OLD CHEMISTRIES

Alonzo Gray's "Elements of Chemistry"

William D. Williams, Harding University

Many scientists have been inspired to pursue their careers by reading an old textbook when they were at a very young age. A case in point is Charles Martin Hall (1863-1914), who discovered the first practical, inexpensive method of producing aluminum. He began research on this problem while still a student at Oberlin College, OH. Working with homemade equipment in the family woodshed, he found that molten cryolite would dissolve aluminum oxide and that a carbon anode would allow electrodeposition of metallic aluminum. On February 23, 1886, at the age of 22, Hall produced the first globules of aluminum by this method. Subsequent patents and founding of what became the Aluminum Company of America resulted in a new industry that has touched every facet of modern life.

In 1911 Hall was presented the Perkin Medal for his contributions in electrochemistry. His speech at that occasion recalled his early study of chemistry (1):

> My first knowledge of chemistry was gained as a schoolboy at Oberlin Ohio, from reading a book on chemistry which my father studied in college in the forties. I still have the book, published in 1841. It is minus the cover and the title page, so I do not know the author. It may be interesting to see what this book, published seventy years ago, says about aluminum: "The metal may be obtained by heating chloride of aluminum with potassium in a covered platinum or porcelain crucible and dissolving out the salt with water. As thus prepared it is a gray powder similar to platinum, but when rubbed in a mortar exhibits distinctly metallic lustre. It fuses at a higher temperature than cast-iron and in this state is a conductor of electricity but a non-conductor when cold.

Some Hall biographers mention the 1841 chemistry book, but none has sought to identify it (2). After searching through chemistry texts in use in the 1840s, the present author has located Hall's quotation in *Elements of Chemistry* by Alonzo Gray (3).

Gray's *Elements of Chemistry* undoubtedly influenced many young students in addition to Charles Hall. It went through forty "editions" from 1840 to 1858, with a remarkable 28 "editions" in a two-year span, 1846 to 1848. Most of the "editions" were merely reprintings. Only three differences in content and pagination are found: 1840 (1st, 359 pp.), 1841 (2nd, 395 pp.), and 1848 (40th, 452 pp.). Contemporary John Griscom recommended the work as (4):

> An exceedingly judicious arrangement of the facts of Chemistry. Its consecutive order is lucid and logical. It indicates a mind accustomed to teach as well as study. It seems to me to hold a happy medium between the brevity which only obscures the subject, and the copious details of works too elaborate and minute for the general student.

Little is known of the life of Alonzo Gray. Born in Townsend, Vermont on 21 February 1808, he received the A.B. in 1834 from Amherst and the A.M. in 1838 from Andover Theological Seminary, Andover, Mass. From 1837 to 1843 he taught natural science, chemistry, botany, geology and mineralogy at Teacher's Seminary, a division of Phillips Academy, at Andover. Following the 1844-5 school year as professor of chemistry at Marietta College, the remainder of his career was spent as headmaster of two schools in Brooklyn, NY: Brooklyn Heights Female Academy and Brooklyn

Heights Female Seminary. He died March 10, 1860, in Brooklyn (5).

Gray's *Elements* was one of several American texts based upon that of British chemist Edward Turner's Elements of Chemistry (6). Silliman's *American Journal of Science* noted this trend in its review of Gray's book (7):

> Unhappily for our reputation as advancers of science, almost all the works on chemistry which have been issued here have been written on the basis of some foreign treatise. We hope the day is not far distant when American chemists will take a high rank as original investigators.

Gray acknowledged that his work was a compilation from Webster, Liebig, Berzelius, and Griffin, in addition to Turner. He even listed page numbers in Turner for further reading. He followed the same order as Turner, but his judicious simplification of Turner's intimidating treatise was a welcome contribution. A second edition was issued within a year because of "the rapid sale of the first edition and its introduction into several colleges (8)."

The first sentence in the book, "Science is classified knowledge," emphasized Gray's philosophy of teaching. Indeed, a very important attribute of the text was its eye-catching outline format. A 14-page Table of Contents provided a detailed outline of the entire book. That same outline was accentuated in the body of the text with numbers, headings, and frequent changes in type. Experiments were described to illustrate almost every topic—always in the same small type to make them quickly recognizable. Likewise, special paragraphs on "Theory" followed many sections. He encouraged the use of chemical formulas as "the most efficient aid to clear, definite, and easy comprehension of the whole science (9)." Because he believed that teachers should emphasize principles rather than details, he gave more attention to a few very important nonmetals and the imponderable agents (heat, light, and electricity). The remaining elements, compounds, organic chemistry, and analytical chemistry were condensed to almost outline form.

The only personal comments in the volume that yield an insight into Gray's personality were several brief references to God as the "great and ultimate cause" of a nature that is designed for the benefit of man (10). In describing Hare's compound blowpipe, Gray added a footnote that inferred that he had experience using the system (11). Under the topic, "Steam Artillery," the same argument was made for a war deterrent that has been used about nuclear arms in our modern era (12):

> A [steam] musket may be made to throw from one hundred to a thousand balls per minute. It is greatly to be hoped that this experiment will prove successful; for, if such engines of death could be brought into the field of battle, few nations would be willing to settle their disputes in that way. Few would fight in the prospect of certain death.

Gray wrote two other widely used texts as companion works to his chemistry: *Elements of Natural Philosophy* (1850-1875) and *Elements of Geology* (1853-1863, with former classmate Charles B. Adams). His *Elements of Scientific and Practical Agriculture* (1842) was one of the earliest American books to promote agricultural chemistry. Written for his class at Phillips Academy, it was a critical digest of the work of European chemists, in which the author urged the introduction of agriculture as a branch of study in high schools (13). Gray acknowledged the principle we now call photosynthesis but disagreed with Liebig's theory that plants derive all their carbon from the air. Although the book gave special thanks to Samuel L. Dana, it was already in press before Dana's *Muck Manual for Farmers* (14) was published the same year.

REFERENCES AND NOTES

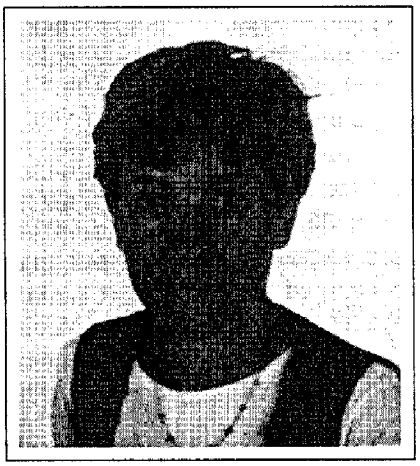
1. "The Perkin Medal Award," *J. Ind. Eng. Chem.*, 1911, 3, 146.
2. J. Kendall, *Young Chemists and Great Discoveries*, D. Appleton-Century Co., New York, 1940, pp. 236-244; C. Carr, *ALCOA An American Enterprise*, Rinehart, New York, 1952, pp. 5-21; J. Edwards, *The Immortal Woodshed*, Dodd, Mead and Co., New York, 1955; N. Craig, "Charles Martin Hall—The Young Man, his Mentor, and his Metal," *J. Chem. Educ.*, **1986**, *63*, 557-9.
3. A. Gray, *Elements of Chemistry*: containing the principles of the science, both experimental and practical, intended as a text-book for academies, high schools, and colleges, Dayton and Saxton, New York, 1841, p. 234.
4. S. A. Allibone, *A Critical Dictionary of English Literature*, J. B. Lippincott, Philadelphia, 1870, Vol. 1, p. 723.
5. J. Wilson and J. Fiske, *Appleton's Cyclopedia of American Biography*, D. Appleton, New York, 1888, Vol. 2, p. 728; M. D. Gilman, *The Bibliography of Vermont*, Free Press Association, Burlington, 1897, p. 105; R. Dake, "The History of Chemistry at Phillips Academy," *J. Chem. Educ.*, **1939**, *16*, 403-9.
6. Turner went through seven British editions from 1827 to 1842. Franklin Bache edited six official American editions from 1828 to 1840, exact copies of the British work with footnotes by Bache. A seventh American edition in 1846 was edited by James and Robert Rogers. Other American texts based on Turner were: J. Green, *A*

Text Book of Chemical Philosophy (1828); J. Comstock, *Elements of Chemistry* (over 100 "editions" from 1831 to 1859); L. Beck, *A Manual of Chemistry* (four editions from 1831 to 1844); J. Johnston, *A Manual of Chemistry* (eight editions from 1810 to 1874).

7. "Miscellanies," *Amer. J. Sci*, **1840**, *39*, 391.
8. Reference 3, p. 3.
9. Reference 3, p. 5.
10. Reference 3, pp. 120, 133, 163, 176.
11. Reference 3, p. 153. Note that the illustration of Hare's blowpipe is a different design from that in Steele's 1868 text, which was used on the cover of *Bull. Hist. Chem.*, **1989**, Number 4.
12. Reference 3, p. 59.
13. A. Gray, *Elements of Scientific and Practical Agriculture*, or the application of biology, geology, and chemistry to agriculture and horticulture. Intended as a textbook for farmers and students in agriculture, Allen, Morrill and Wardwell, Andover and Dayton and Newman, New York, 1842. This text was reviewed in The New Genesee Farmer, 1842, 3, 134.
14. S. Dana, *A Muck Manual for Farmers*, D. Bixby, Lowell, MA, 1842. America's enthusiastic acceptance of soil and plant chemistry is discussed in: M. Rossiter, *The Emergence of Agricultural Science. Justus Liebig and the Americas*, 1840-1880, Yale University Press, New Haven, CT, 1975.
15. No likeness of Alonzo Gray has been found.

ABOUT THE AUTHOR

William D. Williams is Professor of Chemistry, Emeritus, at Harding University, Box 602, Searcy, AR 72149-0001. He is an authority on early American chemistry texts and their authors.



Recipient of the 1997 *DEXTER AWARD* is Professor Bernadette Bensaude-Vincent, University of Paris X. The award will be presented at the Spring 1998 American Chemical Society Meeting in Dallas, TX, March 29 - April 2. See Book Notes, p. 71.