philosophical studies of chemistry at this point in the book, Aquilanti puts those fears to rest when he states, "no expert in quantum mechanics can take the

place of a chemist whose problems arise from his direct experience of substances under specific experimental conditions" (p. 120).

Similarly, Mosini's comparison of realist and instrumentalist views in her discussion of resonance structures underscores the significant contributions that philosophical studies of chemistry offer. This article also contains a wonderful comparison of the Valence Bond and Molecular Orbital theory's explanations of resonance structures during the first part of the 20th century that proved enlightening and a joy to read.

The section on Chemistry and Its Neighboring Sciences contains three articles, "*In vitro* vs. *In vivo*: The Problem of Justifying the Biological Relevance of Biochemical Studies" by Roger Strand (Bergen, Norway); "Research Practice of Modern Bioinorganic Chemistry and the Eretectic Conception of Explanation" by Ewa Zielonacka-Lis (Poznan', Poland); and "A New Kind of Chemical Computer-based Chemical Conversions" by Lech Schulz (Pozna n', Poland). While each of these discussions is specific to a chemistry sub-discipline, they each have wider implications upon further examination. For example, Strand's discussion of the relevance of *In vitro* testing in an *In vitro* world can easily be extended to the realm of computational chemistry where the results are only as accurate as the theory. As computational speed and power continues to grow and we become increasingly dependent upon simulations of the virtual-kind, these issues will come to the forefront of philosophical discussion.

The final section, Chemical Heritage of the Ancient Greek World, contains a single contribution entitled "Experimental Techniques and Laboratory Apparatus in Ancient Greece" by Evangelina Varella (Thessaloniki, Greece). While we often think of ancient Greece as the realm of philosophy and the antithesis of science, Varella's excerpts from the ancient literature highlight the presence, and importance, of a variety of experimental techniques. Although a valid argument may be made that the examples are of technology, not science, it is interesting, and sobering, to read laboratory procedures from a time past.

In conclusion, *Ars Mutandi* is a worthwhile addition to a personal, or institutional, library. The issues discussed are varied with something for everyone who is interested in the pertinent issues in the philosophy of chemistry. Numerous articles lend themselves to inclusion in the undergraduate curriculum as discussion pieces. This is an important aspect since a growing awareness of philosophical issues will only occur if we expose our students to their existence.

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