Names | A Journal of Onomastics

Book Review

Antimony, Gold, And Jupiter's Wolf: How the Elements Were Named. BY PETER WOTHERS. Oxford: Oxford University Press. 2019. Pp. 273 (Hardback). $29.95. ISBN13: 978-0-19-965272-3.

Antimony, Gold, and Jupiter's Wolf: How the Elements Were Named, hereafter *Antimony*, is an onomastic feast on two levels. First, the content takes readers from ancient to modern understandings of the earth and, in the voices of the scientists of the times, how and why nomenclature changed along the way. Second . . . for now, let's just say it has nothing to do with the content but everything to do with onomastics and may have had something to do with the way *Antimony* was received when it was released in 2019.

Its title notwithstanding, *Antimony* is not a straightforward march through the periodic table noting along the way the etymological origins of the chemical elements from hydrogen (atomic number 1) to oganesson (atomic number 118).[1] Rather, author Peter Wothers invites readers to immerse themselves in the worlds in which the elements were identified and named, to experience the cultures and conditions surrounding the discoveries by encountering them in pages that include artifacts such as writings, engravings, and woodcut illustrations culled from Wothers' collection of chemical textbooks dating back several centuries.

Antimony traces, through the lens of nomenclature, how the art and science of chemistry developed primarily in the Western world,[2] and Wothers, a teaching fellow in the Department of Chemistry at the University of Cambridge and co-author of several modern chemistry textbooks, discusses mostly elements isolated through the year 1950. Why 1950? That was the year the International Union of Pure and Applied Chemistry (IUPAC), which previously had focused on standardizing chemical terms, symbols, and measurements, gave greater attention to standardizing chemical nomenclature. However, as Henri Diament explains in his somewhat sardonic 1991 *Names* article, the number of chemical compounds—combinations of

ISSN: 0027-7738 (print) 1756-2279 (web) Vol. 74 No. 1, Spring 2026 DOI 10.5195/names.2026.2903

elements—being created in the twentieth century vastly exceeded the number of new elements being discovered and/or created artificially. This disparity, Diament notes, resulted in a lack of policies regarding the naming of elements which then remained subject to nineteenth- and twentieth-century nationalism and politics (204). Not until 2002 did the IUPAC formulate a process by which new elements would be named, a process involving, as Wothers explains in his preface, not only what name should be applied but whether "the atoms of the element in question were actually formed (albeit briefly), then establish[ing] who exactly made them first, and, finally, wait[ing] for all the concerned parties within the group who first made the discovery to agree on a name" (vii).

By contrast, Wothers invites readers to experience the world of alchemy, not the world of pseudoscience but that of protoscience—i.e., the precursor to modern chemistry. Drawing on his extensive collection of antique texts, Wothers transports modern readers to the cultures and thinkings of past ages, a time before today's sterile laboratories were stocked with graduated beakers and burettes, microscopes, spectrometers, probes, and imaging devices that can map what is happening at even subatomic levels. A time before elements, compounds, and solutions could be purchased from a supply house already refined, combined (or not), packaged, and neatly labeled. A time when chemistry was hands-on, earthy, and intertwined with every facet of a daily life based on a much more holistic and integrated view of the physical and the metaphysical than what we moderns sometimes can conceive. And a time before telegraphs, telephones, and internet made it possible for scientists to communicate in real time around the world.

Non-chemists and chemists alike are welcomed on Wothers' tour. For the most part, he doesn't assume readers remember long-ago courses in chemistry or mineralogy much less ones in medieval history or ancient philosophy.[3] Rather, Wothers' narrative tone and use of the inclusive "we" throughout draws in people from various positions of knowing to stand on the common ground of not-knowing-but-willing-to-explore the nine chapters—galleries may be a more fitting term—that Wothers has curated from his collection. Readers are advised to examine the illustrations carefully. Wothers discusses each within the text itself, but to only read about the illustrations without examining them for oneself is like reading about a meal without savoring its flavors. Additionally, when Wothers quotes passages from historic texts, he retains the spelling and sometimes the original typeface of such texts, providing, again, a visual link to the times in which they were written. Wothers includes translations and clarifications when needed, but reading a short passage by Chaucer, as written in the late 1300s and as printed in the 1400s by one of the earliest printing presses in England, brings the era to life (4). And, if one reads between the lines a bit, there's intrigue, drama, and intellectual snobbery. Impish elements causing havoc with the newly created periodic table? Elements switched at birth—so to speak—with each getting the other's name and causing generations of mischief? See chapters 2 and 4. And elements whose "discovery" outpaced chemists' supply of astral names and, therefore, according to Henry, writing in 1801, "must be satisfied with the name given them accidentally and, in most instances, by the common miner" (as cited in Wothers, 24)? Horrors!

Throughout most of chapter 1, titled "Heavenly Bodies" (1–30), Wothers delves deeply into the mystic connections ancient peoples made between the seven earliest known metals of the earth, the sun-moon-planets of the sky, the Greco-Roman gods, and even human anatomy. Wothers explains how and why the ancients used their names for the planets, in turn named for their gods, to name the metals, and then traces how we retain those connections in the names we use today to reference the days of the week (e.g., gold [La. aurum, AU] | the Roman god Sol | the sun | Sunday (6–8). While in English some of the day-names have become disconnected from the Greek/Latin, Wothers provides some examples of how other languages have retained them. The other six metals known to ancient peoples were silver (Luna/the moon), mercury (Mercury), iron (Mars), lead (Saturn), tin (Jupiter), and copper (Venus), and Wothers expounds on each in turn, and then traces more modern connections between chemical elements and astral names. Uranium (planet Uranus discovered in 1781, metal in 1786); cerium and palladium, elements named for bodies thought to be planets (Ceres, 1801; Pallas Athena, 1802) but now known to be part of the asteroid belt; neptunium (planet Neptune discovered 1612 or 1846, metal synthesized 1940); plutonium (planet Pluto discovered 1930, metal synthesized 1940). Even our own earth, which was not seen as a heavenly body by the ancients, was in 1789 accorded a namesake metal, tellurium (23–27).

Again, however, we are not just reading Wothers' twenty-first-century words reflecting on the past. Infused throughout the text are writings and illustrations that, to us, look archaic but which sound very contemporary. Consider, for example, a passage Wothers includes that was written by a Spanish miner in 1640, more than a century before the eighth metal (uranium) was identified, who protested that the connections made between the seven then-known planets and the seven then-known metals "is uncertain, as is also the conceit that Mettals are but seven in number; whereas it is very probable, that in the bowels of the Earth there be more sorts than we yet know" and also suggesting—referencing Gallileo de Galiles—that "if one should admit the [. . .] resemblance between metals and Planets, modern experience, by excellent Teliscopes has discover'd, that they are more than seven" (Barba, as cited in Wothers, 23). That sense of being on the cusp of discovery was as exciting in 1640 as it is now, even though it is doubtful that any modern chemistry

DOI 10.5195/names.2026.2903 Vol. 74 No. 1, Spring 2026 ISSN: 0027-7738 (print) 1756-2279 (web)

textbook makes astral connections with chemical elements. But, as Wothers notes, there is one place where that connection has, within the last several years, been made. In the early 1500s, Wothers writes, Nicolaus Copernicus was the first person known to posit "the modern, heliocentric view of our solar system [. . .] [which] is often taken to mark the beginning of the modern astronomy that led the scientific revolution" (3). That scientific revolution placed distance between the fields of astronomy and chemistry. It wasn't until 2009, Wothers explains, that the astronomer Copernicus's "achievements were recognized [in the field of chemistry] with a place in the chemists' periodic table; man-made element 112 was officially named copernicium, bringing the relationship between astronomy and chemistry into the twenty-first century" (3).

I have written at length about chapter 1 to give readers a sense that *Antimony* should be approached not as a chronological textbook but as a treasure hunt. The title of each chapter is the first clue as to the general content of the chapter, but readers are urged to stroll rather than stride through the pages. In chapter 2, titled "Goblins and Demons" (31–58), Wothers guides readers through the mining and refining of ores, showing how the intersection of working conditions with tales of the ill-tempered, malevolent creatures of the underworld influenced the naming of elements such as bismuth, antimony, arsenic, cobalt, nickel, and zinc. Wothers also traces how metals, minerals, and the methods of refining them migrated across trade routes and were named and renamed by different cultures along the way.

In chapter 3, "Fire and Brimstone" (59–82), Wothers explores the connections between the rotten-egg smelling element sulfur, volcanoes, subterranean fires, and what Homer in his *Iliad* refers to as "blazing sulphur" (i.e., lightning bolts,as cited in Wothers [61]). And yet, as Wothers explains, "the Greek word for 'sulfur', [. . .] 'thion', is also the word meaning 'divinity'" (62) and "[t]he divine origin of sulfur remains [. . .] in our modern chemical nomenclature" in such compounds with a prefix *-thio* or *-thi* and in other compounds with a suffix *-thiol* (63). Wothers also discusses various forms of sulfur before turning, in the second half of the chapter to an element whose Latin name is *Lucifer*: phosphorus (71). Not only does Wothers recount the different names given to this luminescent element he also shares stories of intrigue, theft, and guile associated with its discovery and production.

For everyone who has ever wondered why the chemical symbol for water—H_20—came to be termed hydrogen dioxide instead of dihydrogen oxide, Wothers explains, in chapter 4, "'H Two O' to 'O Two H'" (83–124), how an onomastic error in the late 1700s—"based on an incorrect theory" (83)—has persisted until today, a reminder, perhaps, that what science states as fact is true only until a new theory or new knowledge comes along disproving and displacing the old.[4] Chapter 4 also includes a section on the first concerted effort to address the composition and naming of elements, which culminated in the 1787 publication of "the book that was to mark the beginning of modern chemistry: the *Méthode de Nomenclature Chimique*" or, translated into English, "the *Method of Chymical Nomenclature*" (113). In chapter 5, "Of Ashes and Alkalis" (125–156), Wothers illustrates how even before onomastic rules were developed, new names also displaced older ones. "Modern chemists", Wothers writes, "understand 'nitre' to mean 'potassium nitrate' [. . .] containing the elements potassium, oxygen, and nitrogen" but in ancient times "the name nitre initially referred to a completely different compound containing no nitrogen at all" (125), that is, *natrium* (Na) or what we today call sodium. Wothers describes the uses of salts in ancient Egypt for everything from making glass to embalming to bathing to curing various ailments and the extraction of a different alkali—*pot-ash*, today known as potassium—distilled from the ashes of plants in what is today's Middle East (112). All of which, Wothers notes, has resulted in multiple terms for salts, their roots tangled through various languages. Wothers also discusses other salts (calcium, magnesium, and barium), the development of electrolysis at the turn of the nineteenth century—an easier and quicker method of separating compounds into individual elements—and the development of modern chemical symbols.

Chapters 4 and 5 deal with different aspects of the transition from an ancient understanding of the elements as earth, air, fire, and water to modern chemistry's understanding of an element as a solid, liquid, or gas that cannot be decomposed or separated into smaller units. In chapter 6, "Loadstones and Earths" (157–186), Wothers describes a similar change in mineralogy based on "[Cronstedt's] development of a classification of minerals based not on their physical appearances [. . .] but on their chemical composition" (157), which was published in 1758. Loadstones—today's lodestones—are minerals with magnetic properties. Earths were defined at the time as minerals that could not be dissolved in oil (as were bitumens), could not be dissolved in water (as were salts), and were not melted by heat (as were metals) (157). Wothers explains how, as mineralogists from various European counties teased out the different elements from the earths during the 1700s and early 1800s, each scientist decided what to call their discoveries and began using those terms in correspondence and articles. Sometimes the names were similar and consensus was achieved. Sometimes, Wothers notes, one name prevailed but with remnants of other names attached, as with the Swedish *tungste*, which now is known as *tungsten*, but the element's chemical symbol (W) refers to the older German name *wolfram* (171).

Some of Wothers' material was a bit too dense for me, and I hopped, skipped, and jumped through chapter 7, "The Salt Makers" (187–202), that is the halogens such as chlorine which react with metals and produce salts of various types. Again, however, it should be remembered that Wothers is not hyper-focused on the moment of discovery and the naming but rather on the false assumptions, dangerous missteps—more

ISSN: 0027-7738 (print) 1756-2279 (web) Vol. 74 No. 1, Spring 2026 DOI 10.5195/names.2026.2903

than one chemist was injured—and dialogue that occurred along the way that influenced chemical nomenclature then and now. Suffixes were topics of debate among the chemists of this time period—the early 1800s—and the solutions devised are reflected in the names of various related elements. Not to be missed is the reproduction of Mendeleev's first published periodic table of the elements issued in 1869 (201).[5]

Chapter 8, "From Under the Nose" (203–232), considers the rare gases which were first detected in the 1890s but which built on the incremental work of scientists from centuries before who, often, had no clue the direction their observations would lead. Isaac Newton's prism of the 1600s, for example, which revealed light as a spectrum of rainbow colors, was modified by William Hyde Wollaston in 1802. Wollaston's modification revealed dark lines in the spectrum, which led to Joseph Fraunhofer mapping, beginning in 1814, more than five hundred of the dark lines, which led to Gustav Kirchhoff and Robert Bunson, between 1855 and 1860, developing the first spectroscope which could detect miniscule amounts of previously undetected elements—each needing a name—and which, Wothers writes, "was to revolutionize chemical analysis" (203–204). In chapter 9, "Unstable Endings" (233–237), Wothers shares parts of the discussion surrounding the naming strategies considered for derivatives of radioactive elements. At one point, for example, it was proposed that derivative gasses be named using the prefix "ex" attached to the elements from which they were derived. Had a different system of nomenclature not prevailed, we might today be referring to *exradio, exthorio,* or *exactinio* (235)—which seemed perfectly logical at the time but which today suggests wands and wizards.

Overall, *Antimony* offers a wealth of information about Western chemical naming practices, supported and illustrated with historic writings and images throughout, and serving up a feast for curious readers of many intellectual appetites. However, the book also provides a striking example of a different kind of onomastic reading, and it is to this that I now turn, or rather, return—i.e., to the first component of the book, the one an old adage claims we ought not judge the contents by, and the one often ignored or given short shrift in reviews: the cover. While an exhaustive semiotic analysis of *Antimony*'s cover could be a paper in itself, here I will only briefly address the design imagery, the typography, and what isn't included in the cover, each of which shapes—to one degree or another—readers' expectations of the content they will encounter.[6 and 7] While the process may seem tedious, Serafini explains that "[n]aming the visual elements of a multimodal text is an initial aspect of the comprehension process [which] helps [. . .] develop a metalanguage for describing and interpreting [such] texts" (344). I beg the reader's indulgence.

I begin by describing the cover (https://global.oup.com/academic/product/antimony-gold-and-jupiters-wolf-9780199652723?cc=us&lang=en&#). Against a matte-black background, copper-gold lines form a geometric design which frames stylized text, some of which is rendered in copper-gold and some of which is in white. The frame consists of a copper-gold, double-lined rectangle with concave corners which creates the outline of a large plaque extending almost the length and width of the cover. At each corner of the plaque, a white dot denotes what would have been the corner of the rectangle had the lines extended fully. From each dot, nine copper-gold rays fan, in a long-short-long pattern, toward each of the curved corners of the rectangle. Between each pair of the long rays and extending from each of the short rays sits a white dot. At the midpoint of each side of the rectangle, the copper-gold lines break, and a white dot sits at the center point of the broken space. Copper-gold rays also extend from the interior of the rectangular frame toward the center. The graduated lengths of the rays, which begin a short distance from the midpoint of each side and continue around the convex (from the interior perspective) curved corners to the next midpoint, create a large diamond shape centered in the rectangle and suggested by the positioning of the ends of the rays rather than delineated by an actual line. Affixed to some of the rays are small copper-gold circles, most containing one-to-three letters (some upper-case, some lower-case) and one containing just a gold dot.

What is framed by the graphic imagery is the title itself which is arranged vertically within the large diamond shape centered in the rectangular plaque. Reading from top to bottom, we first see "how the / elements / were named" in copper-gold, smaller point, lower-case, serifed letters (.5–.75 cm tall). This portion of the title fits into the top quarter of the diamond. In the second and third quarters of the diamond, we see "ANTIMONY / GOLD [AND] / JUPITER'S/ WOLF" in white, much larger point, upper-case, semi-serifed letters (2 cm tall). With the exception of the word *AND*, the letters in the other four words are embellished with copper-gold ticking behind and, in some cases, underneath the letters which gives them the illusion of depth. The word "AND" is rendered in copper-gold, upper-case letters of the same size and similar style as the text in the top quarter of the diamond, and the word itself is encased in a small, horizontally oriented plaque similar in style to the large, vertical plaque. In the bottom quarter of the diamond, we see the author's name "PETER / WOTHERS" in white, upper-case, tall and thin serifed font. However, the author's first name is half the size (.5 cm tall) of the author's last name (1 cm tall).

More connotatively, the cover conveys a sense of drama. The bursts of rays in each corner suggest spotlights illuminating the large plaque. The rays emanating from each side of the interior of the plaque point to the text within the diamond. The large, white letters with copper-gold ticking seem to be emerging from the darkness, and readers familiar with early twentieth-century black-and-white movies might find similarities with this cover and the title frames of those movies. But what exactly is this movie about? The most

DOI 10.5195/names.2026.2903 Vol. 74 No. 1, Spring 2026 ISSN: 0027-7738 (print) 1756-2279 (web)

prominent four words might suggest noir detective fiction featuring a gumshoe named *Antimony Gold*, his sidekick *Jupiter*, and Jupiter's pet canine, *Wolf*, who are working a case about how something was named.[8] Almost lost on the cover are the words, in all lower-case letters, "how the elements were named"—and yet the flourishes on the beginning *h* and the ending *d* suggest drama from beginning to end.

Or, perhaps, those rays are drawing us into something dark and mysterious, perhaps the world of alchemy, as suggested by the small circles with the letters or symbols, which scientists and others with a basic knowledge of chemistry might recognize as chemical symbols, some of which are used today and others of which were used in times past (148–156). Perhaps the cover can be read as drawing readers back into the world of protoscience, of alchemy, and as preparing them to encounter that world in the words and images of the people who lived in it. There are, after all no commas or other punctuation or semiotic symbols to guide us to a "correct" reading.

The titular ambiguity does not end there. The spine of the cover and the first recto page of the front matter render the title as *Antimony, Gold, and Jupiter's Wolf*, with no mention of elements or naming. The second recto page of front matter reproduces the text on the cover in reverse shading, that is, with dark stylized letters against the cream-colored paper. The same fonts are used, the word *AND* is encased in a horizontal plaque, and no punctuation is added. [9] The copyright page, on the verso side of the previous page, does not give the title of the book at all, nor could I find the title of the book anywhere on the back cover or the inside flaps. The only place the title is listed in full is on the publisher's website. Perhaps this is standard British formatting; the purchase link on OUP's site led to an Amazon listing which reads *Antimony, Gold, and Jupiter's Wolf: How the elements were named*.

Does it matter? Maybe. Maybe not. I found the design itself intriguing and enjoyed puzzling out the possible meanings in the title. But in a world subject to miscommunications of all sorts, it seems clarity might be of some import. Regardless, Wothers' work is a welcome addition to my library and is one that will not languish on its shelf.

Notes

[1] Readers of this journal interested in such an approach might reference Fred Ellis, Jr.'s 1953 article, "Naming of Chemical Elements", at the end of which Ellis provides a neat table listing, in alphabetical order, the names of the ninety-eight elements isolated through 1950, their years of discovery, their discoverers or name-givers, and the origin and brief etymology of each name. Ellis's article, which appeared in the third issue of the first volume of *Names*, contains no references to external sources, a practice which seems not to have been unusual at the time. However, the "Editor's Page" at the beginning of the issue provides biographical and other information about each of the issue's authors and their contributions. About Ellis, the unnamed editor (later discovered to be Erwin G. Gudde) writes that he was "with the Shell Oil Development and Research Company" and had drawn, in part, on information found in a 1918 publication "The Romance of Chemical Elements" by I. W. D. Hackh, creator of a chemical dictionary "which has [. . .] become the standard reference work of its kind throughout the world" (225).

[2] In his acknowledgements, Wothers recognizes colleagues from "a melting pot of great minds" (ix) who provided information about and/or translations of material written in languages ranging from Anglo-Saxon Norse to Celtic to medieval French to Russian and Chinese.

[3] My one, long-ago high-school chemistry course, with lab, has been augmented over the years by my own eclectic readings and by conversations with a spouse whose interests in metallurgy, ceramics, and gardening have led to his extensive readings in the chemistry underlying each. That said, I made liberal use of dictionaries and online sources to fill gaps in understanding as I read this book and wrote this review.

[4] The National Institute of Health's website—and, no doubt, other official texts—correctly terms *water* as dihydrogen oxide: https://pubchem.ncbi.nlm.nih.gov/compound/Water. Still, H_2O persists in common culture.

[5] Readers are reminded that the Periodic Table of the Elements lists the elements by atomic weight and not by year of discovery or by alphabetical order. Gold (Au), for instance, was among the first of the elements to be recognized as a pure metal—an element, in modern terms—but its atomic weight of 79 puts it in the middle of the table. Mendeleev left blank spaces in the table for elements not yet discovered as of 1869 but which would have atomic weights falling between the weights of known elements.

[6] Elsewhere, I have parsed out theories of interpretation of multimodal documents and have developed a method/framework for analyzing such documents (Anderson 2020).

[7] It should be noted that the book cover was not designed by Wothers (Anne Anderson, email message from author, August 5, 2025) but was the work of a designer chosen by the publisher and using fonts and graphic elements from iStock.com/Gleb_Guralnyk (inside back cover).

ISSN: 0027-7738 (print) 1756-2279 (web) Vol. 74 No. 1, Spring 2026 DOI 10.5195/names.2026.2903

[8] Robert M. Rennick, in his 1968 article "Obscene Names and Naming in Folk Tradition", found fictional titles created for similar, if bawdier, humorous effect.

[9]An image of the book cover can be found here: https://global.oup.com/academic/product/antimony-gold-and-jupiters-wolf-9780199652723?cc=de&lang=en&

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DOI 10.5195/names.2026.2903 Vol. 74 No. 1, Spring 2026 ISSN: 0027-7738 (print) 1756-2279 (web)