

The Origin of Stoichiometry Problems

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Question

When did elementary chemistry textbooks begin to include quantitative stoichiometry problems?

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Answer

The simplest way to gauge this is to examine special supplementary booklets designed to specifically teach stoichiometry to beginning students of chemistry. The Oesper Collections at Cincinnati contain roughly 20 of these, spanning the period between 1865 and the present. The two volumes dating from 1865 - one by the German chemist, Albert Frickhinger, and the other by the American chemist, Josiah Parsons Cooke (figure 1), are both later editions of books first published in 1843 and 1857 respectively (1, 2).

Cooke's booklet covered the topics of nomenclature and chemical symbols, formula weights, balancing equations, mass-mass calculations, specific gravity and mass-volume calculations, unit conversions, gas-law calculations, and empirical formulas. Frickhinger's book is similar but also contained an introductory section on mathematical notation, including exponents and logarithms. Despite the work of Cannizzaro in 1858 both of these books continued to use equivalent weights rather than atomic weights. By the first decade of the 20th century, stoichiometry books were also including problems on converting empirical formulas to molecular formulas using experimental molecular weight data, percent composition, normality of solutions, dilution problems, and titration problems (3, 4).

The extent to which the textbooks themselves incorporated student exercises dealing with all of the above topics is more variable, and heavily depended, as it does today, on their intended audience. A survey of introductory American texts from 1820 to 1960 found that none of the textbooks in the survey that were published before 1867 contained numerical prob-

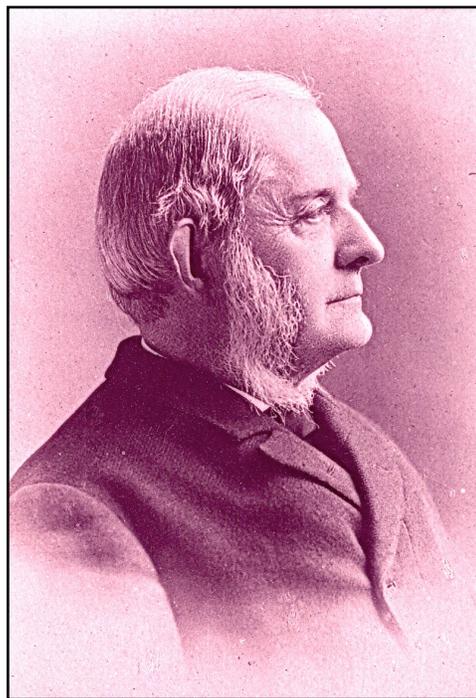


Figure 1. Josiah Parsons Cooke (1827-1894).

lems, whereas all but two published between 1870 and 1900 contained at least simple mass-mass problems (5). Indeed, this inadequate coverage was the main reason why Cooke wrote his small booklet. As indicated by its subtitle, "To Accompany Stockhardt's Elements of Chemistry," it was intended to supplement the textbook used by Cooke at Harvard, whose coverage of the topics in question was, in his opinion, "insufficiently developed for the purposes of college teaching." Once Cooke's own textbook, *First Principles of Chemical Philosophy*, appeared in 1868, this problem was obviated and Cooke allowed his supplementary booklet to go out of print (6).

Literature Cited

1. A. Frickhinger, *Katechismus der Stöchiometrie*, 4th ed., Beck'schen Buchhandlung: Nördlingen, 1865.
2. J. P. Cooke, *Chemical Problems and Reactions*, Butler: Philadelphia, PA, 1865.

3. E. J. Bartlett, *Calculations of the Quantitative Chemical Laboratory*, Dartmouth Bookstore: Hanover, NH, 1909.
4. G. Bornemann, *Stöchiometrie*, Hirzel: Leipzig, 1909.
5. W. B. Jensen, *The Secondary Chemistry Textbook and the History of Secondary Chemistry Teaching, 1820-1960*, MS Thesis, University of Wisconsin, Madison, WI, 1972.
6. J. P. Cooke, *First Principles of Chemical Philosophy*, Sever, Francis & Co: Boston, 1868.

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

2009 Update

Since writing this column the Oesper Collections have considerably expanded their acquisitions in this area. These new acquisitions indicate that the German tradition of speciality monographs on chemical calculations actually goes much further back than indicated in the original column, though the conclusion with regard to the coverage of these topics in the typical introductory textbook remains unchanged. Some of these earlier monographs include:

H. Buff, *Versuch eines Lehrbuchs der Stöchiometrie*, Scrag: Nürnberg, 1829.

M. Ehrmann, *Die Stöchiometrie*, Ehrmann: Wien, 1829.

O. B. Kühn, *Lehrbuch der Stöchiometrie*, Köhler: Leipzig, 1837.