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Kevin C. de Berg

The Iron(III) Thiocyanate Reaction

Research History and Role in Chemical Analysis

Springer

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Preface

Histories of chemistry and histories of science commonly focus on the historical development of ideas, themes, concepts and the personalities involved in these historical developments. Some histories will focus on a particular chemist giving insight into their family background, academic life and contributions made to chemistry or more broadly, scientific endeavour. Some examples that come to mind have been those written about Robert Boyle, Joseph Priestley, Antoine Lavoisier, Fritz Haber, Ernest Rutherford and Madame Curie just to name a few. It is less common to write a history about a chemical reaction but I have discovered that such a history will involve personalities, controversial ideas and applications to the broad landscape of science. By its very nature, a history of a chemical reaction will involve addressing some detailed chemistry, probably more than one might expect in a history focussed on a personality or a particular scientific idea. In the eighteenth century, chemists were disappointed that their discipline lacked the rigour that mathematics had brought to physics. It proved much easier to apply mathematics to visible objects like planets, projectiles and inclined planes than to the invisible constituents of matter undergoing chemical change. The development of calculus and its application to the thermodynamics and kinetics of chemical reactions proved an important turning point for chemistry. To demonstrate this often forgotten legacy, I do make use of mathematics in this book, but a level of mathematics not beyond that of a typical chemistry graduate. Some of the basic principles are revisited for the benefit of the reader where derivations are given. However, my challenge in a book series like this is to provide enough detail that will satisfy the historian and the chemist and I trust I will have been at least partly successful in achieving this.

My interest in history began in the mid-1980s when I completed a master's thesis on the history of the gas laws. What provoked my interest was the question: 'How did we come to express gas laws in the form used in modern chemistry'? This interest coincided with the establishment of the International History and Philosophy of Science and Science Teaching Group (IHPST) in 1989 and the opportunity to make subsequent contributions to its journal, *Science & Education-Contributions from History*, *Philosophy and Sociology of Science*, as an

author and reviewer. In 2014, I contributed a chapter on the role of the history of chemistry in the teaching and learning of chemistry for the *International Handbook of Research in History, Philosophy and Science Teaching*.

The iron(III) thiocyanate reaction, where an intense blood-red colour is produced by mixing solutions of ferric ions and thiocyanate ions, has captured my interest since high school days. The reaction was used in my first-year university chemistry laboratory days as a test for the presence of ferric ions and when I was given the opportunity to teach senior high school chemistry for a time, the reaction was used as the centrepiece for equilibrium study in what was then known in the 1970s as the CHEM STUDY syllabus. More recently, I was given the opportunity to study the reaction in the laboratory of Professor Marcel Maeder at the University of Newcastle since there were still some unresolved issues with the reaction. Two papers, published in *Inorganica Chimica Acta*, have resulted from this collaboration to date.

One is often asked the question, particularly by fellow chemists: 'What use is a study of history to the chemistry community or more broadly to the scientific community, or even more broadly to the general community'? My own reflections on an answer to this question have to do with the contribution of history to our broad understanding of how knowledge of our world has been built through many circuitous paths involving errors, controversies and clashes of culture. Even while giving specific detailed study to a particular chemical reaction like the iron(III) thiocyanate reaction, these reflections remain with me, even though occasionally sitting in the background. Hopefully, such a study will make us sympathetic to the role science plays in providing information on broader controversial topics like climate change.

Cooranbong, Australia Kevin C. de Berg

Acknowledgements

I wish to acknowledge four sources that have had some influence on my embarking on the study of a chemical reaction from an historical perspective.

1. Associate Professor Michael Matthews, founding president of the IHPST group, provided an international platform upon which newcomers to history and philosophy of science research could receive helpful reviews of initial attempts at writing in this area from experts in the field. These reviews helped to hone one's skills at writing history while still being involved in the practice of a science discipline, which in my case, was chemistry.
2. Avondale College of Higher Education provided funding towards my travel and presentation of a paper on the iron(III) thiocyanate reaction at the 11th International Conference for the History of Chemistry in Trondheim, Norway, in 2017.
3. Professor Marcel Maeder from the University of Newcastle willingly gave me access to his laboratory facilities for conducting further research on the iron (III) thiocyanate reaction and from his chemometrics background was able to suggest procedures for addressing some difficulties which proved valuable in the final analysis.
4. Dr. Sarah Clifford from the University of Newcastle who willingly gave me practical assistance in learning how to operate the stopped-flow apparatus and its computer interface for recording large amounts of absorbance data.

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About the Author

Kevin C. de Berg completed his Ph.D. in physical chemistry in 1978 at the University of Queensland and his MAppSc in 1989 from Curtin University. His research thesis for the MAppSc degree examined the historical significance of the gas laws particularly for the education context. Interests in chemistry and history and philosophy of science led to an invitation to serve on the editorial committee of the journal: *Science & Education-Contributions from History, Philosophy, and Sociology of Science and Mathematics*; and to contribute a chapter titled: *The Place of the History of Chemistry in the Teaching and Learning of Chemistry*, for the International Handbook of Research in History, Philosophy and Science Teaching (2014). Kevin has spent 9 years as a High School Science and Mathematics Teacher and 36 years lecturing and researching in the area of physical and inorganic chemistry and history and philosophy of science. He is currently Conjoint Associate Professor at Avondale College of Higher Education.