BOOK REVIEWS

Antimony, Gold, and Jupiter's Wolf, Peter Wothers, Oxford University Press, 2019, xv+273 pp, ISBN 978-0-19-965272-3, $25.95.

"How the elements were named" precedes the unusual title of this book on its title page. The author, Peter Wothers of St. Catharine's College, Cambridge, elaborates a bit on this description in the preface: the book isn't an etymological table but a series of brief explanations of how some names became attached to their elements. "For example, while it's easy to find out that selenium was named after the goddess of the moon, why did the discoverer choose to do that in the first place?" (vii-viii) The names examined include not just those one can find on a current periodic table, but some discarded names, some attached to discoveries that were not accepted, and a few of important compounds or groups of elements. The vignettes are arranged and connected in a way that recapitulates many key episodes in the discovery of elements and their classification. And the tales are abundantly illustrated, mainly from the author's own library, including many from alchemical and early metallurgical texts.

Organized topically, the book contains interesting digressions into all manner of chemical trivia. In the first chapter, for example, we read that gold, associated with the sun, was sometimes prescribed as a medical remedy for the heart, because the sun was thought to govern the heart. One such remedy was the explosive compound, fulminating gold. Today, a different explosive compound, nitroglycerine (containing no gold), is often prescribed for angina, chest pain related to heart disease.

That first chapter, Heavenly Bodies, treats elements associated with celestial objects. It begins with the seven ancient metals, which were linked to the seven planets of geocentric astronomy and astrology. The metals (gold, silver, mercury, copper, iron, tin and lead) and their corresponding planets (Sun, Moon, Mercury, Venus, Mars, Jupiter and Saturn) shared symbols. Planets, asteroids and dwarf planets discovered more recently also had elements named for them, namely uranium, cerium, palladium, neptunium, and plutonium. Tellurium is another element named for a planet, namely the one on which we live.

The second chapter, Goblins and Demons, moves back in time to the days of Basil Valentine (if he existed) and Georgius Agricola, when miners were plagued and sometimes confused by gnomes and goblins and metals that seemed to be not quite the ancient ones they knew. The names cobalt and nickel are derived from mining demons according to the 19th-century philologists and folklorists, the brothers Grimm. Or perhaps cobalt comes from the ancient Greek cobathia, the toxic white smoke produced by roasting arsenic-containing minerals in air. Nickel certainly comes from Kupfernickel, where the Kupfer clearly refers to copper; perhaps the Nickel part derives from the Latin nichelus, a name applied to agate and sometimes onyx.

From minor demons in the second chapter, we pass to the devil's elements, sulfur and phosphorus, in the third, Fire and Brimstone. Brimstone is an older English word for sulfur, literally meaning burning stone. It was long associated with subterranean fires, both natural (volcanoes) and infernal. A delightful 15th-century woodcut of the destruction of Sodom and Gomorrah ornaments this section.

Pneumatic chemistry is the theme of the fourth chapter, "H two O" to "O two H." Among the terms examined here are the word gas, coined by van Helmont with chaos in mind, but related by Lavoisier to spirit (Goast, Ghost, Geist). Several examples of specific gases are treated, both compounds and elements, some as named by their

discoverers (fixed air, inflammable air), and some under the new nomenclature of Lavoisier and Guyton de Morveau (oxygen, azote). The name "azote" was displaced in English, but not by the name proposed by American chemist Samuel Mitchill, "septon;" we call the element "nitrogen."

Nitrogen means nitre-former, and when the name was coined, nitre referred to potassium nitrate. But the word nitre and variations like nitron, nitrum, and natrun referred to other salts, rich in compounds we know as sodium carbonate and sodium bicarbonate. The Wadi El Natrun in Egypt shares its name with such materials, although it is not clear whether the place or the material was named first. That is where the element symbol Na comes from (for Latin natrium). Chapter five, Of Ashes and Alkalis, treats names and symbols of sodium and potassium among others.

The next chapter, Loadstones and Earths, addresses the names of a great number of metals, most of them isolated in the early 19th or later 18th century. In this chapter we encounter Jupiter's wolf, of the book's title. This ore robbed or spoiled tin (Jupiter), as it was too dense to be separated from tin ore in slurry tanks. This heavy ore was variously called Wolfrumb, Wolffschaum (wolf foam) or Wolffshar (wolf hair). We call the metal of this mineral tungsten, Germans call it Wolfram and we all use W as its symbol. The end of the chapter draws attention to the end of a couple of element names. The name silicon was proposed by Thomas Thomson early in the 19th century for the element recently isolated by Berzelius. Before its isolation, it had been widely expected to be a metal, as were the bases of many other earths, and it had been called silicium. Thomson proposed to change its ending to emphasize similarity to carbon and boron rather than to metals. Most metallic elements' names end in -ium, including aluminium according to IUPAC but not to ACS.

Chapter seven is called The Salt Makers, and its title gives the meaning meaning of the term halogens, the subject of the chapter. The convoluted path to the name chlorine for the prototypical halogen is outlined in the first few sections of the chapter. The mineral acid we know as hydrochloric acid was known for centuries as spirit of salt or oyle of salt. The gaseous compound was isolated in reasonably pure form in the 18th century, and dubbed marine acid air or muriatic acid. Scheele isolated a related gas, the dephlogisticated acid of salt, later recognized to be an element. But Lavoisier's theory of acids, which held oxygen to be part of all acids, prevented its recognition as an element until the early 19th century. In the meantime, it was known as oxygenated muriatic acid or oxy-muriatic acid. Davy recognized the elemental nature of the gas, and he named it chlorine after its color.

Elements discovered by spectroscopy and the noble gases are the two main subjects of chapter eight, From under the Nose. That chapter begins with the first few elements discovered by spectroscopy. Caesium (cesium to Americans), rubidium, thallium, and indium were named after colors—not for the colors of the elements but the colors of distinctive spectral lines. The name helium also comes from spectroscopy, not because of color but because of its origin from a line identified in the spectrum of the sun (Greek helios). Helium, the second noble gas discovered on earth, is the link between spectroscopy and the noble gases. Most of the latter were discovered in the atmosphere, so they were literally under the nose. Shortly before argon was isolated, William Ramsay speculated that there might be a trio of such gases, for which he had the names anglium, scotium and hibernium in mind, echoing the nationalistic names of elements discovered in the previous two decades, gallium, scandium and germanium.

The last chapter, Unstable Endings, is a brief one, treating the last four element names approved by IUPAC, namely nihonium, muscovium, tennessine, and oganesson.

Antimony, Gold and Jupiter's Wolf is above all an interesting and entertaining collection of elemental and etymological anecdotes organized and assembled into a coherent order. Wothers points interested readers to plenty of additional material. In addition to an extensive bibliography of primary sources, he includes a page of books for further reading on related topics. These include classics from past Dexter Award winners such as Mary Elvira Weeks's *Discovery of the Elements* and Maurice Crosland's *Historical Studies in the Language of Chemistry*. More recent titles like Kit Chapman's *Superheavy* and *The Lost Elements* by Marco Fontani, Mariagrazia Costa, and Mary Virginia Orna are also recommended.

Carmen J. Giunta, Le Moyne College, Syracuse, NY, USA, giunta@lemoyne.edu