NATIONAL ACADEMY OF SCIENCES

EDWARD CURTIS FRANKLIN

1862—1937

A Biographical Memoir by

HOWARD M. ELSEY

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Courtesy, Berton Crandall

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March 1, 1862–February 13, 1937

BY HOWARD M. ELSEY[1]

EDWARD CURTIS FRANKLIN, president of the American Chemical Society in 1923, was born on March 1, 1862 in Geary City, Kansas. He died at Stanford University on February 13, 1937, having become in the intervening seventy-five years one of America's most honored and best-loved scientists.

LOVE OF NATURE

As a boy Franklin was definitely not a scholar, though it is understandable that, when contrasted with the attractions to be found outdoors, the primitive educational facilities of frontier schools held but little appeal. Until 1854 Kansas had been in the hands of the Indians, so that the country Franklin grew up in was not yet spoiled by ruthless civilization. His brief autobiographical sketch—describing his boyhood pleasures of hunting, fishing, swimming in the Missouri (even then noted for being muddy), collecting fossils from the River's limestone banks, and the seemingly infinite variety of

[1] An earlier version of this article appeared in the *Journal of the American Chemical Society* 71(1949):1–5. The portrait of Edward Curtis Franklin that appears as this memoir's frontispiece was painted in 1928 by Rem Remsen, son of the noted chemist, Ira Remsen. It is reproduced here from a photograph furnished to the Academy by Franklin's daughter, Mrs. Anna Franklin Barnett, in 1937.

nuts, fruits, and berries for use and wildflowers to be admired—conveys something of his eagerness to avail himself of his surroundings.

His delight in the beauties of the outdoor world, and particularly of the mountains, stayed with Franklin throughout his life. As a youth he roamed the hills along the Missouri; as a young man he climbed the mountains of Colorado and, during a year as a student in Germany, he crossed the Alps on foot. He was active in the Stanford Sierra Club until well into his fifties, having by then climbed five peaks of over fourteen thousand feet and many only slightly lower. Sighting Kiliminjaro for the first time when he was sixty-seven and attending a meeting as the guest of the British Association for the Advancement of Science, he deeply regretted not being able to climb the great peak that, even at a distance of thirty or forty miles, towered majestically some nineteen thousand feet above the clouds. In his later days, Franklin climbed mountains by automobile; in 1933 he drove to the fourteen-thousand-foot summit of Mount Evans.

In the last few years of his life Franklin managed to see again most of the scenic wonders of our land. In 1936 he drove to Kansas "by way of the Hoover Dam, Zion Canyon, Bryce Canyon, the North Rim of the Grand Canyon, Albuquerque, Santa Fe, and Boulder, Colorado," and thence on a "wild tour of thirteen thousand miles, lecturing before groups of defenseless chemists through the Middle West to Philadelphia and Washington, and thence south to Florida and home by way of the southern route." To Franklin, the longest road was always the best if it offered even a slight promise of more interesting views, new or old.

From 1914 to 1918 when I had the privilege of working with him, it was always Franklin who first succumbed to spring or fall fever and proposed that we play hookey on a Saturday afternoon, running away on our bicycles into the

Stanford hills. We sought dove, quail, squirrels, and the ducks that could be hunted from a "sneak-boat" on nearby San Francisco Bay. Though we usually returned empty-handed, these too brief, back-to-nature jaunts were treasures that always ended with a vigorous and enthusiastic attack on the laboratory problem we had so rudely abandoned.

EDUCATION AND EARLY LIFE

In 1877, when Franklin was fifteen, he was sent away to a small sectarian college where he found himself both physically and spiritually starved. It was still possible fifty years later to find schools in that region whose dining hall rations might have kept a canary alive, but certainly not singing. Even as a youth, furthermore, Franklin was inclined to be a "free thinker" and agnostic. It is easy to understand that a man who, throughout his life, was blunt and honest could not be content in a rigid, fundamentalist environment. After two months, he ran away.

From 1880 to 1884 Franklin was a pharmacist's assistant in Severance, Kansas, where he also ran a small-job printing shop and played a cornet in the village band. In the fall of 1884, he visited his younger brother at the University of Kansas with no thought of making a new start on his own education. But once on campus, the congenial surroundings aroused his interest; then aged twenty-two, he decided to enroll as a special student in chemistry. He did odd jobs around the chemical laboratory during his first three undergraduate years and as a senior acted as an assistant in qualitative and quantitative analysis.

UNIVERSITY OF KANSAS (1888–1903)

Franklin apparently showed promise as a teacher, for he was retained on the faculty as an assistant in chemistry from 1888 to 1893, and as an associate professor from 1893 to

1899. He became professor of physical chemistry in 1899, which position he held until 1903. He was, however, still restless and footloose and felt uncertain about his future. Thus we find him from 1890 to 1891 as a student in Germany, and from 1893 to 1895 at Johns Hopkins, where he took his doctorate. These excursions might be regarded as part of an orderly preparation for a university career if one did not know that much of the year abroad was spent sight-seeing rather than in serious study, or had Franklin not taken leave again in 1896 for a one-year visit to Costa Rica to work as chemist and co-manager of a gold mine and mill.

The fact is (as he himself recorded), Franklin was still uncertain as to his fitness for the teaching profession. But there was no such doubt in the minds of his students. As E. E. Slosson, a Kansas alumnus, so succinctly put it, "all of his former students are his friends, and that is more than can be said of most teachers."

Others have written that Franklin relied little on books as a means of gaining knowledge, a conclusion not warranted by the evidence. For though, in the 1890s, two small cases in the department office contained the entire Kansas University chemistry library and the number of scientific journals received by the university as a whole was very small, each journal was watched for impatiently and devoured eagerly upon its arrival.

Barely finished reading of the discovery of argon, Franklin was already making plans to check the separation; the samples of both argon and helium he prepared were probably the first in America. The same could be said of his Dewar vessels and the X-ray tube he made for the use of Professor Blake of the Physics Department. Franklin needed the written word for information, but it was not sufficient for him. He had to do experiments and make equipment with his own hands; he had to see results with his own eyes.

Proud of his glass-blowing skill, Franklin prepared a con-

siderable number of argon- and helium-containing Plücker tubes and sent them to friends and acquaintances in various universities. He was most satisfied to find, on his arrival at Stanford years later, his gifts to that school stored along with other valued items in an exhibit case on prominent display.

The diligence with which he trained himself in the laboratory arts, the eagerness with which he followed the chemical literature, and the pleasure he took in repeating for himself experiments that had led to the outstanding discoveries of the day show how diverse were Franklin's interests in the material world. By the 1890s, the sights and experiences within the walls of a laboratory had become fully as appealing to him as the outdoor attractions of his youth, for throughout his life, Franklin—like Kipling's elephant child of the *Just So Stories*—was filled with the most insatiable curiosity about all things around him.

Repeating others' work, while instructive and satisfying, did nothing to spark Franklin's creative gifts. That spark came rather from one of his students, H. P. Cady. In the autumn of 1896, Franklin records, he was teaching Cady (then an undergraduate) quantitative analysis:

> "Observing after a time that the young man was becoming bored with his task . . . [Franklin], at the time giving instruction in analytical chemistry, proposed to him that he prepare several of the cobalt-ammine salts and confirm the composition of one or two of them by analysis. Some days later, with a beautifully crystallized specimen of one of these interesting salts in his hand, Cady stated that the ammonia in these and other salts containing ammonia must function in a manner very similar to that of water in salts with water of crystallization. He suggested furthermore that liquid ammonia would probably be found to resemble water in its physical and chemical properties. As a direct consequence of Cady's suggestion has followed all the work done in this country on liquid ammonia."

Franklin promptly ordered a cylinder of liquid ammonia, prepared the Dewar vessels, and obtained other apparatus needed for Cady's proposed study of ammonia as an electro-

lytic solvent. But the ammonia was slow in arriving and, before the experiments were started, he left for Costa Rica. On his return he learned that Cady had found many salts that dissolve in ammonia to form conducting solutions, even though the pure solvent further resembles water in being practically a nonconductor.

These results, obtained with simple apparatus designed and built with his own hands, aroused Franklin's research instincts for the first time. Ceasing to view research reported in the literature as a source of experiments to copy, he began instead to regard it as a source for devising new experiments he and his co-workers could conduct.

The years 1897 to 1903 were richly fruitful for the new research team, which was soon enlarged by the addition of C. A. Kraus, weaned from the Physics Department. There seemed to be no limits to the work Franklin's aroused imagination devised. Typical titles of papers from this productive period are: "Liquid ammonia as a solvent," "Determination of the molecular rise of the boiling point of liquid ammonia," "Metathetic reactions between certain salts in liquid ammonia," "Electrical conductivity of liquid ammonia solutions," and "Concentration cells in liquid ammonia."

But in the fall of 1903, this team of productive researchers, each outstanding in his own way, broke up. Kraus left for the Massachusetts Institute of Technology, Franklin went west to Stanford, and Cady remained at Kansas, where he would pass his entire professional career.

Franklin's evaluation of his two junior partners is of interest.

He said many times that Kraus was the most skilled glassblower and practitioner of all the laboratory arts whom he had ever known. I dare to question the first part of this opnion; Kraus might equal, but certainly could not surpass Franklin himself as an artist and artisan in the designing and

working of the old German soft glass. Chemists of today who are accustomed to placing a piece of cold Pyrex tubing directly into the flame of an oxygen-gas blast lamp can have no appreciation of the difficulty of constructing the intricate cells used in the Franklin team's ammonia work. It required the patience of Job and the manipulative skills of a master, and these Franklin had. Kraus's later research record speaks for itself—an outstanding pupil graduated into an outstanding and productive research professor.

Franklin rated Cady his most brilliant student and coworker, an evaluation I believe to be fair, though Cady's most productive and active research years were those spent under Franklin's stimulating guidance.

STANFORD YEARS (1903–1937)

In 1903 Franklin left Kansas for Stanford University to fill the chair of organic chemistry left vacant by Professor Richardson's death. Stanford was a rich school in those pre-earthquake days, and David Starr Jordan was adding outstanding research men (whenever he could find them) to his faculty.

For Franklin the change proved a happy one. Several Kansas friends had preceded him in this western journey, and one—Vernon Kellogg—was instrumental in persuading him to accept the Stanford offer. The university lay in a beautiful setting. Rolling foothills that began at the edge of the campus soon merged into the coastal mountains. Beyond these, only twenty miles from the university, lay the Pacific Ocean. While the Coast Ranges are comparatively low, the higher, much more rugged and scenic Sierras are only a hundred miles to the east. We can be sure that to Franklin, not the least of the attractions of this western wonderland were the mountains he loved so well.

While Franklin's work at Kansas had been spectacular be-

cause of its greater emphasis on physical-chemical measurements, the purely chemical work he did at Stanford was much the more important. To quote Alexander Findlay:

"From their earlier experiments . . . Franklin and his collaborators were led to an exhaustive examination of the parallelism between the chemical behavior of derivatives of ammonia dissolved in liquid ammonia and the behavior of derivatives of water, 'aquo-compounds' as Franklin called them, in aqueous solution. The investigation of the behavior of the former class of compounds, the 'ammono compounds' to use Franklin's nomenclature, constitutes the chief and most characteristic contribution of Franklin to chemistry."

The record of this contribution is embodied in his monograph, *The nitrogen system of compounds* (1935,1). His detailed classification of the organic compounds of nitrogen as belonging to the ammonia system make this book a classic and a most stimulating guide to further investigations.

Franklin wrote slowly and painstakingly; this monograph was rewritten many times and was over ten years in preparation. He also produced some eighty-seven papers, the step-by-step account of his forty years of research, though—due to his generosity toward his collaborators—less than half of these bear his name.

Franklin was a great experimentalist, and the few fortunate enough to have been accepted by him as collaborators insist he was also without peer as a teacher of graduate students. Every one of these men acquired a skill in laboratory technique far above the average; each learned to think independently, and, in addition, to view his own experimental results with that critical skepticism that is the true measure of a scientist.

Though Franklin never acquired the smooth and polished delivery characteristic of Julius Stieglitz, his lectures in organic chemistry were models of clear and orderly thinking. His experimental interests and belief in teaching by example

made his lectures—illustrated by many elaborate and skillfully done demonstrations—unusually instructive.

He had an infinite capacity for making lifelong friends of all ages, from babes-in-arms to emeritus professors. He tailored the elaborate demonstrations in his Christmas lectures, which (like Faraday) he enjoyed giving to the children of his friends and colleagues, to fit the occasion and the audience. (I dare say that many a middle-aged matron of today[2] has in her jewel box a glass ring with a "red" stone made by Dr. Franklin just for her during one of these lectures.) To the end of his days he was a welcome and honored guest in the home of every former student and associate in this and other lands. He delighted in talking of his own work and pleasures and equally enjoyed listening to the exploits of others.

From the beginning of his professional career until the year of his death, he attended the meetings of the American Chemical Society and, of all the honors he received, valued his election to the presidency of that society the most.

His wife, Effie Scott Franklin, who was a student at Kansas at the time of their marriage in 1897, died in 1931. The older of two sons, Charles Scott Franklin, was killed in an airplane accident in 1928. Worthy of their parents, the two surviving children are: Dr. Anna Franklin Barnett, a happy wife, mother, and practicing physician; and John Curtis Franklin, an electrical engineer who [as of 1949 was] manager of Oak Ridge Directed Operations for the Atomic Energy Commission.

[2] Dr. Elsey was writing in 1949.

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