

The Origin of Bond Lines

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Question

What is the origin of bond lines?

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Answer

The first use of lines in chemical formulas to indicate pairwise bonding interactions between atoms within molecules is usually attributed to the Irish chemist, William Higgins, in 1789 (1). However, Higgins's notation never caught on, in part because his molecular structures were purely speculative. Though the Scottish chemist, Archibald Scott Couper, used dotted lines for the same purpose in his famous paper of 1858 on the formation of chains and rings in carbon compounds (2), the use of solid bond lines in conjunction with the rise of modern structure theory is usually credited to the Scottish chemist, Alexander Crum Brown, in 1864 and to the German chemist, Lothar Meyer, who also used them in some of the formulas appearing in the first edition of his famous monograph, *Die modernen Theorien der Chemie*, published the same year (3, 4).

Unlike Meyer, Crum Brown enclosed the atomic symbols in his formulas in circles, a practice which gave them appearance of two-dimensional projections of ball and stick models (figure 1). This practice was repeated in Edward Frankland's popular 1866 textbook, *Lecture Notes for Chemical Students*, which played an important role in popularizing Crum Brown's symbolism (5). By end of the decade, however, the circle had largely been eliminated as an unnecessary embellishment and structural formulas began to appear much as they are today. Frankland is also generally credited with being the first to popularize the term "chemical bond" (6).

Literature Cited

1. W. Higgins, *A Comparative View of the Phlogistic and Antiphlogistic Theories*, Murray: London, 1789. A pho-

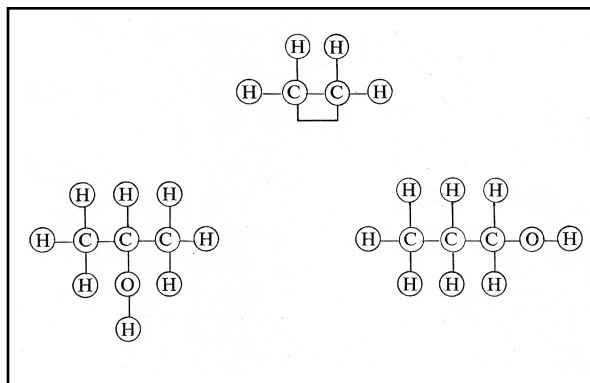


Figure 1. Examples of Crum Brown's "ball and stick" structural symbolism of 1864 (3).

toreproduction of Higgins's book along with a biographical sketch and commentary on his symbolism may be found in T. S. Wheeler; J. R. Partington, *The Life and Work of William Higgins, Chemist (1725-1825)*, Pergamon: New York, NY, 1960.

2. A. S. Couper, "On a New Chemical Theory," *Phil. Mag.* **1858**, 16[4], 104-116. This is reprinted along with related papers in A. S. Couper, *On a New Chemical Theory and Researches on Salicylic Acid*, Alembic Club Reprint No. 21, Livingstone: Edinburgh, 1953.

3. A. Crum Brown, *Trans. Roy. Soc. Edinburgh*, **1864**, 23, 707. Crum Brown had actually first introduced his symbolism in 1861 in his unpublished M.D. thesis at the University of Edinburgh.

4. L. Meyer, *Die modernen Theorien der Chemie und ihre Bedeutung für chemische Statik*, Maruschke & Berendt: Breslau, 1864.

5. E. Frankland, *Lecture Notes for Chemical Students*, Van Voorst: London, 1866.

6. C. A. Russell, *The History of Valency*, Leicester University Press: Leicester, 1971, pp. 89-91.

Do you have a question about the historical origins of a symbol, name, concept or experimental procedure used in your teaching? Address them to Dr. William B. Jensen, Oesper Collections in the History of Chemistry, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221-0172 or e-mail them to jensenwb@ucmail.uc.edu