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# Rachel Lloyd, Ph.D. Pioneering Woman in Chemistry

University of Nebraska–Lincoln

OCTOBER 1, 2014

American Chemical Society

**“Dr. Lloyd’s work must be more satisfactory to her than anything we can say of it. She has seen develop, largely by her efforts and under her eye, one of the largest chemical laboratories in the West. She has seen her lecture rooms crowded by enthusiastic students of all courses and departments. Wherever Lloyd may go, she takes with her the gratitude of an institution and of a state where she has helped not only to fashion chemists, but to inspire and kindle earnest young men and women to that culture which society most needs.”**

**—Willa Cather, *Hesperian student newspaper*, 1894**

**“Dr. Lloyd was a woman of unusual ability. By means of thorough scientific training and hard work, she attained for herself a place in the scientific world above that ordinarily reached by a woman.”**

**—Rosa Bouton, *R. Lloyd memorial address*, 1900**

Rachel Lloyd was a pioneer in the field of chemistry. Lloyd became the first American woman to earn a doctoral degree in chemistry when she graduated from the University of Zurich in 1887. Six years earlier, she had become the first woman to publish research in a major American chemical journal. And when Lloyd joined the faculty of the University of Nebraska, she was among the earliest women to teach and conduct research at a coeducational university. In a life of near-constant adversities, Lloyd achieved distinction for her teaching and research and earned wide admiration by her colleagues and students.

#### **RACHEL LLOYD’S EARLY LIFE**

Rachel Abbie Holloway was born on January 26, 1839, to Robert Smith Holloway and Abigail Taber, a Quaker couple in eastern Ohio. When she was five years old, Rachel’s mother died, and seven years later, her father died as well. From age 12, Rachel was raised by her stepmother from her father’s second marriage.

At the age of 14, Rachel was sent to boarding school near Philadelphia. She began teaching at a girls finishing school upon her graduation. In 1859, Rachel married Franklin Lloyd, an employee of a large chemical producer in the city. Franklin graduated from the Philadelphia College of Pharmacy in 1861, and worked as a chemist and businessman. Rachel later said that Franklin kept a chemical laboratory in their home, and her introduction to the field came through her husband’s work.

In 1863, the Lloyds moved to Michigan, where Franklin pursued new business interests. Two years later, he died. The couple’s two infant children preceded him in death. Rachel, a widow at age 26, took her sizeable estate and traveled in Europe. A financial panic 10 years later left her without the means to support herself abroad, and she returned to the U.S. to find work.

#### **EARLY TEACHING AND TRAINING**

Upon her return, Lloyd taught chemistry at a prominent girls finishing school in Philadelphia. Lloyd was noted for introducing laboratory experiments into the curriculum—a rarity in science courses for women and girls of any age in this era.

Lloyd applied her knowledge of chemistry from her husband’s profession, but she also worked to attain an education for herself. In 1875, she enrolled in summer school at Harvard University, where she learned to do chemical research. Harvard, like most leading universities at the time, did not accept women as regular students. The summer school offered teachers training, although without the chance to earn a degree. Lloyd took seven chemistry courses and audited several botany courses in the summers from 1875 until 1883.

While at Harvard, Lloyd studied advanced quantitative chemistry under Charles F. Mabery (1850–1927), director of the summer chemistry program. In 1881, Mabery and Lloyd published their research in the *American Chemical Journal*, marking the first publication by a

woman author in a major chemical journal in the U.S. Two subsequent publications by Mabery and Lloyd followed in 1882 and 1884.

Lloyd taught briefly at a girls school in New York before becoming an instructor of chemistry and physics at the Hampton College for Women in Louisville, Kentucky, in 1882. Two years later, she added the position of chemistry instructor at the Louisville School of Pharmacy for Women.

In 1884, Lloyd applied for a position as professor of chemistry at the newly established Bryn Mawr College, a women’s college outside of Philadelphia. Despite her years of teaching experience and a favorable reference by Mabery, Lloyd’s application was declined. The college cited her lack of degree in its explanation. Lloyd, whose ambition was to teach at the collegiate level, resolved to earn a degree.

#### **WOMEN IN THE SCIENCES**

While a handful of universities in the U.S. accepted women into doctoral programs at the time, none had accepted a female candidate in chemistry. For the sciences and mathematics, the University of Zurich was the leading center for women’s higher education. In admitting women, Zurich was a rare exception among the prestigious German-speaking universities.

Lloyd studied under the organic chemist August Viktor Merz (1839–1904). On February 21, 1887, at age 48, Lloyd graduated from the University of Zurich. She was the first American woman (and second woman in the world) to receive a doctoral degree in chemistry.



Interior of the qualitative laboratory of the original University of Nebraska chemistry building in 1892.

### RACHEL LLOYD AT NEBRASKA

Shortly after her graduation from Zurich, Lloyd received a letter from Henry Hudson Nicholson (1850–1940), chair of the Chemistry Department at the University of Nebraska, asking her to join the faculty there. Lloyd and Nicholson had met during their Harvard summers, both having studied under Mabery. Nicholson presented Lloyd with a rare opportunity to teach and conduct research at a co-educational university at a time when most of her female peers were relegated to teaching at secondary schools or women's colleges.

Lloyd arrived in Lincoln, Nebraska, in the summer of 1887. Upon her arrival, Lloyd was named associate professor of analytical chemistry. In addition to her teaching responsibilities, Lloyd took on the role of assistant chemist at the Nebraska Agricultural Experiment Station. The next year, she was promoted to full professor.

Her research centered on chemical analyses of the concentration of sugars in sugar beets, an emerging crop in the U.S. in the late 1800s. Lloyd had been introduced to the beet while studying in Switzerland. Her expertise and the new agricultural station in Lincoln provided an opportunity to explore the possibility of raising beets across Nebraska.

Lloyd and Nicholson grew a test crop of beets in 1888 and determined there was a favorable outlook for the crop. The following year, the team sent seeds to farmers across the state in an effort to conduct a wider study. At the end of the season, farmers returned their harvests to Lincoln. Total sugar concentration was determined using a saccharometer that works according to Archimedes' principle of displacement and a test called Fehling's reduction. Lloyd and a team of student researchers completed roughly 700 such analyses.

Nicholson and Lloyd published the first of three reports on sugar production in the state in 1890. Findings were so encouraging that investors established a sugar factory near Grand Island in the same year. Production in Nebraska expanded rapidly, from 736,000 pounds of granulated sugar in 1890 to 8,378,000 pounds in 1895, and additional factories were built.

At Nebraska, Lloyd received wide praise by faculty and students for her technical expertise, teaching ability, and devotion to public service. She became a popular figure at the university due in equal parts to her warm personality and her cultural refinement, provided by an Eastern upbringing and extensive European travels.

While traveling during the summer of 1892, Lloyd suffered an attack of

partial paralysis, a condition from which she never fully recovered. Because of her health problems, Lloyd announced her retirement from the university in the spring of 1894, after only seven years. She returned to the Philadelphia area to live near friends and relations. On March 7, 1900, Lloyd died at the age of 61.

### LEGACY OF RACHEL LLOYD

Lloyd's time at the University of Nebraska launched a period for the campus as an important node for women's education in chemistry that was unusual among its peers. Between 1888 and 1915, 10 of the 46 graduate students in the chemistry department were women. One, Rosa Bouton (1860–1951, B.S. 1891, M.A. 1893) went on to found the university's School of Domestic Science (now the Department of Nutrition & Health Sciences) in 1898.

Lloyd was involved in a number of scientific associations of local and national importance. In 1889, Lloyd was elected a fellow of the American Association for the Advancement of Science. In 1890 and 1891, Lloyd served on the Science Committee of the Association for the Advancement of Women, an organization that called for the expansion of opportunities for women in science, among other causes. Also in 1891, Lloyd was elected as a member of the American Chemical Society in a class that included Nicholson; she was only the second woman admitted.

**“She was not only a trained chemist, she was a great teacher, and more than that, she was a beloved advisor and counselor of students. You do not know it, but many of you are still influenced by the life of this strong, helpful woman.”**

**—University of Nebraska Acting Chancellor Charles Edwin Bessey, 1900**

## Rachel Lloyd, Ph.D., Pioneering Woman in Chemistry A National Historic Chemical Landmark

The American Chemical Society designated the contributions of Rachel Lloyd, Ph.D., to the field of chemistry as a National Historic Chemical Landmark in a ceremony in Lincoln, Nebraska, on October 1, 2014. The commemorative plaque at the University of Nebraska–Lincoln, reads:

*Rachel Holloway Lloyd (1839–1900) became the first American woman to earn a doctorate in chemistry in 1887 when she received her degree from the University of Zurich. In the same year, she was hired as a researcher and professor of chemistry by the University of Nebraska, positions she held until her retirement in 1894. Her work on determining the concentration of sucrose in Nebraska-grown sugar beets contributed to the establishment of a commercial sugar industry in the state as early as 1890. Lloyd's warm personality, cultural refinement, and commitment to scientific research drew young women into the Chemistry Department and earned the university a reputation for nurturing women chemists at a time when they were largely excluded from the field.*

### About the National Historic Chemical Landmarks Program

The American Chemical Society established the National Historic Chemical Landmarks program in 1992 to enhance public appreciation for the contributions of the chemical sciences to modern life in the United States and to encourage a sense of pride in their practitioners. The program recognizes seminal achievements in the chemical sciences, records their histories, and provides information and resources about Landmark achievements. Prospective subjects are nominated by ACS local sections, divisions, or committees; reviewed by the ACS National Historic Chemical Landmarks Subcommittee; and approved by the ACS Board Committee on Public Affairs and Public Relations.

The American Chemical Society is a nonprofit organization chartered by the U.S. Congress. With more than 161,000 members, ACS is the world's largest scientific society and a global leader in providing access to chemistry-related research through its multiple databases, peer-reviewed journals, and scientific conferences. Its main offices are in Washington, D.C., and Columbus, Ohio.



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