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EDITORIAL 14

Now that philosophy of chemistry has firmly taken root is seems appropriate to re-print what is among the most important articles written in the field during the twentieth century. Although Paneth's article first appeared about seventy years ago it gets to the heart of nature of modern chemistry and perhaps the time has now come for it to be appreciated more widely. Paneth was a world-leading inorganic chemist whose early work with von Hevesy led to important developments in the field of radio-chemistry. Their collaboration began when, as young chemists they were working with Rutherford, who asked them to try to separate some isotopes of lead. After attempting to do so, and failing, Paneth and Hevesy began trying to understand this negative outcome. Paneth in particular devoted much time to clarifying the nature of isotopes. The fact that isotopes of most elements behave identically in chemical terms became the foundation of his writings on the nature of the elements, and the subject of the article reproduced in this issue. Hevesy proceeded to work on radio-isotope tracing techniques, which he pioneered in association with Paneth. It was a mystery to many observers when Hevesy alone was later awarded the Nobel Prize for these developments since much of the fundamental work had been carried out by both chemists working together.[1]

The substance of Paneth's article concerns a question that I have mentioned previously in editorials. Paneth revisits the ancient question of how the elements persist following compound formation. Whereas the elements sulfur and iron are clearly seen to persist following a physical mixture of the two elements, this is not the case when elements such as sodium and chlorine are chemically combined. There appears to be no trace of the gray metal sodium and the green gas chlorine in the resulting compound. According to Paneth, and many authors before him, the way to

Foundations of Chemistry **5:** 107–111, 2003.

appreciate the persistence of the elements, after compound formation, is to consider the elements as basic unobservable substances that are the bearers of properties. On the other hand the elements regarded as simple substances that can actually be isolated, such as gray sodium and green chlorine, obviously do not persist in the compound sodium chloride. This distinction between elements as basic substances and simple substances is one that was known to Mendeleev, although this particular terminology is due to Paneth. Indeed for Mendeleev the classification of the elements in the periodic system was primarily concerned with the elements as unobservable basic substances and not with elements as simple substances. For example, this explains why the three allotropes of diamond, graphite and buckminsterfullerene all occupy one single place in the periodic table. The three isotopes represent three simple substances but only one basic substance.

The philosophical importance of this issue to chemistry is also very interesting. Paneth believes that the chemist needs to adopt an intermediate position between realism and what he terms reductionism or a transcendental view provided by physics. In the case of most chemical applications the chemist can stay within the realm of realism and can continue to think of a substance like cinnabar as simply being red. The reductive view would be to try to reduce the color to some particular frequency corresponding to the color of this ore of mercury. However, when it comes to asking what aspect of elements persist after compound formation, Paneth claims that the chemist needs to abandon the realism of elements as observable simple substances. Instead, as mentioned earlier, the chemist should adopt the view that elements are transcendental or abstract bearers of properties. In other words, the elements should be regarded as basic substances that are devoid of properties.

This distinction between realism and the reductive view seems to cut across the usually discussed dichotomies in general philosophy of science such as realism and anti-realism but in doing so promises to case new light on these much discussed issues. The view in philosophy of science seems to be that one should be a realist or anti-realist across the board. By contrast, Paneth is suggesting that the question of realism is contextual, not just to a particular field of science such as chemistry, but also within chemistry itself depending on what particular aspect one may be discussing. Such contextual realism is not altogether absent in philosophy of science however given the work of Fine and Crasnow in particular (Fine, 1984; Crasnow, 2000).

The second article in the present issue is part two of Markus Reiher's study on system theory in chemistry that appeared in the previous issue (Reiher, 2003). In the current article Reiher attempts to apply the general ideas he developed in the earlier publication to particular areas of chemistry. For example, he discusses the manner in which the electron seems to be regarded differently in chemistry and physics. Whereas chemists frequently speak of 2s electrons or Π_{2py} electrons, the view from physics is that electrons are completely indistinguishable. In fact this may be an example of Paneth's suggestion that chemists adopt an intermediate position. It is not that chemists are unaware of the fact that electrons are fundamentally indistinguishable. It is just that it is convenient in the case of many chemical applications to regard electrons as being approximately distinguishable to the extent that they can be assigned to particular orbitals.

The third contribution is a response to a previous article by Rein Vihalemm in which he criticized John and Maureen Christie's views on chemical laws. The Christies have now provided a robust response in which, among other things, they "reject the idea that physics should, in the sense of Vihalemm intends, be regarded as a model of science." Once again this debate should be of interest to general philosophers of science as well as those concerned with more specific issues in the philosophy of chemistry regarding the way in which chemistry and physics differ from each other.

The issue is brought to a close with two book reviews, both of which concern books that are edited by Peter Morris the historian of chemistry and chemical technology. The first book consists of a collection of papers by the great synthetic organic chemist Robert Burns Woodward. The second book which Morris has co-edited with Ted Benfey is a collection of papers on the instrumental revolution in modern chemistry.

In the first review, Jeffry Ramsey provides yet another highly insightful analysis in the course of which he suggests a number of possible avenues of future research in history and philosophy of chemistry based on different aspects of Woodward's work. For example, historians and philosophers of chemistry could consider Woodward's research in the context of recent attempts to understand representational practices as seen in a volume recently edited by Ursula Klein (Klein, 2001). Ramsey points to Woodward's liking for chemical rules, such as the Woodward-Hoffman rules and that this aspect might be relevant to recent work aimed at understanding the practice of chemistry which does not rely on the use of fundamental theories. Finally, Ramsey draws this book to the attention of those who have begun to analyze chemical synthesis in a philosophical manner (Bhushan, Rosenfeld, 2000).

The final piece is a review essay by historian of science Klaus Hentschel whose own work has ranged from the history of relativity theory to that of spectroscopic instrumentation. Hentschel gives a critical overview of the papers in Morris' edited collection of papers on chemical instrumentation, most of which were given at a meeting held at Imperial College, London in August of 2000. The paper that Hentschel singles out for particular praise is a reprinted version of Davis Baird's classic article on the scientific instrumentation revolution in analytical chemistry in which Baird argues for a revolution in the sense of Hacking rather than Kuhn.

NOTE

1. A short biography of Paneth, in the context of philosophy of chemistry, has been written by Klaus Ruthenberg (Ruthenberg, 1997).

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