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BIOGRAPHICAL MEMOIR ALEXANDER SMITH

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BY

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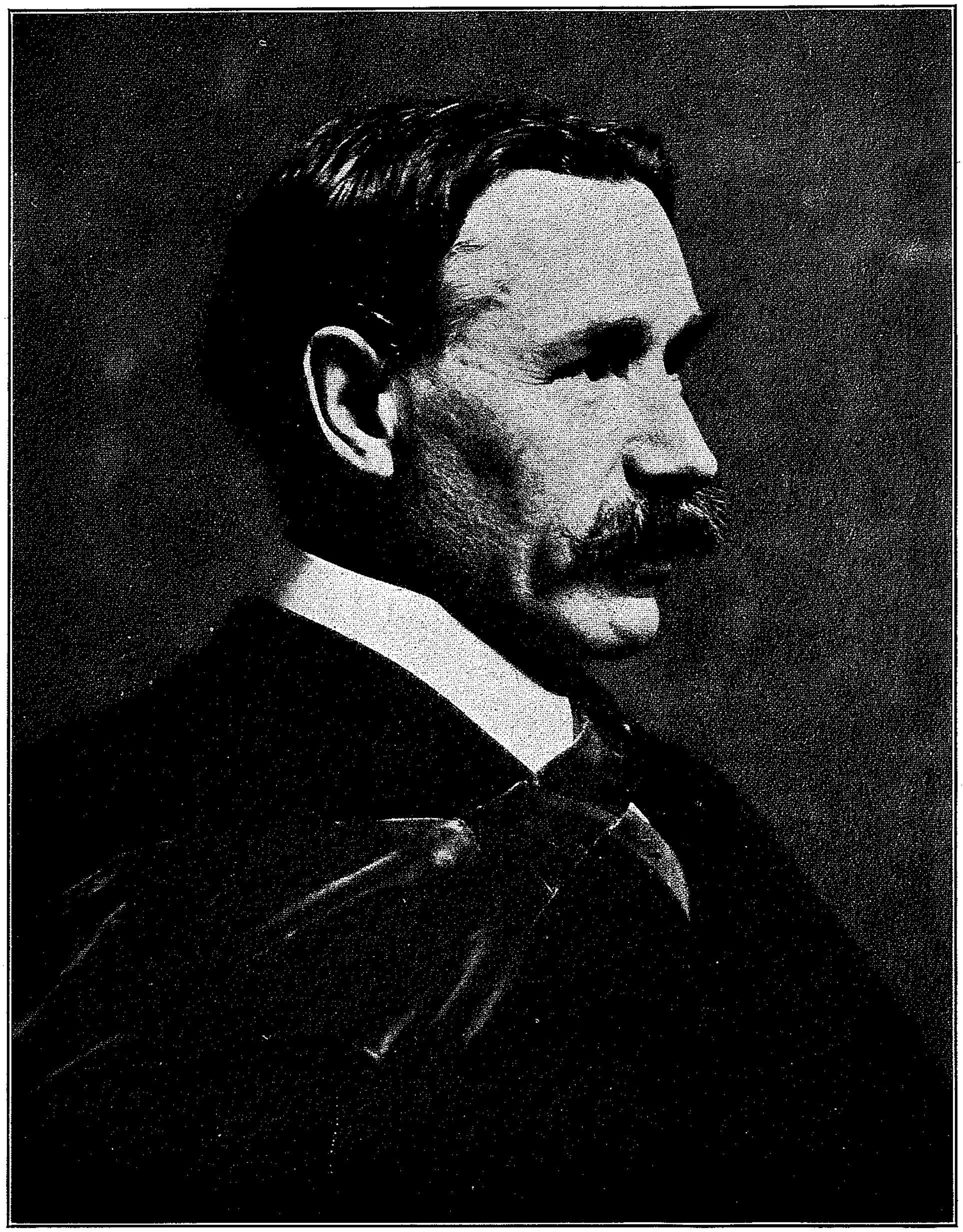

Alexander Smith

ALEXANDER SMITH

By William A. Noyes

Alexander Smith was born at No. 4 Nelson Street, Edinburgh, Scotland, on September 11, 1865. His grandfather, Alexander Smith, was a sculptor. His father, also Alexander Smith, studied modeling in clay in the school of art in Edinburgh and was awarded a first prize for his work. He also studied music and became a musician and a teacher of singing. At least one very noted American chemist is the son of an artist, and in his ancestry and in that of Alexander Smith we may find strong evidence that the spirit of science is very closely akin to the spirit of art. His uncle, John Smith, was interested in paintings, and his aunt, Mary Smith, in church work. His paternal grandmother's maiden name was Jane Stewart.

His mother, Isabella Carter Smith, was the daughter of Andrew Carter. Her sister married John Bryce. They had nine children, of whom five were sons, all of whom engaged in business. One is a farmer in Dakota, another is in Australia.

He has one sister, Isabella Carter Smith, now Mrs. James Rae, of Edinburgh.

Alexander Smith married Sara Bowles, of Memphis, Tenn., February 16, 1905. Her grandfather was born in Kentucky and was one of the earliest settlers of Memphis. Her father, William Bowles, succeeded his father as head of the oldest firm of cotton buyers in Memphis. Her father entered the Confederate Army at the age of 16 and was a member of Forest's Cavalry. He was a celebrated shot and was a sharpshooter in the army. His mother was a Montague of Virginia. Mrs. Smith's maternal grandfather was Henry Potter, brother of Martin Potter, who founded the Cincinnati Enquirer. She has one brother, Potter Bowles, of Santa Ana, Calif.

There are two children, Isabella Carter Smith, born February 8, 1909, and William Bowles Smith, born October 27, 1910. Isabella is interested in literature, William in art. They are now attending schools in England.

Prof. George E. Fellows, now professor of history in the University of Utah, was one of the English and American group of students in Munich in 1889, living there at the time with his wife and small daughter. After Doctor Smith and Doctor Fellows had taken their degrees the latter spent several months with the family of Doctor Smith in Edinburgh and at Dunblane. In the summer of 1890 Doctor Smith visited Professor and Mrs. Fellows at Aurora, Ill. After he went to Chicago he lived for five years in their family, before his marriage. I am indebted to Professor Fellows for the following anecdote:

Alexander Smith showed very early an unusual interest in scientific research. It is well known and related by the members of his family that when he was between 3 and 4 years of age he became much interested in a bird that he saw. He turned the pages of an encyclopedia until he found the picture of this particular bird, then carried the book to members of the family and demanded that the story of the bird should be read. Not getting all that he desired, he continued to drag the heavy book about with him for several days until compelled to desist.

At the age of 10 he entered the Edinburgh Collegiate School. The principal was Archibald Hamilton Bryce, a brother of Lord Bryce, the British ambassador to the United States. The school report for 1879–80 shows that his work in Latin and Greek was poor, but that he was proficient in mathematics, French, bookkeeping, and shorthand.

He entered the University of Edinburgh as a candidate for the degree of B. Sc. in chemistry in 1882 and graduated in 1886. For some time before entering the university and while attending there he studied astronomy more than chemistry. He found, however, that there was no opportunity in Great Britain to earn a salary which would sustain life if he continued in that field. Accordingly, after graduation at Edinburgh he went to study chemistry in the laboratory of Baeyer at Munich. At that time a very large majority of the chemists of the world were working in the field of organic chemistry, and while Alexander Smith secured at Edinburgh and at Munich very thorough training in inorganic and analyticical chemistry—physical chemistry was only just beginning to be noticed as a separate field—he gave especial attention to organic chemistry and carried out a piece of work on 1, 3-diketones under the guidance of Ludwig Claisen, one of the brilliant group working in Baeyer's laboratory at that time. The work contributed toward the solution of some of the problems concerning tautomerism and condensations of the acetoacetic ester type, which were then engaging the attention of Claisen and other chemists.

After securing his degree Doctor Smith returned to Edinburgh and spent another year at the university as an assistant in charge of qualitative analysis. He also gave a course on organic syntheses. As promotion seemed likely to be very slow in Scotland or England, he visited America during the summer of 1890, hoping for an appointment. I had made his acquaintance in Munich in 1889. By one of those happy coincidences which sometimes occur, I received within a very few days a letter from Doctor Smith saying he would be glad to secure a position in America, and a letter from Prof. John M. Coulter, then at Wabash College, Crawfordsville, Ind., saying that their chair of chemistry was vacant and asking me to suggest a candidate. I named Doctor Smith and he visited Crawfordsville and interviewed a number of the trustees. Wabash College has Presbyterian affiliations and Doctor Smith's Scotch relationships and his other brilliant personal qualities made a very favorable impression, and the appointment was made as professor of chemistry and mineralogy.

During the four years that followed, 1890–1894, Professor Smith rapidly gained experience as a very careful and forceful lecturer and successful teacher. He also continued his researches in the field of organic chemistry, studying especially condensation by means of potassium cyanide, and derivatives of benzoin.

In 1894 he was asked to go to the University of Chicago as assistant professor of chemistry in charge of the instruction in elementary inorganic chemistry. In 1898 he was promoted to the rank of associate professor, and in 1904 he was given the title of professor of chemistry and director of physical and inorganic chemistry. From 1901 to 1911 he was dean in junior colleges, in charge of science students.

When he went to Chicago Professor Smith saw very clearly that it would be to his advantage, personally, to change his field of research from organic to inorganic and physical chemistry. Such a change was also very useful in promoting the development of a more varied department of chemistry in the university. His early training in mathematics and physics gave him a splendid preparation for his new line of work, and he soon became one of the best-known physical chemists in America.

In physical and inorganic chemistry, his first research of considerable importance was an exhaustive, classical investigation of the forms of sulphur. Many others had preceded him in this field, but he brought to the problem such an insight into the varied and complex factors involved and such an ingenuity in applying the methods of modern physical chemistry that at the close of his work the subject might be considered as an almost completed chapter of our chemical knowledge.

In recognition of his work with the forms of sulphur and his studies of vapor pressure in collaboration with A. W. C. Menzies, Professor Smith was awarded the Keith prize and medal in 1912 by the Royal Society of Edinburgh. In announcing the award, Sir William Turner summarized his work as follows:

> The work on sulfur was published in seven papers. At the time these investigations were begun, the published observations upon the behavior of melted sulfur were full of apparent inconsistencies, and could not be formulated in harmony with physico-chemical theory.
>
> The first step was to settle the disputed question as to the relations of amorphous and soluble sulfur in the melt. Measurements of freezing points and of the corresponding proportions of amorphous sulfur in the freezing liquid showed that Raoult's law held rigorously. This established the existence of liquid amorphous sulfur dissolved, but distinct from the melted soluble sulfur.
>
> The fact that melted sulfur, when kept at a given temperature, gives, on chilling, very inconstant proportions of amorphous sulfur was next investigated. It was discovered that the introduction of sulfur dioxide and

other foreign substances greatly influenced the proportions. These foreign bodies were proved to act catalytically, and retard or hasten the change from amorphous to soluble sulfur. The establishment of this conclusion at once afforded a basis for explaining a large proportion of the apparent inconsistencies in the older as well as the more recent observations. In connection with this work, the proportions of amorphous sulfur present in equilibrium at various temperatures were measured.

In the fifth paper, studies of some other peculiarities in the behavior of melted sulfur were described, and all the results were shown to harmonize with a theory of the relation of the two liquid forms as dynamic isomers.

Precipitated sulfur was the subject of the sixth paper, and it was shown that, when first liberated, the sulfur consists of droplets of liquid amorphous sulfur. In presence of weak acids, or in neutral or alkaline solutions, this changes wholly to crystalline, soluble sulfur. In presence of active acids, the amount of amorphous sulfur surviving in the final product is proportional to the concentration of the acid.

In the seventh paper, the generally accepted melting points (or freezing points) of the various forms of sulfur, determined before the complex nature of the problem which such measurements involved was in the least suspected, were subjected to revision, and the correct values, in harmony with the theory, were given.

The work on Vapor Pressures (carried out in collaboration with Prof. A. W. C. Menzies) is described in seven papers. The first two deal with a simple device, named the "submerged bulblet," by which boiling points and vapor pressures of liquids and of non-fusing solids may be determined with the use of only minute amounts of material.

In the third and fifth papers, forms of apparatus for the exact study of vapor pressures, and named respectively the static and dynamic "isoteniscope," are described. To ascertain the possibilities of the methods, values for water, which agree with the best previous determination, were obtained by the static method, and values for benzene and for ammonium chloride by the dynamic method.

The fourth paper describes a determination of the vapor pressures of mercury. These were made because exact values were required for the subject of the sixth paper, and the existing results (e. g., those of Regnault, Ramsay and Young, and others) were highly inconsistent with one another, and the methods used were open to serious criticism.

The sixth paper deals with the constitution of calomel vapor, a matter long but inconclusively discussed by chemists. By making measurements of the vapor pressures of mercury, of calomel, and of a mixture of the two, and applying the laws of chemical equilibrium to the resulting data, it was shown conclusively that the vapor is wholly composed of mercury and corrosive sublimate. The close quantitative correspondence showed that in these measurements the order of accuracy was much higher than in any previous measurements of vapor pressures at elevated temperatures.

The seventh paper shows that, as the laws of chemical equilibrium applied to the result of the preceding paper predict, calomel, when dried in the most rigorous manner, exercises, even at high temperature, no measurable pressure whatever. This is the only successful experimental confirmation of a familiar and important application of the theory.

In 1911 he was called to Columbia University, New York City, as professor of chemistry and administrative head of the department of chemistry, succeeding Prof. C. F. Chandler, who had retired in 1910. He continued in this position till his failing health compelled him to retire in the fall of 1919. He died at Edinburgh, on September 8, 1922.

At Columbia University he directed his attention chiefly to a study of the vapor pressures and densities of the ammonium halides. Some years before, Baker had shown that thoroughly dry ammonium chloride vaporizes without dissociation (J. Chem. Soc., **65**, 615 (1894) and **73**, 422 (1898). It had long been known that ordinary ammonium chloride, containing a trace of moisture, is almost completely dissociated when it is heated somewhat above its point of vaporization. Professor Smith and his collaborators devised methods for determining the density of *saturated* vapors of ammonium halides and demonstrated that the dissociation is very far from complete in such conditions. The dissociation of ammonium chloride does not exceed 67 per cent at 280° to 330°, while the dissociation of ammonium bromide and ammonium iodide is still less. They also demonstrated that the transition point of ammonium chloride is the same for the carefully dried as for the undried salt. The purpose of these later experiments was to find some explanation for the anomalous fact that the vapor pressure of carefully dried ammonium chloride, which vaporizes without dissociation, is the same as that of the partially dissociated chloride. A satisfactory explanation was not found, but the suggestion of Wegscheider (Z. anorg. Chem. **103**, 207 (1918)), that the constancy of the vapor pressure was due to the fact that the dried salt does not undergo a transition at 184.5°, was shown to be untenable.

From the time when he began his work at Wabash College Professor Smith gave very careful attention to the selection and proper presentation of those topics which should be used in the instruction of students during their first year in the study of chemistry. After going to Chicago he was especially responsible for the elementary courses in the university. His experience led him to a very firm belief in a system of instruction by recitations in comparatively small classes and the use of a textbook rather than instruction by means of lectures.

On September 8, 1899, Dean Russell, of Teachers' College, asked him to write the portion devoted to chemistry of a book on the Teaching of Chemistry and Physics. The portion on the teaching of physics was written by Prof. E. H. Hall, of Harvard. The book was published by Longman, Green & Co. in 1902, and still holds a unique place in our scientific literature.

The first edition of his Laboratory Outline of General Chemistry was published in 1899. The sixth edition (sixty-sixth thousand) appeared in January, 1917, under the title "Experimental Inorganic Chemistry." The book was translated into German by Prof. F. Haber and Doctor Stoecker, in 1904; into Russian by N. B. Schmoelling, in 1908; into Italian by Dr. F. C. Palazzo and Prof. A. Peratoner, in 1910.

The Introduction to Inorganic Chemistry was begun at the Yerkes Observatory, Williams Bay, September 18, 1903. It was completed to chapter 34 on January 3, 1904. June 13 to August 8, 1904, were spent at Williams Bay in completing the first writing of the book. June 10 to July 10, 1905, were devoted to correcting, adding to, and adjusting the manuscript. The book was issued by the Century Co. on February 15, 1906, and the demands surprised both Professor Smith and the publishers. More than 6,000 copies were sold before October 1, 1906. A second revised edition was published in 1908 and a third edition, largely rewritten, in 1917. The success of the book was partly due to the clear, lucid style in which it is written, but it was due fully as much to the adequate presentation of modern theories of solution and of equilibria for the first time in an introductory English textbook.

The book was translated into German, Russian, Italian, and Portuguese.

He also wrote a General Chemistry for Colleges, published in 1908, and a Textbook of Elementary Chemistry, which appeared in 1914.

Professor Smith was president of the American Chemical Society for the year 1911. His presidential address on "Lomonossoff, an early physical chemist," was a notable contribution to a little-known historical subject.

He was elected to membership in the Royal Society of Edinburgh in 1891; as an honorary foreign member of the Societdad Espagñola de Fisica y Quimica of Madrid in 1911; as a member of the American Academy of Arts and Sciences in 1914; as a member of the National Academy of Sciences in 1915.

In 1919 his alma mater, the University of Edinburgh, awarded him the degree of LL. D. He was introduced at the graduation ceremonies as follows:

> A most distinguished graduate of our own university, Professor Smith, has risen to the rank of a superchemist in the United States, head of a department embracing many specialized professorships, and director of one of the most important laboratories in the New World. We congratulate Columbia University on the possession of a teacher and investigator of such rare ability, and we congratulate ourselves on the opportunity of laureating an alumnus whose success reflects no little luster on the institution where he received his early training.

To those who knew him best Professor Smith was a valued and loyal friend, a kind and considerate husband and father, with the highest ideals in his personal life and with a broad human interest in art and literature and in many fields of science other than chemistry. His knowledge was broad and profound, and his keen wit, quickness of repartee, and the epigrammatic quality of his remarks made conversation with him stimulating in a high degree. He has left a deep impression on many students who worked with him, and the science of chemistry in America and in the world has been enriched by his labors as a teacher and as an investigator.

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