

Book Review

The Thirteenth Element: The Sordid Tale of Murder, Fire and Phosphorus,

by John Emsley (John Wiley & Sons, 2000) 327 pp., ISBN 0.471 39455-6; \$24.95 (hardcover)

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“The Thirteenth Element”, by John Emsley, traces the history of phosphorus from its discovery to its importance in the present day. The book is billed as the first biography of an element, although I would almost be tempted to describe it as something between a portrait and a police “rap sheet”.

The story begins in the latter part of the seventeenth century with an account of the discovery of elemental phosphorus by the alchemist Hennig Brandt. Seeking the philosopher’s stone, the legendary substance reputed to be able to convert base metals into gold, Brandt pyrolyzed the residue of large volumes of urine, obtaining the first impure sample of the element. Fascinated by its luminescence, Brandt spent several years vainly attempting to use it to transmute elements. Eventually, he settled into a less dramatic, albeit somewhat more lucrative, career as a supplier of phosphorus to others, who took the element “on the road” as a scientific curiosity, performing demonstrations at the courts of European princes, and for groups of scientists willing to pay for the privilege of witnessing its eerie glow and ability to combust spontaneously. During the twilight period when alchemy was gradually transforming into chemistry, the unique behavior of phosphorus brought it to the attention of serious scientists, who seem to have expected it to have almost magical powers. The story of Robert Boyle’s fascination with phosphorus is intriguing and illustrative of the times, encompassing extensive scientific study of its properties, attempts to use it to transmute base metals into gold, and what can only be described as the type of antics that would get a freshman chemistry student thrown out of lab.

“His [Boyle’s] favorite trick was to dip his finger in the liquid phosphorus and draw lines on linen or on the hands of guests, both men and women, noting how a little phosphorus went a long way, and that those hands he touched could then touch others and pass the luminosity on.”

By the time Boyle got around to phosphorus, however, it was already on the medical map, a subject taken up by Emsley in chapter 3. Paracelsus' conviction that all disease had a chemical basis had prepared the ground for the use of chemicals as medications, and the seemingly magical properties of elemental phosphorus naturally led to its use as a tincture to treat a wide variety of conditions. Oddly, despite the twin impediments of its ineffectiveness and its toxicity, its use persisted even into the very early twentieth century, and one wonders what collateral damage its prescription might have entailed. (One rather amusing sidelight: a nineteenth century source refers delicately to its ability to produce "venereal excitation", conjuring up a picture of phosphorus as a kind of potential Victorian Viagra.)

By far, though, the most wide-spread use of phosphorus was in the production of lucifers and strike-anywhere matches, and Emsley devotes several chapters to the development, growth, and social impact of the match industry, including the dreadful plague of "phossy jaw" that afflicted its workers. This material is really social history, and provided me with more information about the match industry than I really wanted to know.

The catalog of grim stories continues in the next chapter, with an account in gory detail (in both the literal and metaphorical senses) of the development of phosphorus incendiary bombs in the war. Here again, the chapter read much longer than it was. Was a day-by-day account of the firebombing of Hamburg really necessary?

Succeeding chapters recount the use of phosphorus in nerve gases and insecticides, and as a readily available, cheap, and apparently common poison (in the latter instance, in perhaps somewhat more detail than was warranted). Quite a few murder cases were outlined, most of which seemed rather repetitive without affording much new insight.

Chapter 10 affords a brief respite, with the story of the growth of the phosphorus industry, but is quickly succeeded by a survey in chapter 11 of environmental disasters involving phosphorus.

Chapter 12 finally brings some welcome relief from the rather long and dreary tale of illness, death and destruction by introducing phosphorus' ubiquitous role in the biosphere, principally in the forms of adenosine diphosphate and adenosine triphosphate. Justus Von Liebig's research in agricultural chemistry led him to formulate the Law of the Minimum, essentially an application of the limiting reagent principle, a theme continued as Emsley outlines the positive role of phosphorus, and I found myself wishing this portion of the book were longer.

In the book's final chapter, Emsley veers toward the border of the gothic, focusing on the topic of spontaneous human combustion, a subject that I have hitherto tended to associate more with supermarket tabloid headlines and horror films than with serious science.

Nonetheless, he recounts several instances throughout history (including some supposed eyewitness reports) in which humans have allegedly spontaneously burst into flame and been virtually entirely consumed.

Seeing possible significance in the common observation that flames seem often to initially erupt from the chest cavity, Emsley hypothesizes that one conceivable mechanism might be the generation of the pyrophoric gas diphosphine (P_2H_4) in the stomach or intestines and its subsequent contact with oxygen, either internally, or through body openings. Since it is unclear whether there is any evidence for the metabolic production of diphosphine, this hypothesis, while interesting and perhaps entertaining, seems speculative at best.

The book underwent a name change at some point on its trans- atlantic journey, from “The Shocking History of Phosphorus”, a title both less mysterious than “The Thirteenth Element”, and more subtle than its subtitle “The Sordid Tale of Murder, Fire and Phosphorus.” In fact, Emsley’s Acknowledgements and his Introduction still refer to it by the British title, a small slip that should have been caught for the sake of consistency.

Like all of Emsley’s books, The “Thirteenth Element” is entertaining and informative, although since the chemistry of phosphorus is relatively limited, there is little in the way of variety that Emsley is able to offer, and he thus places much more emphasis on the misuses of phosphorus, Mr. Hyde after all, being rather more interesting than Dr. Jekyll. However, I am reminded of having once heard someone comment of “Paradise Lost” that Milton did such a masterful job of depicting the evil persona of Satan, that God rather paled by comparison, and while it is entertaining and informative, I am a bit concerned that the long litany of perfidy and harm in “The Thirteenth Element” might only serve more to reinforce a non-scientist’s pre-conceptions about chemicals than to create a positive impression of their importance.