

**Alexander Smith, B.Sc., Ph.D., LL.D. By Professor  
Sir James Walker, F.R.S.**

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ALEXANDER SMITH was born on 11th September 1865, in Edinburgh, where his father was a well-known musician. He was educated at the Collegiate School, and in 1882 he entered the University of Edinburgh as a science student. He studied chemistry under Crum Brown, mathematics under Chrystal, and natural philosophy under Tait. Although chemistry was his main subject, he spent some time at research in physics under Tait's direction. In 1886 he graduated as B.Sc., and during the three following years pursued the study of chemistry in the University of Munich, where he worked in Baeyer's laboratory, chiefly under the direction of Claisen. After graduating as Doctor of Philosophy in 1889 he returned to Edinburgh, and was appointed Assistant in the chemistry department of the University. This appointment he only held for one year, for during a trip to the United States in the summer vacation of 1890 he was offered and accepted the chair of Chemistry and Mineralogy in Wabash College, Crawfordsville, Indiana. During his short tenure of the chair the number of undergraduates studying chemistry more than doubled. In 1894 he joined the staff of the newly-founded University of Chicago with the rank of Assistant Professor, soon raised to that of Associate Professor. In 1903 he was appointed to an independent chair and was made Director of General and Physical Chemistry. He remained in Chicago until 1911, when he received the appointment of head of the Department of Chemistry in Columbia University, New York, a position which he retained until his retirement through illness in 1921.

As a teacher and organiser of instruction in chemistry Alexander Smith stands pre-eminent. The qualities which later gained him so high a reputation were observable in his teaching in Edinburgh when he was a young man of four-and-twenty. A course of lectures which he delivered then on organic synthesis stimulated the interest of his hearers in an extraordinary degree. He had an easy, fluent style of delivery, knew intuitively how to keep the attention of the audience he was addressing, and had the invaluable gift of selecting and impressing the essential points of his subject. In America he devoted much thought to the manner of presentation of chemistry to students of various types and of different

ages, ranging from secondary scholars to post-graduate workers, and fortunately for his fellow-teachers he embodied his principles in an admirable series of text-books. As chairman of a sub-committee of the National Education Association of the United States he prepared in 1899 an outline course in chemistry for secondary schools, which became the basis of the chemistry work of the secondary schools throughout America. His *Laboratory Outline of General Chemistry*, issued in the same year, was the precursor of the corresponding theoretical work, the *Introduction to General Inorganic Chemistry*, which, appearing in 1906, met with immediate acceptance in the English-speaking world, and has since been translated into the language of almost every country where scientific study is pursued. His other educational works of later date were characterised by the same originality of thought and orderliness of method. It is a testimony to the esteem in which his text-books were held that one of them was translated into German by Professor Haber. He may without exaggeration be said to have revolutionised the teaching of chemistry in America.

Smith at the outset of his career was an organic chemist, and the ten papers which he published between 1889 and 1902 are exclusively concerned with organic topics, chiefly the chemistry of diketones, the benzoin synthesis, and, generally, the action of potassium cyanide as a condensing agent. As a result of his teaching work in Chicago, and his critical review of the matter and mode of presentation of elementary inorganic chemistry, he gradually became engrossed in this fresh field, and his research after 1902 is exclusively inorganic and physico-chemical. A series of papers on amorphous sulphur is of outstanding merit. At the time his investigations were begun, the published observations on the behaviour of melted sulphur were full of apparent inconsistencies and could not be formulated in harmony with physico-chemical theory. He investigated the relationship between the freezing-point of the melt and the proportion of amorphous sulphur contained in it, and showed that Raoult's law was rigorously obeyed, thus establishing the existence of liquid amorphous sulphur dissolved in, but distinct from, the liquid "soluble" sulphur. He investigated the problem why melted sulphur kept at a constant temperature should give on chilling varying proportions of amorphous sulphur. The variation he proved to be due to catalysts which accelerated or retarded the change from amorphous to soluble sulphur. As one of these catalysts was sulphur dioxide, always present in varying proportions in ordinary experiments, the inconsistencies in previous observations received a simple explanation. The true equilibrium proportions of amorphous

sulphur at various temperatures were determined, and the conclusion established that the two forms of sulphur in the liquid state behaved with respect to each other as dynamic isomerides. He then turned his attention to precipitated sulphur, and showed that, when first set free, precipitated sulphur consists of minute drops of liquid amorphous sulphur. In alkaline, neutral, or feebly acid solutions these change wholly to crystalline sulphur. In presence of strong acids the amount of amorphous sulphur in the final product is proportional to the concentration of the acid. Finally, he subjected the melting- and freezing-points of the various forms of sulphur to revision, and determined the correct values, in harmony with the theory.

In conjunction chiefly with A. W. C. Menzies, now Professor of Chemistry at Princeton, Smith published a long series of papers on vapour-pressures, the experimental work being of a very high order of accuracy. A simple method—that of the “submerged bulblet”—was devised by means of which the vapour-pressures of liquids and solids and the boiling-points of liquids could be determined with the use of minute amounts of material. Then forms of apparatus were described for the exact measurements of vapour-pressures, which were named the static and dynamic “isoteniscopes” respectively, and tested by determination of the vapour-pressures of water and benzene, the results agreeing with the best previous determinations. Since for the purpose of a research on calomel vapour an exact knowledge of the vapour-pressures of mercury up to high temperatures was required, a series of accurate determinations for the metal between  $250^{\circ}$  and  $435^{\circ}$  were made and values obtained which entirely supersede the inconsistent observations of previous investigators. The vapour-pressures of mercurous chloride, mercury, and mixtures of the two were measured, and by the application to the data of the ordinary law of chemical equilibrium there was deduced the result that the vapour consists wholly of mercury and mercuric chloride. Proceeding from this deduction, it was found that mercurous chloride, when rigorously dried, so as to prevent dissociation, has no measurable vapour-pressure even at high temperatures.

The problem next considered was the dissociation of the ammonium halides. Vapour-density determinations for ammonium chloride had shown that whilst the rigorously dried salt had in the vaporous state a density corresponding to the formula  $\text{NH}_4\text{Cl}$ , it was completely dissociated into ammonia and hydrochloric acid at  $350^{\circ}$  if a trace of moisture were present. It was pointed out that this dissociation value had been obtained in an unsaturated vapour. For the saturated vapour at the same temperature the degree of dissociation did not exceed two-thirds. The other ammonium halides were found to be considerably less dissociated. An

investigation was undertaken to explain the paradoxical fact that the vapour-pressure of ammonium chloride is at a given temperature the same whether dried or undried, although in one case the vapour is highly dissociated and in the other not at all. Although the problem was not solved, the untenability of hypotheses which had been put forward by other investigators for its explanation was clearly demonstrated.

Smith's research work is characterised by the same qualities of clear insight, logical development, and scrupulous accuracy as we find in his work as a teacher. The merit of both was recognised officially by his appointment to the Presidency of the American Chemical Society in 1911, by his election to membership of the National Academy of Sciences, by the award of the Keith Prize and Medal by the Royal Society of Edinburgh in 1912, and by the degree of LL.D. which was conferred on him by the University of Edinburgh.

His personality was most attractive. His interesting and amusing conversation, his hearty, infectious laugh, will long remain in the memory of his friends. Always of boundless energy, he overstrained himself during the war period, and insisted, in spite of medical warnings, on continuing his writing and on carrying on his huge department with a depleted staff. A complete breakdown, complicated by a serious operation, followed, and as his health did not improve after a year's leave of absence he was obliged to relinquish his chair. Becoming gradually weaker, he died in his native town on 8th September 1922.

He married in 1905 Mrs Sara Bowles of Memphis, Tennessee, and is survived by her and by two children, a son and a daughter.