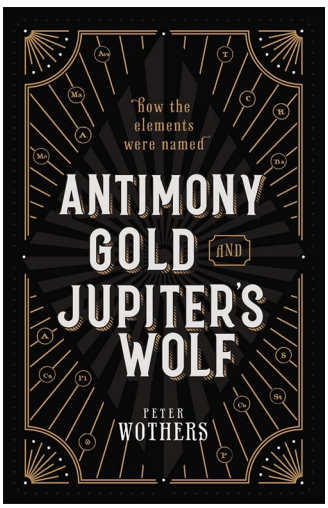
Orderly as a swarm of bees



Antimony, Gold, and Jupiter's Wolf: How the elements were named
By Peter Wothers
Oxford University Press (2019), 304pp £20

Naming and taxonomy (classification) are fundamental aspects of science: they allow discoveries to be communicated — and are frequently bitterly debated. For the chemical elements, these tasks began centuries ago and continue to this day. Peter Wothers' *Antimony, Gold, and Jupiter's Wolf* guides the reader through this surprisingly tumultuous part of chemistry's development.

In the Acknowledgements to his book, Wothers writes that he owns twenty editions of Lavoisier's *Traité Élémentaire de Chimie*. This seems reasonable, as *Traité* is arguably the first book of chemistry's 'scripture', but it was a vehemently opposed book when it appeared in 1789. Wothers quotes the contemporaneous English physician John Berkenhout on this new dephlogisticated chemistry, then emerging from *Traité* and other French texts: "It was born in France, and there let it die. It has been considered in other nations only to be ridiculed."

Not ridiculed today, this period in the late 18th century saw the birth of modern chemistry, with its cornerstone the modern concept of a chemical element. Nearly half of Wothers' book deals with events before the publication of *Traité*; and although many chemical element names predate this period, it is only in retrospect that we can recognize this. When Swedish mineralogist Axel Cronstedt discovered nickel in the mid-18th century, it was seen as a new metal, not a new element. But with far more than the seven metals of antiquity known by the end of that century, ideas coming from chemistry's nomenclatural heroes, including Torbern Bergman, Guyton de Morveau and Lavoisier — and soon thereafter Davy, Berzelius and many others — rapidly displaced the ancient ideas of elements and intermediate theories, such as the aforementioned phlogiston. A bonus: *Antimony, Gold, and Jupiter's Wolf* contains one of the clearest discussions of phlogiston theory I have ever encountered. But after *Traité*, systematic naming of the chemical elements could truly begin.

Reality was more disorganised than systematic. Some readers may know the connections between lead, molybdenum and graphite, for instance, but Wothers excels at weaving together centuries of confusion into a coherent story. Smart advice also abounds: when following a 16th century recipe for making ammonium chloride, "You muste take heede, that the cauldron ronne not over, whan the Uryne boyleth". Reading such passages in their original spelling may be an acquired taste, although I greatly enjoyed this aspect of the book. The characters are charming: William Ramsay frequently wrote to his wife about his discoveries; when he wrote to his co-discoverer of argon, Lord Rayleigh, about a new element, krypton, he began with "You are the first person, outside the family, to whom I write". Element discoveries have transcended politics — multiple times. In 1813, during the Napoleonic Wars, Napoleon himself gave Humphry Davy, Davy's wife and Davy's assistant Michael Faraday permission to visit Paris — so that Davy could receive honours for his alkali metals work. While there, Davy showed that the recently discovered element iodine was similar to chlorine — a productive wartime visit. But sometimes folks had new element fatigue: in 1898, one commentator noted that "new elements, especially among the rarer earths and gases, hardly excite the interest that similar discoveries did some years back". If only they could have seen the excitement — and press coverage — in 2016 about naming four new superheavy elements, of which only a few atoms have ever been glimpsed, and then for only a fraction of a second!

Wothers covers the elements' controversial symbols too: Berzelius originated our modern single- and two-letter element symbols — including symbols such as "Na" and "K", which still puzzle beginning chemistry students. Scottish chemist Thomas Thomson, when translating Berzelius' element symbols paper, missed the point of Berzelius' choice of universal Latin-derived symbols, and substituted "So" and "Po" to make them "intelligible to the English reader", prompting an angry rebuke from Berzelius. Obviously, Berzelius' symbols prevailed in the end — thankfully, in my opinion — for the periodic table includes symbols that require every chemistry student to learn at least a little of the field's deep history.

Wothers' long-time interest in historical chemistry texts shaped and led to this book. Indeed, the majority of the book's illustrations come from these long-ago published books in his personal collection. His book's numerous references, both as endnotes and as a bibliography, are primary sources from the times when the names of the elements in question were being minted, or were in flux. This choice does sidestep some scholarship that has happened in the intervening centuries. Perhaps a flaw, but not everyone dares to write a history book with no or few intervening interpretations. Wothers' book stands on its own and is more impressive for that decision.

Antimony, Gold, and Jupiter's Wolf is not comprehensive for the entire periodic table. 20th- and 21st-century elements, and their naming stories, make only cameo appearances. To learn that tennessine is the first element name derived, albeit indirectly, from a Native American language, you'll have to look elsewhere. But there is plenty to enjoy here. The diverse names of the chemical elements encode chemistry's rich history and for that reason are worth studying. Wothers' book is an enjoyable read for anyone interested in chemistry's history — and especially for anyone with an interest in why we chemists use the words we do.

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Competing interests
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