

Homely holmium

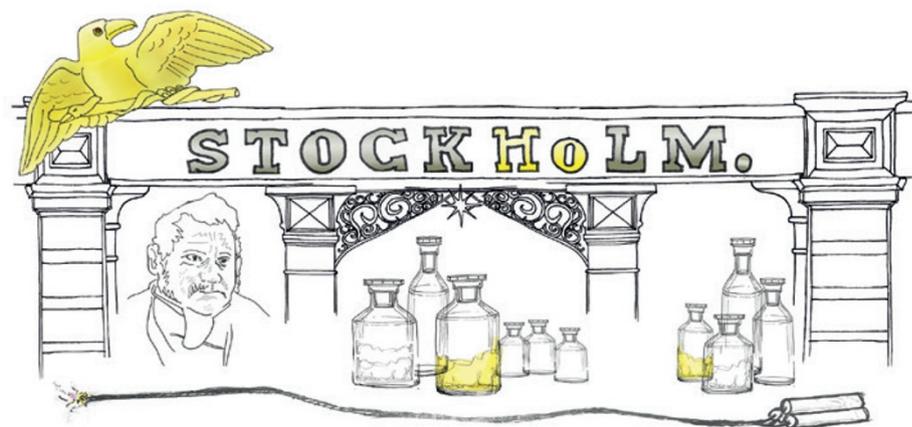
Brett F. Thornton and Shawn C. Burdette consider holmium's hotly contested discovery and later obscurity.

In 1878 Marc Delafontaine, a Swiss native working in Chicago, noticed previously unknown emission lines when studying a solution extract of samarskite ore. This observation alone was not enough to claim that element 67 had been discovered — newly observed spectral lines often heralded the identification of a new element, but it was not unusual for the same element to be 'discovered' multiple times with different spectral lines. Such spurious element discoveries appeared frequently in the late nineteenth century.

Nevertheless, Delafontaine's observations were confirmed by Jacques-Louis Soret, who was working in Switzerland with solutions extracted from gadolinite ore. Delafontaine suggested the name philippium (after the Swiss chemist-physician Philippe Plantamour), but uncertainties about the element's identity lingered; both he and Soret became embroiled in a priority dispute with the American chemist J. Lawrence Smith. Smith claimed to have discovered the same element (he named it mosandrum after Carl Gustaf Mosander, discoverer of three lanthanoids). The dispute culminated in French-language journals^{1,2}.

During this period, Per Teodor Cleve in Uppsala, Sweden was analysing erbia-containing residues from Lars Fredrik Nilson's recent separation of scandium from erbium ores. A spectroscopic analysis of erbia (erbium oxide) by physicist Tobias Robert Thalén led Cleve to propose the presence of additional undiscovered elements in erbia, and he went on to separate two new oxides from a sample of it. A brown oxide he named *thulia* (hence, thulium) and a green oxide *holmia* — the medieval Latin name for Cleve's hometown of Stockholm³. Because Cleve had more comprehensive and convincing data, Cleve's claim gained precedence, and the new element became known as holmium.

Stockholm's chemistry pedigree is legendary. Berzelius worked in the city and helped discover at least four elements (his students, including Mosander, found



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five more). Former Stockholm pharmacist Carl Wilhelm Scheele found oxygen before Priestley, even though the latter published his results first. Many other famous chemists hail from the city including solution chemist Svante Arrhenius (who studied under Thalén and Cleve) and, of course, Alfred Nobel. Stockholm county boasts Ytterby, the periodic table's most-honoured suburb (namesake of Y, Yb, Er and Tb), and the original source of several elements, including holmium.

Delafontaine later attempted to obtain a purer sample of philippium, but holmium had already become elemental dogma. Modern texts often acknowledge Delafontaine, Soret and Cleve for finding holmium, but Thalén could share credit for the discovery because Delafontaine and Soret also used spectroscopy to identify the element.

Holmium's chemical similarity to its neighbouring elements made it difficult to discover; today this similarity often leads to few compelling reasons to select it for a given purpose from a choice of other similar — and often cheaper — lanthanoids. Holmium's high magnetic susceptibility means that it is occasionally used in high-strength magnets, especially as a magnetic-flux concentrator; however, elemental holmium's magnetic properties only manifest themselves at cryogenic temperatures.

Holmium is now commonly used in surgical lasers, where holmium-doped aluminium garnet (Ho:YAG) is the lasing material, with an infrared emission around 2,100 nm. This wavelength is particularly

useful for surgery because water-laden tissues absorb the laser energy within half a millimetre, allowing for precise cutting. Cuts made with Ho:YAG lasers generally self-cauterize, minimizing bleeding. In urology, Ho:YAG lasers are used for removal of urinary stones⁴ and the treatment of an enlarged prostate⁵.

137 years after its discovery, holmium languishes as one of the most underutilized elements on the periodic table. Although medical uses of Ho:YAG lasers account for an order of magnitude increase in mentions in the scientific literature beginning in the late 1980s, holmium remains one of the least-discussed elements — perhaps some fascinating holmium chemistry may yet be discovered⁶.

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