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## **Izaak Maurits Kolthoff**

### **The Life of Izaak Kolthoff**

Izaak Maurits Kolthoff, whom was considered by many to be the Father of analytical Chemistry was born in Almelo, Holland on February 11, 1894. the youngest of three children, he acquired the nickname "Piet", which he was called by almost everyone. It was during his first chemistry course in high school that Kolthoff became interested in the part of kitchen for his laboratory. Although his family did not approve, many of his experiments were done using hydrogen sulfide.

Upon graduation of high school in 1911, Kolthoff entered into the School of Pharmacy at the University of Utrecht. Although he enjoyed the "pure" physical sciences rather than pharmacy, he could not enroll due to his lack of Latin and Greek, which were needed to register in "pure" physical sciences. Although he was not fluent in Latin or Greek, he was however fluent in German, French, English and Dutch, and it is wondered what other directions his career would have taken had he not needed Latin or Greek as a prerequisite.

The pharmacy program, however, did involve some analytical chemistry and he was also influenced by one of his professors, Nicholas School, who

found it necessary to have a balance between descriptive chemistry and the fundamental principles of the field. Schoorl studied with J.H. van't Hoff who was the first Noble Laureate in Chemistry in 1901.

Kolthoff received his "apotheker" diploma in 1915, but proceeded to enroll in more courses at the University of Utrecht in colloid chemistry and physical chemistry. In that same year he published his first paper on the theory of acid-base titration's. This was a paper which talked about the analysis and location of the end points in the titration's of phosphoric acid.

In 1918, Kolthoff received his Ph.D in Chemistry since that was the year that Utrecht discarded they're requirements of Latin and Greek. By this point, Kolthoff had published 32 papers, as well becoming the first "conservator" at Utrecht. Between the years 1923 and 1927, he was also the lecturer in electrochemistry. It was in 1924, that Kolthoff accepted an invitation for a lecture tour throughout Canada and the United States. In 1927, he was offered a one year appointment at the University of Minnesota as a professor and the chief of the Analytical Division of the School of Chemistry. After the first year, this became permanent and he stayed there until his retirement in 1962. By the time that Kolthoff retired, he had published 800 research papers during his "active" years, and another 150 before his health failed.

Many of his graduate students went on to a career in industry and academic life and his scientific descendents were numbered at over 1,100. Each of these people could trace their scientific roots back to him. Kolthoff maintained an active grant from the National Science Foundation until only two years before

his death. Izaak Kolthoff died on March 4, 1993 in St. Paul, Minnesota. As said by James Ligane, "...analytical chemistry has never been served by a more original mind, nor a more prolific pen, than Kolthoff's" (qtd. Thory Guides p2).

### **Professor Kolthoff's Research**

Although Kolthoff's research covered many areas of chemistry, he mainly focused on constructing a firm scientific foundation for Analytical Chemistry. Through his work, he transformed Analytical Chemistry from empirical recipes and prescriptions to a very important branchy of modern chemistry. Some of the areas Kolthoff studied with his students included volumetric analysis, acid-base indicators, acidimetry, gravimetric analysis, alkalimetry, the theory of colloids and crystals growth, and also iodometry. Some of the theories that he worked on were the theory of potentiometric analysis, potentiometric titration's, and conductometric titration's.

Kolthoff also contributed greatly to the understanding and use of electroanalytical methods which included polarography and ion selective electrodes. He came to understand this after Jaroslav Heyrovsky discovered polarography and he recognized the significance and practical purpose of it. Kolthoff was one of the earliest workers to understand the fundamental significance of crown ethers and their complexes, and he put emphasis on the role of chemical principles in analysis.

Kolthoff did his thesis work on the fundamentals of idiometry. Doing so, he addressed a variety of reactions occurring in idiometry, and also the

mechanisms of the reactions, the side reactions, and titration errors. He also worked thoroughly on the formation and properties of precipitates. He did this for a year and then eleven years later began it again, and wrote 37 papers on aging of precipitates and co-precipitation.

Kolthoff had also studied a number of induced reactions. Typical of numerous induced reactions, it showed that hydroxyl radicals produced in the first step can induce the oxidation of many organic compounds. Kolthoff was really involved trying to rectify the paradox that chemistry of solutions in textbooks had strong aqua centric bias. His interest in this dated back to the 1930's, but it was in the fifties that he started a series of studies on how solvents influence the properties of solutes.

Some of the awards, medals, and memberships that he has received throughout his life included the National Academy of Sciences of the Nichols Medal of the American Chemical Society and received the Kolthoff Award of the American Pharmaceutical Association.

A few of the books that were written by I. M. Kolthoff are "Polarography", "Treatise on Analytical Chemistry", "Potentiometric Titrations", and "Quantitative Analytical Analysis". His most famous book was "Quantitative Analytical Analysis" and is known to be the ancestor of modern textbooks on Analytical Chemistry.

Kolthoff was very interested in promoting analytical chemistry in every way possible. Aside from the fact that he wrote books and lectures, he also was responsible for the creation of the Analytical Division of the International Union of

Pure and Applied Chemistry. All of Maurits Kolthoff's contributions to chemistry were monumental and he was responsible for forming analytical chemistry into a sound discipline.

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