Chapter 2
American Historians of Chemistry in the Late 19th Century

During the period in American history that led to the formation of the American Chemical Society, there were already distinguished chemists who were interested in the history of chemistry. In this chapter, five of these men will be discussed: Henry Carrington Bolton, Benjamin Silliman, Jr., J. Lawrence Smith, John W. Draper and George F. Barker.

2.1 Henry Carrington Bolton (1843-1903)

One of the most remarkable characters in American chemical history was Henry Carrington Bolton (Figure 2.1).

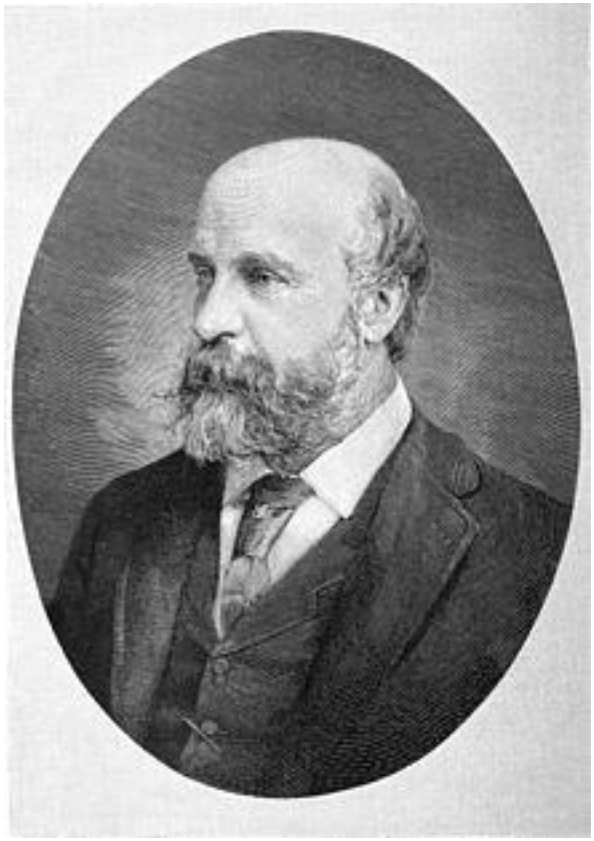
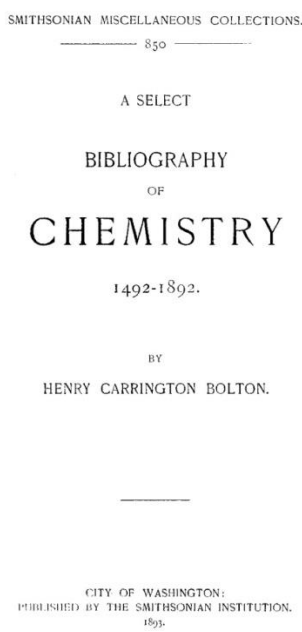


Figure 2.1 Henry Carrington Bolton (1843-1903) Chemist, Historian, Bibliophile

He was born in New York City and received his B.A. in Chemistry in 1862 from Columbia University. He pursued advanced education in chemistry in Europe. He studied in Paris with Jean-Baptiste Dumas (1800-1894) at the Sorbonne and with Charles Adolfe Wurtz (1817-1884) at the Ecole de Medicine. He studied with Robert Bunsen (1811-1899), Gustav Kirchoff (1824-1887) and Hermann Kopp (1817-1892) at Heidelberg. Kopp wrote the famous *History of Chemistry* (Beitrage zur Geschichte der Chemie (1869)). While Bolton learned a great deal about the spectroscopy of chemical compounds, he also fell in love with chemical books and the history of chemistry. He also studied with Friedrich Wohler (1800-1882) at Gottingen and received his Ph.D. in 1866 ("On the Fluorine Compounds of Uranium"). He worked with August Wilhelm von Hofmann (1818-1892) in Berlin. After receiving his doctorate, he continued to travel in Europe, both for pleasure in Nature and to meet more chemists.

While Bolton achieved many things during his lifetime, and joined more learned societies than anyone in his generation, his great life's work was his *Select Bibliography of Chemistry (1492-1892).* (Figure 2.2)


SMITHSONIAN MISCELLANEOUS COLLECTIONS.

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A SELECT

BIBLIOGRAPHY

OF

CHEMISTRY

1492-1892.

BY

HENRY CARRINGTON BOLTON.

CITY OF WASHINGTON:
PUBLISHED BY THE SMITHSONIAN INSTITUTION.
1893.

Figure 2.2 Title page from *A Select Bibliography of Chemistry (1492-1892)*

Bolton was active in the American Association for the Advancement of Science, including serving as its President, and led a committee on chemical bibliography. He also published a *Catalogue of Scientific and Technical Periodicals (1665-1882).* George Washington University appointed him as a non-resident lecturer on the history of chemistry.

2.2 Benjamin Silliman, Jr. (1816-1885)

Although Benjamin Silliman, Jr., is often forgotten in favor of his famous father, he definitely made a name for himself, especially in the area of the journalism and history of chemistry. (Fig. 2.3)

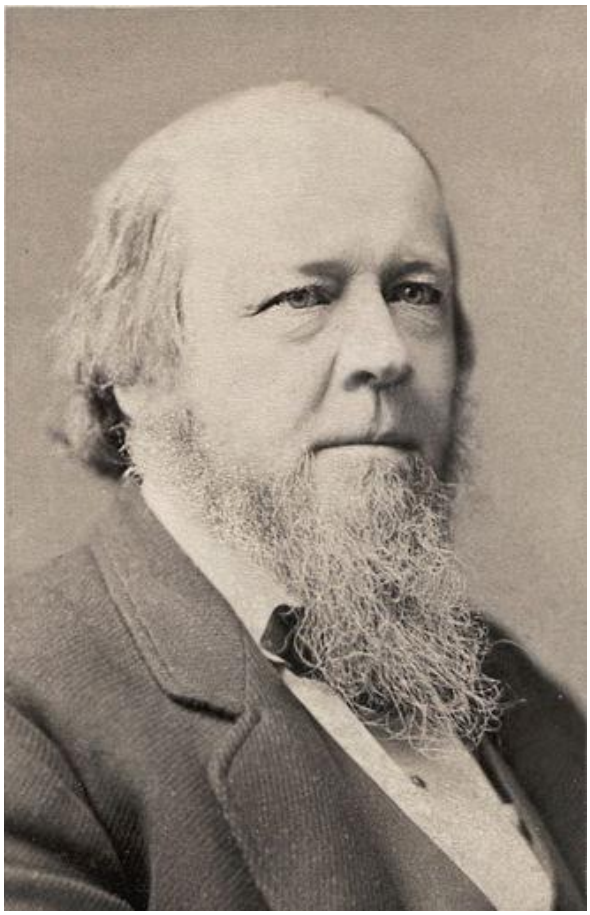


Figure 2.3 Benjamin Silliman, Jr., Professor of Chemistry, Yale University

Silliman's educational career is largely associated with Yale University. He received both his B.A. (1837) and M.A. (1840) degrees in Chemistry from there and became a Professor as well (1846). In 1847 he became a Professor in the School of Applied Chemistry, and in 1861 this became the Sheffield Scientific School. Silliman, Jr., was a dedicated teacher and produced two classic books: *First Principles of Chemistry for the Use of Colleges and Schools (1846)* and *First Principles of Physics or Natural Philosophy Designed for the Use of Schools and Colleges (1859).* And he was a founding member of the United States National Academy of Sciences (1863).

In the present context, Benjamin Silliman, Jr.'s, most important contributions are associated with his editorship of *The American Journal of Science and Arts (1838-1885)* and his contributions to *The American Chemist (1870-1877).* He was elected to present a speech at the 1874 Northumberland Centennial of Joseph Priestley's discovery of oxygen on "American Contributions to Chemistry." This speech grew into a very long article in *The American Chemist* (Volume 5, 1874/5, 70ff). It was reprinted as a single essay in 1874 in Philadelphia. The article is still the best source for a good understanding of the contributions of America to Chemistry from 1776-1876. A detailed discussion of this paper is contained in Chapter 3.

rected by the skill and ingenuity of able chemists. In this particular instance we are indebted to M. St. Clair Deville, than whom there is no more ingenious chemist in working out difficult problems in the metallurgy of the rarer metals.

The production of these metals in quantity has given new agents to the arts, and sodium amalgam is now well known in metallurgic operations on gold. Aluminium and aluminium bronze have found their use for many valuable purposes, and magnesium is much valued for signal and rocket purposes.

Medicines.

But of all the benefits derived from the growth of mere laboratory processes into grand manufactural operations, none can claim more than the art of medicine, for she has received her full share, as we all well know, and as is every day shown by the operation upon cargoes of Peruvian bark to extract that valuable medicine quinine, and the elimination of thousands of pounds of morphine from opium; and, still more recently, the unfolding of the hidden treasures of the chemist has brought to light chloroform and chloral, the earlier specimens of which he valued as gold or silver, while now they are thrown upon commerce by thousands of pounds, alleviating an untold amount of suffering; and these great blessings are afforded mankind as a free-will offering of the skill and industry of the chemist, for he invokes no patent laws to make money from these precious gifts of God, whose high priest he is in one sense, having been favored by the divine dispenser of all good to make known these things to man.

The review just given of the chemical industry of the past hundred years, is but a notice of the salient points in connection with its history and progress. No mention is made of the art in connection with the working of iron, copper, and other metals, for that now takes rank almost as an independent art, called metallurgy, but it is none the less chemical in its character, and, as chemistry progresses, so will this art. The same may be said in regard to glass-making, photography, electrotyping and gilding, and numerous other arts which must have presented themselves to your minds during this discourse.

But I must not detain you longer, and shall conclude by congratulating you that we are living in an age in which an industry requires but a few years for its creation or development.

"In our days a useful discovery is scarcely made, or a happy application of one found out, before it is published, described in the scientific journals, or other technical periodicals, and especially in the specifications of patents. It then becomes the starting-point of a thousand researches and new experiments, entered into by the philosopher in the hope of advancing scientific progress, and by the manufacturer with the expectation of reaping a material benefit. From these multiplied and diverse efforts—these incessant labors of an army of workers—arises an industry which has no sooner sprung into existence than it becomes important and prosperous."

So then let us, American chemists, bend all our energies to do full share of this work. Up to the present epoch our short existence as a nation, and some other causes, have forced us to be the recipients of the numerous discoveries of our European co-laborers without an adequate return on our part; but there will be no such excuse for the future if we do not stand side by side with them in the developments of industrial chemistry.

AMERICAN CONTRIBUTIONS TO CHEMISTRY.*

BY BENJAMIN SILLIMAN,

Of Yale College.

ADDRESS.

Introduction.—The history of modern chemistry, commencing with Priestley's immortal discovery of oxygen, or dephlogisticated air as he called it, on the 1st of August, 1774, by a memorable coincidence is almost identical in date with the evolution of the United States of America out of their colonial pupilage by the declaration of their independence of the mother country. The emancipation of our science from the dominion of phlogiston, with its seductive but false philosophy, may be likened to the overthrow of aristocratic traditions, and monarchical supremacy, under which our ancestors were held, and the building up of the American system of self-government in their place. We note with satisfaction that the scientific revolution was a little in advance of the political revolution; and it would not be a difficult task to show, were it pertinent to our present purpose to do so, how closely and logically the rapid march of human society, the world over, during the century whose close we celebrate to-day, has kept pace with and waited upon the advance of the pioneers of scientific discovery. How Franklin and Black, Rumford and Cavendish, Priestley and Lavoisier, Galvani and Volta, Scheele and Berzelius, Dalton and Davy, Ampère and Faraday, Hare and Henry, Oersted and the Herschels, Liebig, Agassiz, and a multitude more of the noble army of martyrs to science, who have devoted their lives to the search for truth for the truth's sake, have, by the discovery and elucidation of principles before unknown or but dimly discerned, opened the way for the yet greater army of inventors and projectors, who have followed in their lead; with steam engines, railways, steamships, mechanical spinning and weaving, voltaic casting of metals, bleaching and other chemical arts without number, electric telegraphs, illumination by gas, photography, improved agriculture, artificial heat and artificial cold; using and applying in endless forms for human advancement, the public wealth, and private enjoyment the labors of those who have toiled to reveal the hidden truths of God in nature, too often unrequited for their self-sacrificing devotion in the good things of this world, but content to work that others might enter into their labors.

* In attempting to comply with the invitation of the committee in charge of the Chemical Centennial at Northumberland, to prepare an "Essay upon American Contributions to Chemistry" as an address to be delivered on that occasion, I found the "Essay" insensibly and almost unavoidably assuming the historical form, and taking a wider range than may seem consistent with a strict rendering of its title. But such as it became it is now presented as a slight contribution toward a more elaborate historical discourse which yet remains to be prepared. B. S.

Figure 2.4

2.3 J. Lawrence Smith (1818-1883)

Another very active historian of the American chemical sciences in the late 19th century was John Lawrence Smith. He was especially interested in the history of American industrial chemistry.

Figure 2.5 John Lawrence Smith

J. Lawrence Smith showed an early interest in mathematics and chemistry. He attended the University of Virginia when he was yet sixteen years of age and followed a course of study in Civil Engineering. He entered the Medical College of South Carolina in 1838 and received his M.D. in 1840. He presented a thesis on the "Compound Nature of Nitrogen." But, he had already been active as an analytical chemist in Charleston, South Carolina and published two papers in the American Journal of Science and the Arts in 1839.

Dr. Smith then spent many years in Europe, mostly in Paris and in Giessen. He studied with the best scientists, such as Dumas and Liebig. He became a lifelong disciple of Liebig. He was the most learned American analytical chemist of the 19th century. His National Academy of Sciences biography was written by Benjamin Silliman, Jr., a life-long friend and correspondent. A compilation of his

more than 100 scientific papers was published in 1884 by Joseph Benson of Louisville, Kentucky. The first such compilation was published in 1873 as *Mineralogy and Chemistry: Original researches by Prof. J. Lawrence Smith.* My own copy was presented to Benjamin Silliman, Jr.

Professor Smith was associated with the University of Louisville, which was founded by his father-in-law, James Guthrie (1792-1869). He served there from 1854-1866. But, his heart was more in research and travel. His thoughts turned to the history of chemistry and he met many of the leading figures in mid-19th century chemistry. He was also elected to many foreign academies of science. This led to being elected as President of the American Association for the Advancement of Science in 1872. His Presidential address to the 1873 Portland, Oregon national meeting of the AAAS is still in print. It is also still worth reading. He envisioned a day when University professors would be little more than educational drudges weighted down by a heavy teaching load and administrative duties.

At the 1874 Northumberland meeting mentioned above, J. Lawrence Smith gave the lecture on "The Century's Progress in Industrial Chemistry." He set the stage for "modern chemical industry" from the age of Paracelsus, when a scientific challenge was issued to the medical community. He valued chemical medicine with its almost innumerable pharmaceuticals. Chemistry impacted almost all the industrial enterprises of the late 19th century. Smith reminded his auditors that chemical industry provided large sums that could be used to further the science of chemistry. In honor of Priestley, he discussed the industrial chemistry of oxygen first. In this era, pure oxygen was produced primarily by heating chlorate of potash. He also cited the discovery of ozone. He cited the oxy-hydrogen torch as an important industrial tool, allowing the production of platinum on an industrial scale. He went on to discuss the industrial production of chlorine. He discussed bleaching powder (chloride of lime)(calcium hypochlorite), and the manufacturing of Smithson Tennent (1761-1815). He reminded his audience that chlorine bleaching of cotton was what made it such an important substance. While sulfuric acid had been known for centuries, the 18th century saw the invention of the lead vessel method for burning the sulfur. The 19th century monopoly of Italian sulfur led to the development of a method based on the ubiquitous iron pyrites. And, for copper containing pyrites, like chalcopyrite, the process yielded pure copper as a

"byproduct!" Another use for sulfur was in the production of bisulphide of carbon (CS_2). It was employed in the vulcanization of rubber as a solvent. It was also used as an industrial solvent for many fats, oils and fragrances.

While many of the advances in industrial chemistry in the period 1774-1874 were achieved in France and England, Smith also featured American contributions to this area. R.A. Tilghmann of Philadelphia developed a process to saponify fats by heating them with water at high pressure. The glycerine produced in this process is highly useful.

J. Lawrence Smith represented the "full picture" of an American chemist: He had an earned M.D; He had studied in Europe; He appreciated both exploratory and industrial chemistry; and he saw the usefulness of chemistry to pharmacy. He knew the history of all these areas and moved in a very wide circle of world chemists.

2.4 John W. Draper (1811-1882)

John W. Draper was the first President of the American Chemical Society. His biography is also quite interesting.

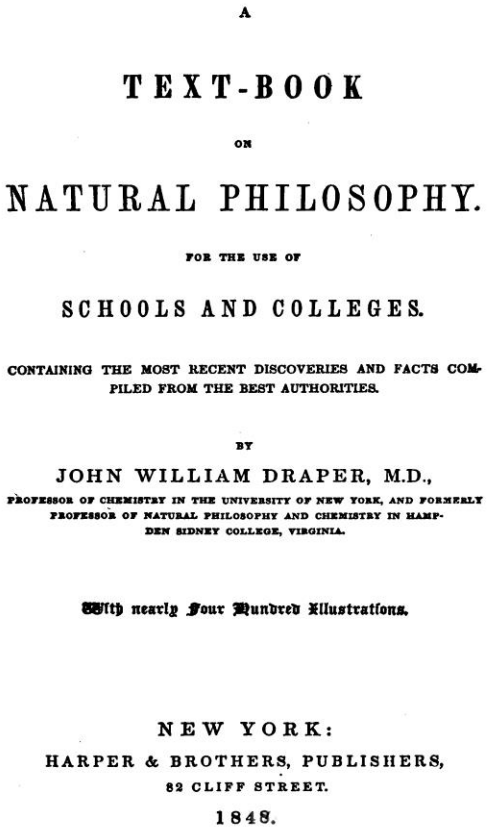
Figure 2.7 John W. Draper

John William Draper was born in England in 1811. He was educated at home for his early instruction, since his father was well qualified to do so. His grammar school was headed by an American. Draper succeeded brilliantly and delivered the valedictory address for his school; the first of many famous speeches. In 1829 Draper entered the University of London and studied chemistry under Edward Turner (1796-1837). After the death of his father in 1832, he immigrated to America with his mother and sister and joined a Wesleyan colony in Virginia. He immediately commenced his career in chemistry and his first paper in the American Journal of Science and Arts appeared in July, 1834.

In 1835 he moved to Philadelphia to attend the University of Pennsylvania. Philadelphia was the leading center for chemistry in America during this time period with notables like Robert Hare (1781-1858) and J.K. Mitchell (1798-1858). Draper received his M.D. in 1836 with a thesis on "Glandular Action." It was soon published in the Journal of the Franklin Institute.

In 1839 Draper was elected Professor of Chemistry at the newly founded University of the City of New York. He became President of the Medical School in 1850. His medical specialty was physiology and he was the American leader in this rapidly developing field.

But, with all his achievements in pure chemistry and medicine, he is best known for his work in Natural Philosophy and History. (Fig. 2.8) One of his pronouncements was: "A true theory is like a window of crystal glass, through which we can see all the objects in their proper positions and colors and relations, no matter whether they are such as are near or those that are at a distance; no matter whether they are directly before us or enter only obliquely into the field of view. A fictitious theory is like a Venetian blind, which has to be set in a certain position with respect to the observer and only shows him objects for which it has been adjusted, and those in an unsatisfactory manner; but if he moves to one side or the other, or endeavors to see objects which are not directly in his way, his view is intercepted, or, perhaps, unless he makes a new adjustment, the light is shut out altogether!"



A

TEXT-BOOK

ON

NATURAL PHILOSOPHY.

FOR THE USE OF

SCHOOLS AND COLLEGES.

CONTAINING THE MOST RECENT DISCOVERIES AND FACTS COMPILED FROM THE BEST AUTHORITIES.

BY

JOHN WILLIAM DRAPER, M.D.,

PROFESSOR OF CHEMISTRY IN THE UNIVERSITY OF NEW YORK, AND FORMERLY PROFESSOR OF NATURAL PHILOSOPHY AND CHEMISTRY IN HAMPDEN SIDNEY COLLEGE, VIRGINIA.

With nearly Four Hundred Illustrations.

NEW YORK:
HARPER & BROTHERS, PUBLISHERS,
82 CLIFF STREET.
1848.

Figure 2.8 *A Textbook on Natural Philosophy* (1848)

John Draper was one of the fathers of photochemistry. He was able to envision many "forms of energy" and focused on what he could prove was true. He collaborated with the United States mint to produce one of the first diffraction gratings in America. It led to dozens of brilliant experiments.

Draper's first great contribution to world culture was *A History of the Intellectual Development of Europe* (1863). It was rapidly published in many languages and in many countries. A favorable review: "It is one of the not least remarkable achievements in the progress of positive philosophy that has yet been made in the English tongue – a noble and even magnificent attempt to frame an induction of all the recorded phenomena of European, Asiatic and North African history." In 1864 Draper was invited by the Historical Society of New York to present a series of

lectures that were published as *Thoughts on the Future Civil Policy of America*. He went on to publish a monumental history of the American Civil War.

One of Draper's most famous lectures was given at his elevation to the Presidency of the newly founded American Chemical Society in 1876. He reviews the progress in America of organizing societies and other formal vehicles for the prosecution of science: The American Philosophical Society of Philadelphia, The Smithsonian Institution, The American Journal of Science (Silliman's Journal), The Sheffield Scientific School at Yale, The Lawrence Scientific School at Harvard, and The American Association for the Advancement of Science. He encouraged all colleges to teach real science, especially chemistry. But, he reminded the chemists, that the existence of industrial chemistry provided the means to pursue the mysteries of material reality independent of both governments and universities. Draper emphasized that chemistry was the same throughout the universe and that spectroscopy had made it possible to study the material nature of the stars, including our sun. He was a medical doctor and encouraged the chemists to consider the physiology of the brain, not just the stomach. Most of all, he challenged the assembled chemists to be courageous and to march forward in their search for Truth.

As prolific as John Draper was during his lifetime, many manuscripts were unfinished at the time of his death. One of the most important was a biography of Benjamin Franklin. This document has been carefully edited by Ronald Wilkinson and presented by the Library of Congress as a gift to all Americans.

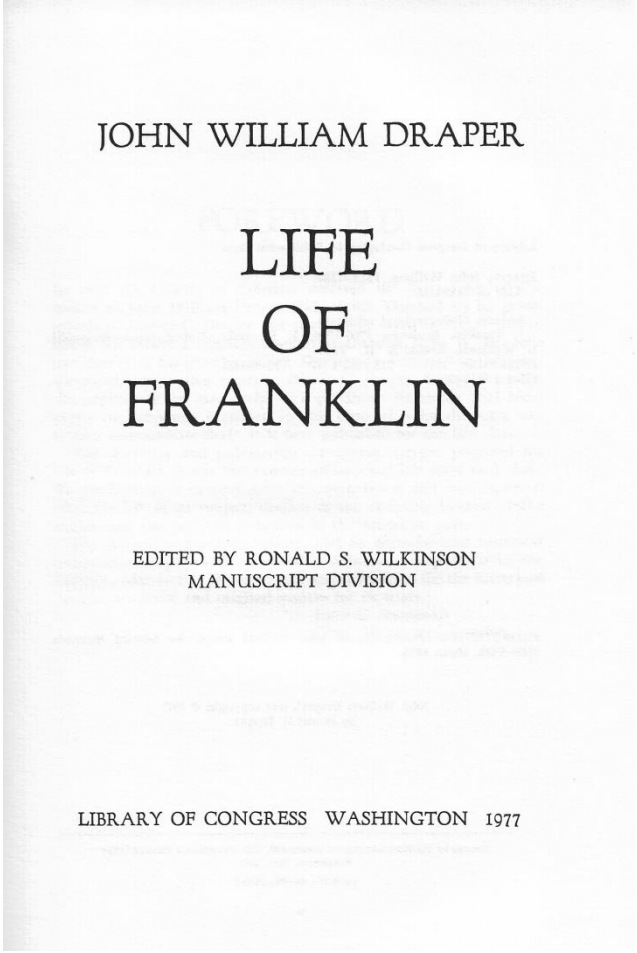


Figure 2.9 ***Life of Franklin*** (1977)

2.5 George F. Barker (1835-1910)

George Barker was the author of the National Academy of Sciences biography of John Draper. He served as ACS President in 1891.

Figure 2.10 George F. Barker

George Barker was a master of both physics and chemistry. He received a Bachelor of Philosophy degree from Yale in 1858. He obtained his M.D. from Albany Medical College in 1863 and became Professor of Physiological Chemistry and Toxicology in the Yale Medical School in 1867. He moved to the University of Pennsylvania as Professor of Physics in 1872.

In addition to his outstanding work in experimental science, Barker was always interested in the history of a subject and delivered a famous lecture, "Electrical Progress since 1743," to the American Philosophical Society in 1893. He was also interested in other scientists and wrote National Academy of Sciences Memoirs for

Frederick Augustus Genth, Henry Draper, John William Draper and M. Carey Lea. George Barker was elected to the National Academy of Sciences in 1876. His own Memoir was written by Edgar Fahs Smith, who will be discussed in Chapter 5.

George F. Barker was the first Physics Professor elected as President of the American Chemical Society in 1891. He believed in the unity of Natural Science and made major contributions to many areas. His chemistry text was first published in 1866 and remained in print well into the 20th century! He was President of the American Association for the Advancement of Science and addressed subjects such as "The Molecule and the Atom" and "Modern Aspects of the Life Question." One of his most famous lectures was his ACS Presidential lecture: "The Borderland between Physics and Chemistry." He employed all the known aspects of atoms and molecules to create a unified classical theory of chemistry. This work is still worth reading and takes into account the full history of chemistry in the 19th century.

2.6 Reflections

During the first 25 years of the American Chemical Society, many chemists both knew and employed the full power of Natural Philosophy in their practice of chemistry. They both knew and employed the history of chemistry, physics, biology and medicine in their daily thoughts. These five men are a reminder of what good American chemistry looked like in the 19th century.