MEMOIR

OF

JOSIAH PARSONS COOKE.

1827-1894.

BY

CHARLES L. JACKSON.

PREPARED FOR THE NATIONAL ACADEMY.

BIOGRAPHICAL MEMOIR OF JOSIAH PARSONS COOKE.

JOSIAH PARSONS COOKE, the son of Josiah Parsons Cooke, a successful lawyer, and Mary (Pratt) Cooke, was born in Boston October 12, 1827. He was educated at the Boston Latin School and Harvard College, from which he graduated in 1848, and after a year of travel in Europe was appointed tutor in mathematics in Harvard College in 1849. In 1850 he became Erving Professor of Chemistry and Mineralogy, a position which he held for the remainder of his life.

Cooke's equipment for the duties of his new place was almost entirely the result of his own exertions. A course of lectures by the elder Silliman first aroused his enthusiasm for chemistry and led him in early boyhood to fit up a laboratory in his father's house, where he attacked the science by experiment with such good results that even when he came to college he had a working knowledge of the subject. At Cambridge he continued these studies essentially alone, as the chemical teaching of the college during his four years of residence was confined to five or six rather disjointed and fragmentary lectures. Immediately after appointment to his professorship he supplemented these meager preparations by obtaining a leave of absence for eight months, which were spent in Europe buying apparatus and material and attending lectures by Regnault and Dumas. These formed the only instruction in chemistry he had received which could even claim to be systematic; yet with this slender outfit, aided by barely a year and a half of experience as a teacher, in 1851, at the age of 24, he found himself confronted with problems which would have taxed the abilities of an old, experienced, and fully educated professor. Chemical teaching in Harvard College had become extinct and must be reëstablished. The college was wedded to methods of teaching excellent for classics and mathematics, but entirely unfit for a subject like chemistry. These must be replaced by better methods, many of which were still to be invented. Finally he was called upon to take a prominent

share in the great battle to introduce science into the college course on an equality with the humanities.

The zeal with which he threw himself into these tasks led to substantial results much more quickly than could have been expected. After only seven years he had succeeded in introducing required courses of chemistry into the sophomore and junior years. These, however, were only lecture and text-book courses; so that really a much more important advance consisted in the fact that he had also induced the Faculty of the College to accept an elective course in qualitative analysis, to be taught in the laboratory by the experimental method. It is noteworthy that from the very beginning of his career Cooke was an ardent adherent of the laboratory method of teaching chemistry invented not many years earlier by Liebig. This seems at first sight a strange breadth of view in a self-taught chemist, but, as he was fond of saying, the fact that he had taught himself chemistry by his own experiments showed him the value of this method for other students. But this was not all; a large building, Boylston Hall, had been built for the use of chemistry and comparative anatomy with money a large part of which had been raised by his exertions.

After this brilliant beginning the progress was continuous, until at the time of his death there were sixteen courses in chemistry and mineralogy, chosen by three hundred and fifteen students and taught by three professors, three instructors, and eight assistants. Boylston Hall was devoted exclusively to chemistry, and the Mineralogical Department was established in a section of the University Museum, also built through his exertions, where was exhibited the rich mineralogical collection created by him.

Cooke's scientific activity began even during his first struggles for the recognition of chemistry by the college, as in 1854 he published a paper on the numerical relation of the atomic weights, in which the periodic system of classification was foreshadowed, vaguely and imperfectly, it is true, but as fully as could be expected at that early day. In the same year his first large experimental research appeared, "On the alloys of zinc and antimony." Some small papers on spectroscopic, crystallographic, and analytical subjects bring us to his striking discovery of danalite and other new minerals from Rockport in 1866, and an extended research,

both analytical and crystallographic, on the vermiculites and chlorites a few years later.

In 1873 he published the first of his most important series of researches, those on atomic weights, beginning with the vexed question in regard to that of antimony. From the first he saw that the great danger in such researches lies not in the accidental, but in the constant errors, and throughout he devoted himself to the study of these constant errors with the utmost patience, perseverance, and sagacity, and a skill in manipulation little short of marvelous, when it is remembered that his only instruction in this art had been derived from his assistants, who had studied in foreign laboratories, and also that a muscular affection rendered his hand so tremulous that it seemed at first sight impossible he could do chemical work of any sort. The result was a series of papers in which he established the atomic weight of antimony to the satisfaction of the whole chemical world. In connection with this work he made a careful study of some of the compounds of antimony with the halogens, in which, by the use of crystallographic methods, he succeeded in giving a probable explanation of the dimorphism of antimonious iodide.

The last of these researches was a careful redetermination of the relation between the atomic weights of oxygen and hydrogen. To this fundamental investigation he brought the same qualities which had helped him to his success with antimony. The experimental difficulties were even greater, but one by one they were overcome, and he was able to publish sixteen successive determinations showing a wonderfully close agreement, but, as Lord Rayleigh almost immediately pointed out, these results contained one of his old enemies, a constant error, due to the contraction of the glass globes when exhausted in order to weigh them empty. Cooke's last paper contained an ingenious method for avoiding this error by determining the tare of the globes without exhausting them.

His achievements in education and research did not, however, exhaust his tireless activity. He was a voluminous writer. In addition to the forty-one papers on his researches, he published thirty-two on other subjects, generally relating to chemistry, and eight books, ranging from such widely used text-books as the

Chemical Philosophy and New Chemistry to works on the relation of religion and science, and an interesting volume of essays.

He was also a brilliant and instructive popular lecturer, and has enriched our stock of lecture apparatus with many excellent contrivances, notably his arrangement for the projection of spectra, his form of the lecture-table eudiometer, and the vertical lantern.

His varied achievements obtained frequent recognition. In 1872 he was elected a member of the National Academy of Sciences, and almost at the beginning of his career he became a fellow of the American Academy of Arts and Sciences, of which he was successively librarian, corresponding secretary, and president. He was also a member of the Royal Institution and an honorary member of the London Chemical Society. In 1877 he was made an associate editor of the American Journal of Science. In 1882 he received the honorary degree of Doctor of Laws from the University of Cambridge, in England, and in 1889 from Harvard University.

In 1860 he married Mary Hinckley Huntington, of Lowell, who survives him. His death occurred in Newport, September 3, 1894.

I cannot sum up his character better than by quoting the words of his colleague, Professor H. B. Hill: "As an investigator, Professor Cooke was clear in thought, persevering amid difficulties, fertile in expedients, impatient of dogma, and to the end he retained the keen curiosity and enthusiasm of his earlier days."

A LIST OF THE MORE IMPORTANT PUBLICATIONS OF JOSIAH PARSONS COOKE.

Books.

1857. Chemical Problems and Reactions.
1860. Elements of Chemical Physics. New editions in 1866 and 1877.
1864. Religion and Chemistry, or Proofs of God's Plan in the Atmosphere and its Elements. New edition in 1880.
1868. Principles of Chemical Philosophy. New editions in 1870, 1875, and revised edition in 1881.
1874. The New Chemistry. New editions in 1876, 1877, 1884, and 1888. Also translations in many languages.
1881. Scientific Culture and Other Essays.

1888. The Credentials of Science the Warrant of Faith. New edition in 1893.

1891. Laboratory Practice. A Series of Experiments on the Fundamental Principles of Chemistry.

*Papers on His Original Investigations.**

1852. Description of a Crystal of Rhombic Arsenic. *Proc. Am. Acad.*, iii, 86.

1852. Octahedral Crystals of Arsenic. *Proc. Am. Acad.*, iii, 204.

1854. The Relation between the Atomic Weights. *Mem. Am. Acad.*, new series, v; *Am. Jour. Sci.* (2), xvii, 387.

1854. On Two New Crystalline Compounds of Zinc and Antimony. *Am. Jour. Sci.* (2), xviii, 229.

1854. On a New Filtering Apparatus. *Am. Jour. Sci.* (2), xviii, 127.

1855. On the Law of Definite Proportions in the Compounds of Zinc and Antimony. *Am. Jour. Sci.* (2), xx, 222.

1860. Crystalline Form not Necessarily an Indication of Definite Chemical Composition. *Am. Jour. Sci.* (2), xxx, 194; *Phil. Mag.*, xix, 405.

1861. On the Dimorphism of Arsenic, Antimony, and Zinc. *Am. Jour. Sci.* (2), xxxi, 191.

1862. On the Spectroscope. *Am. Jour. Sci.* (2), xxxiv, 299.

1863. On the Cleavage of Galena. *Am. Jour. Sci.* (2), xxxv, 126.

1863. An Improved Spectroscope. *Am. Jour. Sci.* (2), xxxvi, 266.

1863. Crystallographic Examination of Childrenite. *Am. Jour. Sci.* (2), xxxvi, 257.

1864. Crystallographic Examination of the Acid Tartrates of Caesia and Rubidia. *Am. Jour. Sci.* (2), xxxvii, 70.

1865. On a Spectroscope with Many Prisms. *Am. Jour. Sci.* (2), xl, 305.

1865. On the Projection of the Spectra of the Metals. *Am. Jour. Sci.* (2), xl, 243.

1866. On the Aqueous Lines of the Solar Spectrum. *Am. Jour. Sci.* (2), xli, 17.

1866. Separation of Iron and Alumina. *Am. Jour. Sci.* (2), xlii, 78.

1866. Analysis of Danalite of Rockport. *Am. Jour. Sci.* (2), xlii, 73.

1867. On Cryophyllite. *Am. Jour. Sci.* (2), xliii, 217.

1867. On Certain Lecture Experiments. *Am. Jour. Sci.* (2), xliv, 189.

1867. Crystallographic Examination of Some American Chlorites. *Am. Jour. Sci.* (2), xliv, 201.

1867. A Method of Determining the Protoxide of Iron in Silicates not Soluble in the Ordinary Mineral Acids. *Am. Jour. Sci.* (2), xliv, 347.

1869. Atomic Ratio. *Am. Jour. Sci.* (2), xlvii, 386.

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* Prepared by T. W. Richards.

1874. The Vermiculites. *Proc. Am. Acad.*, ix, 35.
1875. Melanosiderite. *Proc. Am. Acad.*, x, 451.
1875. On Two New Varieties of Vermiculites. With F. A. Gooch. *Proc. Am. Acad.*, x, 453.
1876. On a New Mode of Manipulating Hydric Sulphide. *Proc. Am. Acad.*, xii, 113.
1876. On the Process of Reverse Filtering. *Proc. Am. Acad.*, xii, 124.
1877. Revision of the Atomic Weights of Antimony. *Proc. Am. Acad.*, xiii, 1.
1877. Re-examination of Some of the Haloid Compounds of Antimony. *Proc. Am. Acad.*, xiii, 72.
1879. The Atomic Weight of Antimony. *Proc. Am. Acad.*, xv, 251.
1880. On Argento antimonious Tartrate. *Proc. Am. Acad.*, xix, 393.
1880. On the Oxidation of Hydrochloric Acid Solutions of Antimony in the Atmosphere. *Am. Jour. Sci.* (3), xix, 464,
1881. On the Solubility of Chloride of Silver in Water. *Am. Jour. Sci.* (3), xxi, 220.
1881. Additional Experiments on the Atomic Weight of Antimony. *Proc. Am. Acad.*, xvii, 1.
1881. The Boiling Point of Iodide of Antimony and a New Form of Air Thermometer. *Proc. Am. Acad.*, xvii, 22.
1883. A Simple Method for Correcting the Weight of a Body for the Buoyancy of the Atmosphere when the Volume is Unknown. *Am. Jour. Sci.* (3), xxvi, 38.
1883. Possible Variability of the Law of Definite Proportions. *Am. Jour. Sci.* (3), xxvi, 310.
1887. The Relative Values of the Atomic Weights of Oxygen and Hydrogen. With T. W. Richards. *Proc. Am. Acad.*, xxiii, 149.
1888. Additional Note on the Relative Values of the Atomic Weights of Oxygen and Hydrogen. With T. W. Richards. *Proc. Am. Acad.*, xxiii, 182.
1889. On a New Method of Determining Gas Densities. *Proc. Am. Acad.*, xxiv, 202.

Papers on Other Subjects.

1862. Review of Trollope's North America. *North Am. Review*, xcv, 416.
1865. On the Heat of Friction. *Proc. Am. Acad.*, vi.
1871. Memoir of Thomas Graham. *Am. Jour. Sci.*
1871. Absolute System of Electrical Measurements. Collected Papers from *Journal of Franklin Institute.*
1874. The Nobility of Knowledge. An Address Delivered before the Free Institute of Worcester. *Pop. Sci. Month.*, v, 610.
1875. Scientific Culture. *Pop. Sci. Month.*, vii, 511.
1875. "Gas." *Johnson's Cyclopædia.*
1875. "Molecules." *American Cyclopædia.*

1877. Chemical and Physical Researches by Thomas Graham. *Am. Jour. Sci.* (2), xiv, 152.
1878. The Radiometer: a Fresh Evidence of a Molecular Universe. *Pop. Sci. Month.*, xiii, 1. Also *Am. Jour. Sci.* (3), xiv, 231.
1878. Chemical Philosophy. *Am. Jour. Sci.* (3), xv, 211.
1880. In Memoriam Josiah Parsons Cooke.
1880. Notice of Berthelot's Thermo-Chemistry. *Am. Jour. Sci.* (3), xix, 261.
1881. Memoir of William Hallowes Miller. *Proc. Am. Acad.*, xvi, 461.
1881. Notice of the Investigation of Dr. J. W. Brühl on the Relations between Molecular Structure of Organic Compounds and their Refractive Power. *Am. Jour. Sci.* (3), xxi, 70.
1881. Notice of Julius Thomsen's Thermo-chemical Investigation of the Molecular Structure of Hydrocarbon Compounds. *Am. Jour. Sci.* (3), xxi, 88.
1883. The Greek Question. *Pop. Sci. Month.*, xxiv, 1.
1883. Memoir of John Bacon. *Proc. Am. Acad.*, xviii, 419.
1883. Memoir of William Barton Rogers. *Ibidem*, 428.
1884. Memoir of J. B. A. Dumas. *Proc. Am. Acad.*, xix, 545.
1884. Memoir of C. A. Wurtz. *Ibidem*, 568.
1884. Further Remarks on the Greek Question. *Pop. Sci. Month.*
1885. Memoir of Benjamin Silliman. *Proc. Am. Acad.*, xx, 523.
1886. Descriptive List of Experiments for Use in Chemistry B.
1886. The New Requisitions for Admission at Harvard College. *Pop. Sci. Month.*, xxx, 195.
1889. The Chemical Elements. History of the Conception which this Term Involves. *Pop. Sci. Month.*, xxxiv, 733.
1889. Address at the Commencement Dinner.
1889. Concluding Address to the Freshman Class of Harvard College.
1890. Report of the Director of the Chemical Laboratory of Harvard College. Presented to the Visiting Committee of the Overseers.
1890. A Plea for Liberal Culture.
1892. The Value and Limitations of Laboratory Practice in a Scheme of Liberal Education.
1892. Memoir of Joseph Lovering. *Proc. Am. Acad.*, xxvii, 372.

Also many Reviews and Reports, including Annual Reports as Director of the Chemical Laboratory during many years.