The story of structure

Chasing the Molecule
by John Buckingham
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Alan Rocke

One of the least familiar of all the heroic stories in the history of science is how chemists managed to learn about the invisible realm of atoms and molecules. At the dawn of the nineteenth century, few scientists paid attention to the world at the molecular level. It was beyond the reach of the senses and it seemed to many at the time that there was little we could ever know about it, aside from the sort of metaphysical conjectures that had engaged philosophers since antiquity.

By the end of the century, the situation had changed radically. Chemists were now in a position to depict the detailed architecture of complex molecules, often even being able to specify the manner in which the atoms were arrayed in three dimensions — all without ever having been able to see these sub-microscopic objects. By 1900, certain branches of physics operated on the nanoscale, too, but it was the chemists who had blazed the trail. The fascinating story of how they did it is filled not only with interest, but also with drama and romance.

John Buckingham, a respected organic chemist not previously known for historical writing, recounts this engrossing history for a general audience in *Chasing the Molecule*. After providing three chapters of historical background, he introduces John Dalton, the first true chemical atomist. Buckingham then proceeds through the famous names and events of nineteenth-century chemistry: the imperious Swede Jöns Jacob Berzelius; the gentle sage of Göttingen, Friedrich Wöhler; the irascible German Justus Liebig; the domineering Parisian Jean-Baptiste-André Dumas; the romantic radicals Auguste Laurent and Charles Gerhardt; the obscure Scot Archibald Couper; the late defenders of organic radicals, Edward Frankland and Hermann Kolbe; the great master of chemistry in London and Berlin, August Wilhelm von Hofmann; and the father of structure theory, August Kekulé.

Buckingham's exposition is clear and lively, his ability to explain the scientific action on stage is first rate, and his command of historical detail is impressive. The task he set for himself is not one for the timid. The story he tells is complex, filled not only with difficult science but with many false starts, misunderstandings, confusing complications, dead ends and long chains of inference that often had weak links. Even among professional historians of science, few are closely familiar with this terrain; the specialist literature is large but of uneven quality. To his credit, Buckingham has read (and cites) a sizeable amount of this secondary literature, including many of the most reliable sources. There are occasional minor errors (consistently misspelling the names Chevreul and Sertuerner, for instance), but considering all the complexities, it is truly impressive how much detail Buckingham has got right.

The author's eye for interesting stories and arresting metaphors gives the book real appeal and bite. For example, in explaining the historical emergence of valency, as distinct from chemical 'affinity', Buckingham notes the difference: "An atom can have powerful urges but be satisfied with a single partner, like Queen Victoria, or polygamous but sluggish, like her uncle George IV."

Occasionally, however, Buckingham rests his interpretations on shaky foundations, for instance when coming to his surprisingly mixed judgements on the careers of what are in my opinion the three greatest chemical masters of the nineteenth century (or any other): Berzelius, Liebig and Kekulé. During his prime in the 1820s and 1830s, Berzelius had a well deserved reputation as the "lawgiver of chemistry"; in his old age (he died in 1848) he exerted a stultifying influence on the development of chemical theory, but it is unjust to focus on that time in his career to the exclusion of his extraordinary earlier accomplishments. Liebig is a paradox. Often generous and amiable, at other times he rode roughshod over the reputations of other chemists. His overall contributions to the science were undeniably massive, however. And some who have attacked Kekulé's stories of inspiration through dreams (which I believe are fully credible) have gone so far as unjustly to impugn his character. It is tempting for any historian to gravitate towards the titillating controversies, but one needs to be careful to maintain balance and perspective.

Professional historians may disapprove of the author's propensity to assess blame, to deplore his protagonists' "errors" and to judge past scientific contributions by today's standards, but they are not the principal audience for the book. In fact, in recounting the story of the rise of chemical atomic theory for a general audience, the author has accomplished what few specialists have even attempted. I hope that this book will be read widely; the author deserves congratulations for his skilled recounting of a complicated and important story. ■

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Exhibition

Frond memories

The discovery of the photographic process in the nineteenth century revolutionized the sciences as well as the creative arts. Natural-history illustrators were among the first to experiment with 'drawing with light', yet this brief movement, centred on a group of mostly English and Scottish artists, has faded from conscious memory.

Anna Atkins' 1853 *Cyanotypes of British and Foreign Flowering Plants and Ferns* was the first printed book to include photographs and text. Atkins created her cyanotypes, such as the alga *Laminaria digitata* illustrated here, by laying specimens directly on to light-sensitive paper.

Atkins' work on seaweed species features prominently in the exhibition *Ocean Flowers: Impressions from Nature in the Victorian Era*, which can be seen at the Yale Center for British Art in New Haven, Connecticut, until 8 August. This is a rare chance to see a visual history of Victorian botanical illustration.

A book to accompany the exhibition, *Ocean Flowers*, edited by Carol Armstrong and Catherine de Zegher, is published by Princeton University Press ($49.95, £32.95). **A.A.**