

Noyes Laboratory:
One Hundred Years of Chemistry
September 14, 2002

Chemical Landmark



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AMERICAN CHEMICAL SOCIETY
SCIENCE THAT MATTERS

Noyes Laboratory: One Hundred Years of Chemistry

Celebrating Chemistry

The American Chemical Society designated Noyes Laboratory a National Historic Chemical Landmark on September 14, 2002.

For additional information see our web site:

www.chemistry.org/landmarks.



William Noyes and the Chemistry Department

William Albert Noyes (1857-1941) received a Ph.D. from The Johns Hopkins University for work on benzene oxidation with chromic acid. In 1886 he began a seventeen-year tenure at the Rose Polytechnic Institute in Terre Haute, Indiana, where he worked on camphor derivatives, especially camphoric acid. In 1903, Noyes became the first Chief Chemist at the National Bureau of Standards in Baltimore, where he determined atomic weights. Burning hydrogen over palladium in pure oxygen and weighing the resulting water gave a value of 1.00787:16 for the critical hydrogen:oxygen weight ratio, still one of the most precise chemical determinations ever made.

In 1907 Noyes became head of the Chemistry Department at the University of Illinois, and in his nineteen-year tenure he helped make it one of the most prestigious in the United States. In 1939, to honor his work, the chemistry building at Illinois was renamed Noyes Laboratory.

Primarily an organic chemist, Noyes is remembered for his work on the structure of camphor, the electronic theories of valence, and the valence and nature of nitrogen in nitrogen trichloride. He served many years as editor-in-chief of the *Journal of the American Chemical Society* (1902-1917). He was also the founding editor of the following: *Chemical Abstracts* (1907-1910), *Chemical Reviews* (1924-1926), and the *American Chemical Society Scientific Monographs* (1919-1941). In 1935 he received the Priestley Medal.



1902: Noyes Laboratory Opens

The University of Illinois at Urbana-Champaign established a Department of Chemistry in 1867, the same year the school was founded. Eleven years later the Department of Chemistry became the first on campus to move into a building of its own, a facility it soon outgrew. In 1901 Arthur W. Palmer, then department head, persuaded the Illinois State Legislature to build a grand laboratory, which opened the following year as the New Chemical Laboratory. Rapid growth dictated need for an expansion within ten years, and Palmer's successor as Head of Department, William A. Noyes, argued successfully for an addition to the laboratory, which by then housed the largest chemistry department in the United States. The addition, which more than doubled the size of the building, was completed in 1916.

The First Century

The principal occupant of Noyes Laboratory has been the Department of Chemistry. But Noyes Laboratory incorporated a groundbreaking design that provided excellent research and teaching facilities for hundreds of faculty and thousands of students. As such, Noyes also housed at various times the departments of Biochemistry, Chemical Engineering, and Bacteriology, and the Illinois State Water Survey.

The roster of scientists who studied or taught at Noyes Laboratory reads like a who's who of American chemistry. It includes ten Nobel

Prizewinners; twenty-three presidents of the American Chemical Society; and twelve winners of the Priestley Medal, the highest honor bestowed by the American Chemical Society.

Fine Chemicals

The traditional source of fine chemicals – Germany – dried up with American entry into the First World War. As a result, the Chemistry Department at the University of Illinois established an organic chemical manufacturing unit, initially under the direction of Professor Clarence Derick. Originally it was a summer project for producing chemicals for classroom use, but Professor Roger Adams turned it into a program for producing organic chemicals for war and industrial use as well. In the process of making the organic chemicals, Illinois chemists tested and perfected the directions for their syntheses. These recipes were incorporated into a series of volumes giving carefully checked directions for the synthesis of organic compounds. The publication, *Organic Syntheses* founded by Roger Adams, continues to the present day.

The Illinois State Water Survey

The Illinois State Water Survey began in 1895 as a unit in the Department of Chemistry at the University of Illinois. Its chief function was to test for the presence of water-borne disease, particularly typhoid fever. In its first fifteen months, the survey responded to 1,787 public requests to perform chemical analyses on water samples as part of its responsibility for maintaining the health and safety of public water supplies. The Water Survey's other missions included addressing methods of water softening, the treatment of sewage and wastewater, and the creating of standards to insure sanitary drinking water. From 1907 to 1951, the Water Survey occupied laboratories and workrooms in Noyes Laboratory.

Chemists and Chemistry at Noyes

Roger Adams: "The Chief"

Roger Adams (1889-1971) was head of the Department of Chemistry at the University of Illinois for nearly thirty years. Through his close contacts with industry, "The Chief" promoted the development of chemistry in the United States and cooperation with industry and government. Under Adams' stewardship, Illinois expanded and became the leading institution training chemists for the chemical industry. Adams contributed many recipes to Organic Syntheses and Organic Reaction over his long career. His synthetic work as a researcher focused on aromatic compounds, important in the dye industry. The "Adams Catalyst," a colloidal platinum oxide, became standard for hydrogenations. In the 1920s and 1930s, Adams investigated the stereochemistry of substituted biphenyl and biaryl compounds, which can be resolved into optical isomers. This research raised questions about the relationship between steric and electronic effects, an issue of concern among physical organic chemists. Adams best-known work on natural products is his research on marijuana alkaloids, which he undertook in the late 1930s at the behest of the Narcotics Bureau. He isolated and synthesized tetrahydrocannabinol and several of its analogues.

John C. Bailar, Jr. and Coordination Chemistry

John C. Bailar, Jr. (1904-1991) became an instructor at the University of Illinois in 1928, the start of a sixty-three year career in the Department of Chemistry. As a graduate student he was interested in organic isomerism, but while teaching a general chemistry course he realized that isomerism, the occurrence of different compounds with the same chemical composition, could also exist among inorganic compounds. He went on to train several generations of coordination chemists, helping to make the University of Illinois as well known for inorganic chemistry as it was for organic. As such, Bailar came to be known as the "father of American coordination chemistry."

St. Elmo Brady: Pioneer

In 1916 St. Elmo Brady (1884-1966) became the first African American to receive a Ph.D. in chemistry in the United States, although blacks had obtained doctoral degrees in physics and biology in the nineteenth century. Brady carried out his thesis work at Noyes Laboratory under the direction of Professor Clarence Derick, writing a dissertation in 1916 titled "The Divalent Oxygen Atom." Brady went on to a distinguished teaching career.

Herbert Gutowsky and NMR Spectroscopy

Herbert Gutowsky's (1919-2000) pioneering work made nuclear magnetic resonance spectroscopy one of the most effective tools in chemical and medical research. In the early days of NMR, he and his students discovered the phenomenon of spin-spin coupling and recognized its utility for the assignment of structure. Along with his colleagues, Gutowsky demonstrated that NMR spectroscopy could be used to study exchange processes in chemical systems and to identify and characterize complex compounds.

Carl "Speed" Marvel: Advances in Polymer Chemistry

Carl "Speed" Marvel (1894-1988) worked primarily on the structure and synthesis of polymers, and he has been recognized as the "father" of synthetic polymer chemistry. In 1937 Marvel began to investigate the structure of vinyl polymers, proving that the repeating units in most polymers prepared from polyvinyl chloride are formed with chlorine atoms on alternate carbon atoms (head-to-tail) and not on adjacent carbon atoms (head-to-head). This work led in turn to the preparation and polymerization of new monomers. During World War II, Marvel headed a group of chemists working on the U.S. government's synthetic rubber program, launched to ease the critical shortage of natural rubber needed for tires for airplanes, trucks, and military vehicles.



Samuel Wilson Parr and Applied Chemistry

Samuel Wilson Parr (1857-1931) supplied the chemistry industry with practical instruments used to analyze coal: the Parr Peroxide Calorimeter, the gas calorimeter, the automatic recording gas calorimeter, and the sulfur photometer. Parr founded the Standard Calorimeter Company in 1899 in Champaign, Illinois. In 1933 the company became the Parr Instrument Company and is now located in Moline, Illinois.

William Cumming Rose and Amino Acids

William Cumming Rose (1887-1985) discovered and structurally analyzed the amino acid threonine and showed that it is not synthesized by the body but must be obtained from the diet. Rose proved that different amino acids are essential for different organisms. In addition, he studied creatine and creatinine metabolism and the nutritive properties of amino acids. Most significantly, Rose investigated the role of proteins in metabolism and the metabolic interrelationships among amino acids. This work led to the determination of amino acid requirements for humans.

Marion Sparks and Chemical Information

Marion Sparks (1872-1929) became the Chemistry Librarian in 1913, the same year she began teaching "Chemistry 19," a course in chemical literature. In 1919 Sparks self-published a textbook for the course based on her class notes. Sparks conveyed to her students that library work was critical: locating previous research, she stressed, was as important as laboratory work.

National Historic Chemical Landmark

The American Chemical Society designated Noyes Laboratory a National Historic Chemical Landmark on September 14, 2002. The plaque commemorating the event reads:

Noyes Laboratory occupies a central place in the development of chemical sciences in the United States. Four departments of national and international stature - Chemistry, Biochemistry, Chemical Engineering, and the Illinois State Water Survey - were at one time simultaneously located within its walls. Generations of scientists and engineers trained here under the leadership of renowned chemists such as William A. Noyes and Roger Adams. Chemical sciences in the United States have been immeasurably strengthened by the important and continuing interdisciplinary research conducted by Noyes Laboratory scientists.

About the National Historic Chemical Landmarks Program

The American Chemical Society, the world's largest scientific society with more than 163,000 members, has designated landmarks in the history of chemistry for more than a decade. The process begins at the local level. Members identify milestones in their cities or regions, document their importance, and nominate them for landmark designation. An international committee of chemists, chemical engineers, museum curators, and historians evaluates each nomination. For more information, please call the Office of Communications at 202-872-6274 or 800-227-5558, e-mail us at nhclp@acs.org, or visit our web site: chemistry.org/landmarks.

A nonprofit organization, the American Chemical Society publishes scientific journals and databases, convenes major research conferences, and provides educational, science policy, and career programs in chemistry. Its main offices are in Washington, DC, and Columbus, Ohio.

Acknowledgments

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