in sending the tie to Gilbert N. Lewis of California, on 17 April 1935:

I am an old prof from Cornell
And my brain is beginning to jell;
I prefer other kinds
To the weird tie that blinds,
It gives me a pain where I swell.

(Could the last word have been misread or miswritten as "smell"?)

G. N. Lewis was, in turn, Mr. Thermodynamics. When one recalls Professor Kahlenberg of the University of Wisconsin stating in his thick, gutteral accent "Thermodynamics is a gut thing for steam engines, but a chemist is afraid of an integral sign," one might suspect that Lewis thought the design was a mass of integrals. Charles Hurd suggests that "Maybe Lewis liked the tie!" It apparently sank into a thermodynamic morass. Of course, the Lewis papers are now in the Bancroft Library on the Berkeley campus of the University of California, and Dr. Robin Rider spoke about preliminary explorations of them at the recent meeting in Los Angeles. Possibly a warning sign could be erected with the hope that some future explorer may find the tie, write a poem, and start it off again on its journey. Many of us would have appropriate nominees for the honor.

James J. Doheny, 3625 McCormick Avenue, Brookfield, IL 60513, is a 64-year member of the American Chemical Society, largely because he was forced to join as an undergraduate in order to pass a course in physical chemistry taught by Ben Freud at the Armour (Illinois) Institute of Technology many years ago.

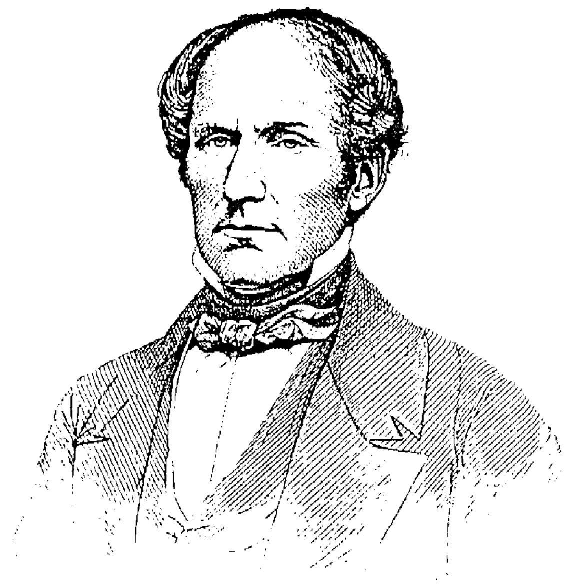
OLD CHEMISTRIES

John Johnston's *Manual of Chemistry*

William D. Williams, Harding University

John Johnston's *Manual of Chemistry* was an extremely popular college chemistry text during the middle of the 19th century (1). It had eight editions from 1840 to 1874, with several editions having over a dozen publishers distributed throughout the eastern half of the United States. It was equally popular west of the Mississippi (2) and continued to be used as late as 1879 (3). Although designed for colleges, it was used in some secondary schools.

Popularly known by its spine label, *Johnston's Turner's Chemistry*, this book was one of several American texts based upon the British work, *Elements of Chemistry*, by Edward Turner (4). Claiming little originality, Johnston referred to himself as a "compiler" and listed dozens of other works used in the preparation of the text. A comparison of the two works reveals that well over half of Johnston's text was a word for word abstract of Turner. He kept Turner's topic arrangement, but omitted tedious details and complicated theoretical material. He emphasized fundamental facts, principles and practical applications. Wherever possible, he replaced British names and applications with American. Johnston greatly enhanced the overview of the material by adding key words at the beginning of paragraphs and by presenting headings in more of an outline form. He added figures and 28 pages of study questions, which were not present in Turner. In short, Johnston altered the dry, tedious Turner in exactly the way needed to make it more palatable. The success of the volume verified his judgement.

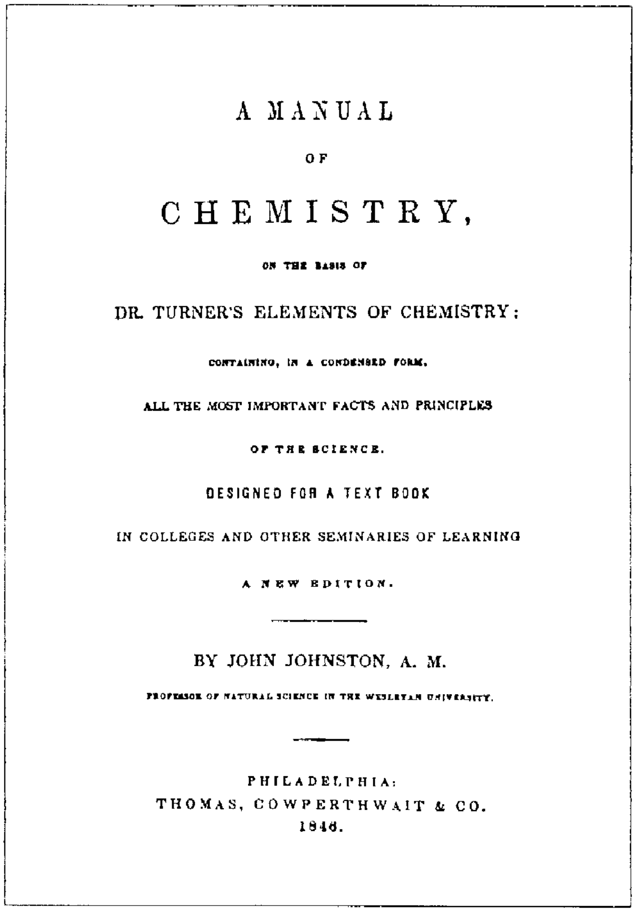


John Johnston (16)

The contents of Johnston's *Manual* were typical of most texts of the era:

* Part I. Imponderable Substances (chapters on Heat, Light, Electricity).
* Part II. Inorganic Chemistry (chapters on Chemical Combination, Non-metallic Elements, Metallic Elements, Salts).
* Part III. Organic Chemistry (chapters on General Principles and Constitution, Vegetable Chemistry, Animal Chemistry).
* Part IV. Analytical Chemistry.

Johnston also inserted several interesting American topics, including Morse's telegraph; Robert Hare's hydrogen-oxygen torch (with a comment that John Webster of Harvard had recently had an explosion using such an apparatus); Silliman's method of preparing fulminate of mercury; and a description of



A MANUAL

OF

CHEMISTRY,

ON THE BASIS OF

DR. TURNER'S ELEMENTS OF CHEMISTRY;

CONTAINING, IN A CONDENSED FORM,

ALL THE MOST IMPORTANT FACTS AND PRINCIPLES

OF THE SCIENCE.

DESIGNED FOR A TEXT BOOK

IN COLLEGES AND OTHER SEMINARIES OF LEARNING

A NEW EDITION.

BY JOHN JOHNSTON, A. M.

PROFESSOR OF NATURAL SCIENCE IN THE WESLEYAN UNIVERSITY.

PHILADELPHIA:
THOMAS, COWPERTHWAIT & CO.
1846.

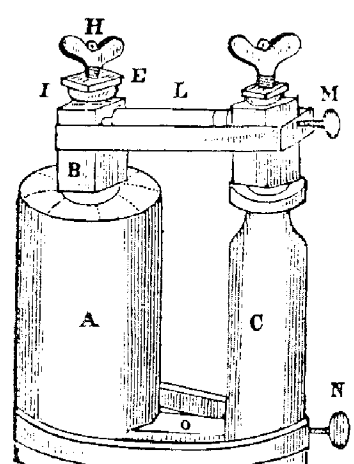
L. C. Beck and Joseph Henry's slide rule scale of equivalents (which used hydrogen as the standard rather than oxygen as Wollaston had done in England) (5). Hare was frequently quoted as if considered the most authoritative American.

The only item of personal experience in Johnston's text was a description of his apparatus for producing solid "carbonic acid", as carbon dioxide was then known. Around 1840, he experimented with Faraday's techniques of liquifying a gas by generating it in a cooled, sealed tube which was strong enough to withstand the high pressure. Then he constructed a metal apparatus and duplicated the work of Thilorier, who had recently obtained solid carbon dioxide. Johnston's apparatus, which used cheap parts so that schools could afford to do the experiment, was described in Silliman's *American Journal of Science and Arts* (6). This article was reprinted in the section on heat of Johnston's *Manual* (7). The gas was liquified in a stopcocked metal collection tank that could be separated from the gas generation tank. When the liquid was rapidly released from this tank, solid carbon dioxide was formed. He constructed such an apparatus for Edward Hitchcock at Amherst and demonstrated one for John Torrey's classes at the College of Physicians and Surgeons in New York. Torrey stated that Johnston's apparatus produced twice as much solid as that of John K. Mitchell, who was the first American to produce solid carbon dioxide (8).

John Johnston was born on 23 August 1806 in Bristol, Maine (9). Details of his early life and education are not known. At the age of 22, he entered Bowdoin College, Brunswick, Maine, and studied science under Parker Cleaveland. Following his graduation in 1832, he taught in a seminary in Cazenovia, New York. In 1835 he was appointed Lecturer in Natural Science and Assistant Professor of Mathematics at Wesleyan University, Middletown, Connecticut. Four years later he advanced to Professor of Natural Science and remained in that position until his retirement in 1873. He was awarded honorary A.M. degrees in 1835 from both Bowdoin and Wesleyan and the LL.D. degree in 1850 from McKendree College, Lebanon, Illinois. In 1854 he was an unsuccessful candidate for Professor of Natural Science and Chemistry at Columbia College, New York City (10).

Johnston had a high regard for his former professor, Parker Cleaveland. He not only dedicated his *Manual* to Cleaveland, but he conducted his lectures at Wesleyan in the same manner that Cleaveland had used at Bowdoin (11). One reference in the *Manual* referred to Johnston's "manuscript notes of Professor Cleaveland's lectures at Bowdoin College, in the year 1832" (12). Johnston probably wrote the anonymous pamphlet, *A Vocabulary, containing a concise explanation of certain terms used in Chemistry; more particularly those which relate to Chemical Nomenclature.* This glossary, which was published in Cazenovia in 1835 while Johnston taught there, was a revision and enlargement of an 1826 work by Cleaveland (13). The two men corresponded and, during his experimentation with liquifying gases, Johnston sent Cleaveland sealed tubes of liquid carbon dioxide (14).

Johnston's experience with gas liquification became a part of a family business. His four sons operated a dental supply



Johnston's apparatus for solidifying carbon dioxide.

business, Johnston and Browne, 1260 Broadway, New York City. They had a factory on Staten Island where they manufactured dental chairs and bottles of liquid nitrous oxide, the "laughing gas" used as an anesthetic for tooth extractions (15).

Johnston authored other widely used texts in chemistry and physics. His secondary level text, *Elements of Chemistry*, which was an abridgement of his *Manual*, was popular from 1850 to 1867. He also wrote the secondary level *Manual of Natural Philosophy* and the elementary *Primary Natural Philosophy*. He contributed articles to several scientific and popular publications. His pamphlet, *The Science of Agriculture* (1846), an address to the county agricultural society, emphasized the chemistry involved in plant growth. He was an authority on Maine history and wrote *A History of the Towns of Bristol and Bremen* (1873). He was an original member of the American Association for the Advancement of Science (1848) and was elected to the American Philosophical Society (1876).

Johnston married Maria Hamilton in 1835. The couple had five sons, with one dying in infancy. In his latter years, he lived with a son at Clifton, Staten Island, New York, where he died on 1 December 1879.

References and Notes

1. J. Johnston, *A Manual of Chemistry, on the basis of Dr. Turner's Elements of Chemistry; containing, in a condensed form, all the most important facts and principles of the science. Designed for a textbook in colleges and other seminaries of learning*, Barnes & Saxe, Middletown, [CT], 1840.

2. H. Hale, "Early Chemical Laboratories West of the Mississippi", *J. Chem. Educ.*, **1937**, *14*, 62-64.

3. F. W. Clarke, "A Report on the Teaching of Chemistry and Physics in the United States," No. 6-1880, *Circulars of Information on the Bureau of Education*, Government Printing Office, Washington, D.C., 1881, p. 161.

4. E. Turner, *Elements of Chemistry, including the recent discoveries and doctrines of the science*, 4th American from 3rd London ed., Grigg & Elliot, Philadelphia, 1832. Turner had seven British editions from 1827 to 1842. Franklin Bache edited six official American editions from 1828 to 1840. These were copies of the British work with frequent footnotes by Bache. A seventh American edition in 1846 was edited by James and Robert Rogers. Other American texts using Turner as a basis were: J. Green, *A Text Book of Chemical Philosophy* (one edition, 1828); J. Comstock, *Element of Chemistry* (over 100 editions from 1831 to 1859); A. Gray, *Elements of Chemistry* (over 40 editions from 1840 to 1858); L. Beck, *A Manual of Chemistry* (four editions from 1831 to 1844).

5. J. Johnston, *Manual of Chemistry...*, Thomas Cowperthwait & Co., Philadelphia, 1846, pp. 111, 153, 376, 133.

6. J. Johnston, "Description of an Economical Apparatus for Solidifying Carbonic Acid, recently constructed at the Wesleyan University, Middletown, Conn.", *Am. J. Sci. Arts*, **1840**, *38*, 297-301 and "Remarks and Suggestions with Regard to the Proper Construction and Use of Apparatus for Solidifying Carbonic Acid", *Am. J. Sci. Arts*, **1842**, *42*, 203-206.

7. Reference 5, p. 52.

8. ALS, J. Johnston to Parker Cleaveland, 4 November 1841, Bowdoin College Library Archives.

9. Biographical information on Johnston may be found in: "Obituary", *New York Times*, 3 December 1879, p. 2, c. 6; Johnston letters in the Bowdoin College Library Archives; N. Cleaveland and A. S. Packard, *History of Bowdoin College*, Ripley, Osgood & Company, Boston, 1882, p. 433; *General Catalogue of Bowdoin College and the Medical School of Maine; A Biographical Record of Alumni and Officers*, no publisher, Brunswick, Maine, 1950, p. 64; C. A. Elliott, *Biographical Dictionary of American Science*, Greenwood Press, Westport, Connecticut, 1979, p. 140; and *Appleton's Cyclopedia of American Biography*, D. Appleton & Co., New York, Vol. 3, 1888, p. 485.

Table 1. Editions of Johnston's *Manual of Chemistry*

Edition	Date	Pages	Publisher	Place
[1st]	1840	453	Barnes & Saxe	Middleton, CT
[2nd]	1842	452	Thomas, Cowperthwait & Co.	Philadelphia
[3rd]	1843-48	480	Thomas, Cowperthwait & Co.	Philadelphia
4th	1848	480	Thomas, Cowperthwait & Co.	Philadelphia and ten other cities
5th	1852	480	Thomas, Cowperthwait & Co.	Philadelphia and ten other cities
5th	1854	480	Cowperthwait, Desilver & Butler	Philadelphia and 11 other cities
6th	1856, 59	528	Charles Desilver; Keen & Lee	Philadelphia; Chicago
6th	1861, 63	528	Charles Desilver; Cushings & Bailey	Philadelphia; Baltimore
7th	1869	528	Charles Desilver	Philadelphia
8th	1872, 74	542	Desilver; Claxton & Haffelfinger; J. B. Lippincott	Philadelphia and 13 other cities

10. ALS, Johnston to Nehemiah Cleaveland, 2 March 1854, Bowdoin College Library Archives.

11. ALS, Johnston to Parker Cleaveland, 4 November 1840, Bowdoin College Library Archives.

12. Reference 5, p. 34.

13. [J. Johnston], *A Vocabulary, Containing a Concise Explanation of Certain Terms Used in Chemistry...*, J. F. Fairchild & Son, Cazenovia, N.Y., 1835. This work was a revision and enlargement of *Vocabulary, Containing an Explanation of Certain Chemical Terms...*, published anonymously at Brunswick, Maine in 1826 and attributed to Parker Cleaveland. Johnston's pamphlet used most of the terms in Cleaveland's, revising about 15%. He added new terms to raise the number of entries from Cleaveland's 159 to a total of 290. As in Cleaveland, the last two pages were devoted to a list of "ancient" chemical names with their corresponding "systematic" names. There were 28 names in Cleaveland versus 45 in Johnston. (Cleaveland's *Vocabulary* was first published in the rear of his 1816 *Elementary Treatise on Mineralogy and Geology*. That shorter version of only 66 items contained many entries identical or quite similar to the 1826 edition. The Bowdoin College archives contain two undated variants of Cleaveland's *Vocabulary*. One is a manuscript copy which was apparently a precursor to the 1816 *Treatise*. The other is a printed edition, without title page, which predated the 1826 edition. It has five fewer entries and a few definitions that have been revised in the 1826 edition.)

14. ALS, Johnston to Parker Cleaveland, 7 November 1840, Bowdoin College Library Archives.

15. ALS, Johnston to A. S. Packard, 10 May 1878, Bowdoin College Library Archives.

16. The author would like to thank Wesleyan University for its help in obtaining a copy of Johnston's portrait.

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WHATEVER HAPPENED TO THE NASCENT STATE?

William B. Jensen, University of Cincinnati

In 1884 the British chemist, M. Pattison Muir, published a textbook on theoretical chemistry entitled *A Treatise on the Principles of Chemistry* in which he attempted to summarize many of the recent results "on the subjects of dissociation, chemical change and equilibrium, and the relations between chemical action and the distribution of the energy of the changing system" - in short, most of the topics which would, within the next ten years, come to become identified with the new and rising field of physical chemistry and the work of Ostwald, Arrhenius and van't Hoff (1). Though Muir himself did not succeed in establishing a British school of physical chemistry and did not make any significant experimental contributions to the new field, he did play a role in disseminating its early results through his review of Ostwald's work on the measurement of affinity coefficients (2), the writing of a monograph on thermochemistry (3), the editing of an influential dictionary of chemistry (4) and, of course, through his textbook.

Muir, who was later to write an important history of chemistry (5), also had an unusual appreciation of the history of his subject and in his textbook attempted to use the new views on chemical equilibrium and kinetics to unravel some long-standing paradoxes of chemical affinity that had been known since the end of the 18th century. Among these were the problems of predisposing affinity, contact actions, and the so-called *status nascens* or nascent state. The first of these topics has long since disappeared from the textbooks, whereas the second, under the rubric of heterogeneous catalysis, has survived. In many ways, however, it is the third topic that is the most fascinating, as not only the explanation of the nascent state, but the very question of whether it really exists, are still unresolved problems. A history of the various attempts to explain this phenomenon provides one with an interesting cross section of 19th and 20th century chemical theory and, though an explicit treatment of this subject has been missing from textbook literature since the 1940's, it is of interest to note that the term is still to be encountered, albeit in passing and without explanation, in more recent textbooks (6).

A knowledge that freshly prepared gases, when generated *in situ* within a reaction system, are frequently more reactive than when added already prepared from an external source seems to date from the late 18th century. This enhanced, but short-lived, reactivity appeared to be associated with the gases only at the moment of their "chemical birth", so to speak, and the resulting metaphor became enshrined within the chemist's lexicon in the phrase "nascent state", though the chemical poet who first coined the term is not known with certainty.

The first explicit use that I have been able to locate occurs in the 1790 edition of Joseph Priestley's work, *Experiments and Observations on Different of Kinds Airs* (7). Having incorrectly postulated that both fixed air (carbon dioxide) and nitrous acid (nitric acid) were compounds of inflammable air (hydrogen) and dephlogisticated air (oxygen), Priestley attempted to rationalize the different products as a function of differences in the reaction conditions, arguing that:

> ... when either inflammable or dephlogisticated air is extracted from any substance in contact with the other kind of air, so that one of them is made to unite with the other in what may be called its *nascent state*, the result will be *fixed* air; but that if both of them be completely formed before the union, the result will be *nitrous* acid.