Found Chem (2008) 10:145–146
DOI 10.1007/s10698-008-9057-2

ISPC 2007 editorial

Tami I. Spector

The following four articles are the first among a series to be published over a number of issues of Foundations of Chemistry from the 11th Annual International Society for the Philosophy of Chemistry (ISPC) Symposium held at the University of San Francisco in 2007. All of the papers from the 2007 ISPC in this issue address the intersections of theory and practice in the chemical sciences, and in doing so highlight the unique way in which this annual symposium brings together philosophers (typically theorists) and chemists (typically empiricists) to present, discuss and argue aspects of philosophy of science that are uniquely related to chemistry.

Jerome Berson was the keynote speaker at the 2007 symposium and therefore it is appropriate that his paper "Fundamental Theories and Their Empirical Patches" be the first published. Berson's paper concerns "bridging the gap" between philosophical ideals about scientific theories and the reality of how scientists, and chemists in particular, actually develop, view and use theories. Essentially, he argues that empirical modifications to theories are commonplace and relatively acceptable to chemists despite philosophical arguments regarding the validity of theories. To do so he employs a number of examples from the chemical/scientific literature including Kekule's revision of his own benzene model to account for the experimental fact that only one isomer of an *ortho-* disubstituted benzene exists, the still unresolved theoretical puzzle underlying the origin of the Pauli exclusion principle, and more generally the methods that today's computational chemists employ.

Alan Chalmers' "Atom and Aether in Nineteenth Century Physical Science" offers a variation on Berson's theme by reminding us that until a theory is empirically legitimated it is often inconsequential to the progress of science and that investing earlier scientific theories with unsubstantiated foresight can lead to an inaccurate historical depiction of their scientific relevance. Specifically, Chalmer's argues that the popular notion that nineteenth century concepts of the atom were precursors to modern atomic theory is incorrect and that, in fact, the metaphysical atomism of that time had little to do with the empirical success of the concept of "chemical atoms" that developed out of Dalton's

T. I. Spector (✉)
University of San Francisco, San Francisco, CA, USA
e-mail: spector@usfca.edu

empirically derived Law of Proportions, nor ultimately with the development of the twentieth century conception of atoms. To fortify his claim he parallels the status of the (meta)physical atom and the aether in nineteenth century science, showing us that as aether theory was ultimately redundant to the development of electromagnetic theory, so nineteenth century mechanical (i.e., Newtonian) notions of the atom were inconsequential to the development of modern atomic theory. Instead, he contends, it was only Thomson's empirical discovery of the electron and the subsequent elucidation of its role in bonding that led to our current understanding of atoms.

While Berson makes a strong case for more a pragmatic perspective on theory development and usage in philosophy of science, and Chalmers shows us that theories either gain (i.e., the existence of physical atoms) or lose (i.e., the lack of existence of an aether) status depending on whether or not such theories are necessary to explain empirical evidence, Gopala K. Vemulapalli's article, "Theories of the Chemical Bond and its True Nature", articulates that when faced with two working theoretical models chemists have favored the one that is more theoretically consistent, although perhaps for pragmatic reasons. His paper focuses on how and why Molecular Orbital (MO) theory ultimately superceded Valence Bond (VB) theory in chemistry. His argument is threefold; first, the initial rise of VB theory was primarily due to Pauling's powers of persuasion as compared to Mulliken's; second, Pauling's use of (electron) resonance to explain a bond's stability is problematic because it attempts to graph the physical structure of resonance onto physically indeterminate wave functions. In contrast MO theory yields delocalized molecular orbitals that (relatively) accurately lead to the low energy bonded state of a molecule without the theoretical inconsistency inherent in valance bond theory; and third, molecular orbital theory's ability to explain properties over valence bonds theory ability to explain structure has brought MO theory greater prominence in modern chemistry.

Chalmers and Vemulapalli provide narratives for understanding the historical development of chemical theories, and Berson is concerned with the gap in how scientists and philosophers perceive the merit of a theory, but none account for the use of theory by contemporary chemical experimentalists. In "Implementation and Innovation in Total Synthesis" William Goodwin broadens the normative philosophical perspective on theory and (applied) science by investigating how a non-quantitative theory actually facilitates applications in late twentieth century synthetic organic chemistry. To do so he distinguishes between synthetic design, in the form of retrosynthetic analysis, and carrying out such a design in the laboratory; carefully stepping us through the theory underlying the set of heuristics codified in a retrosynthetic plan and the more idiosyncratic and localized theoretical strategies employed when carrying out an actual total synthesis—in this case he shows us how the theory of organic chemistry (i.e., "…those concepts and devices, along with the norms governing their application, that are used to explain many of the observable characteristics of organic transformations.") allowed Volkmann to explain, exploit and optimize a serendipitous side reaction to advantage in his total synthesis of longiforlene.

Ranging from the philosophical concept, and failure, of "pure" scientific theories to the underlying theoretical framework of the quintessential applied science of synthetic organic chemistry, the ISPC 2007 papers contained in this issue provide a glimpse at the breadth of topics that fall within the auspices of current philosophy of chemistry. Future papers from the symposium will build on this foundation, including topics from trope theory to chemical symbolism in contemporary art.