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REYNOLD CLAYTON FUSON

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A Biographical Memoir by

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REYNOLD C. FUSON began his career in organic chemistry at a time when structural determination by chemical methods was the principal area of research and the classification of reactions was just beginning. His research provided insights about structure and reactions that were significant in the development of organic chemistry for over thirty years.

Fuson's scientific contributions were recognized by his election to the National Academy of Sciences in 1944, his appointment as a founding member of the Center for Advanced Study at the University of Illinois in 1959, and a number of other honors. Fuson viewed teaching and research as inseparable; he regarded his awards as collective recognition for himself and his students. Throughout his career, Fuson had an outstanding reputation in research, teaching, writing, and as a research advisor.

Fuson was a complex and enigmatic figure, even to those who knew him well. He was usually private and self-contained, but on occasion he generously would share with his students and colleagues one of his many interests. Some found him reserved and remote while others, particularly students in some kind of difficulty or those with rural roots, found him responsive and involved. He retained an

attachment to his early years in deeply rural southern Illinois, but he was also a sophisticated world traveler. Fuson was fluent in several languages, a student of painting and medieval architecture, and a collector of classical music. He was meticulous in his writing and dress and appeared to be the prototypical staid professor. Yet, his outstanding collection of classical music, which he would play for select groups, also included a recording made in his honor by a Mexican street band. Although Fuson appeared to be serious and sober, he had a wry sense of humor, and his inhibitions could disappear under the proper influence; perhaps in the case of this recording, tequila was involved.

Fuson's interests were not solely intellectual. He had a love of sports both as a participant and as an observer. He was an excellent bowler and squash player; he enjoyed professional baseball and Illinois football; and he would spontaneously take a group of students to those events.

Reynold Clayton Fuson was born on a farm near Wakefield, Illinois, as the sixth of eleven children of John Alvin Fuson and Nancy Jane Chestnut Fuson. He attended a rural one-room schoolhouse, where he was able to hear what was taught in higher grades, and he found he had a talent for learning. Fuson passed examinations above his grade level, and after the eighth grade he was expected to leave school to begin farm work. The teacher felt there was nothing further she could teach him. Attending high school in Wakefield was not a possibility; the town was 16 miles away over mud roads, which were impassable for much of the school year. However, a new teacher came to the remote schoolhouse, and Fuson then was able to attend two more years before going to Central Normal College in Danville, Indiana, where after one year in 1914 he was certified as a teacher. He returned to Illinois to teach in one-room schools in Jasper county for three years.

Although his ancestry included many preachers and teachers, Fuson did not enjoy teaching and was planning to become a railroad clerk when he was hired to teach the eighth grade in Montana. When he got to Corvallis, Montana, he found he had been reassigned to teach science in high school. He was given thirty days to learn seventeen subjects sufficiently well to pass an exam that would allow him to take up his assigned post. Fuson studied diligently for the exam, which lasted three days. Even after he had received many awards for his later work, he felt that passing that exam was the most noteworthy achievement of his career.

Although Fuson was certified as a high school teacher, his high school equivalency degree did not qualify him for college. However, he discovered when he took a correspondence course in English history from the University of Montana that this connection could offer him a backdoor admission, and he became a resident student.

Fuson intended to major in language and literature; his favorite subject was German. He had a lifelong interest in languages and later learned French, Italian, Spanish, and Russian. When he visited the Universities of Florence, Padua, Pavia, Palermo, and Rome in 1952, he was very well received not only for his chemistry but because he was the first foreign chemist to make a lecture tour in Italy speaking in Italian. His literary talents and chemical interests were also combined in poems he later wrote under the pseudonym of Robert Fox.

At the University of Montana, Professor J. W. Howard was responsible for encouraging Fuson to select chemistry as a field of concentration. Fuson saw in Howard an individual who was skilled in teaching and dedicated to organic chemistry and to his students. Fuson later remarked that it was the personal life of J. W. Howard that gave him an ideal to

live by. Chemistry was also attractive because Fuson did not want a career that would involve any teaching.

Much to his surprise, Fuson was asked to join a fraternity at Montana. He had thought his farm-home, county-school background and failure to go to high school would separate him irremediably from the university students. It was in his college fraternity that he acquired the name Bob, which he chose to use for the rest of his life. Fuson valued his fraternal relationships. On his receipt of the Kuebler Award from Alpha Chi Sigma, he noted that he found in those relationships a spirit of cooperation and of helping one another for the common good, which greatly appealed to him.

Fuson graduated from the University of Montana in two years and was encouraged by the chemistry faculty to go to graduate school. He was admitted to the Universities of California, Minnesota, and Illinois; he chose to attend Berkeley. However, he left there with a master's degree, discouraged and thinking he would return to high school teaching. The details are not clear, but his California experience was unpleasant and it appears a decision may have been made by an administrator. Fuson's academic accomplishment was not to be terminated; in fact, he later received honorary degrees from the Universities of Montana and Illinois. On the occasion of the latter, he said:

> Unlike the other awardees, I felt incompetent for words of wisdom about life with problems facing mankind, so decided to essay the role of "farmboy makes good." My decision to turn to levity, I realized later, must have been influenced by the fact that for the first time at Illinois I found myself in the camp of the "enemy," the administrators. I wondered if they ever thought to the flesh and blood of the student forced to live on the Procrustean bed they had devised! When a student objected to being mutilated to conform to administrative norms, I almost always found myself on his side.

Fuson matriculated at Minnesota, where he received his

Ph.D. degree in two years. He later was awarded an Outstanding Achievement Award from Minnesota, and he noted that he was forever grateful to the university that rescued him at a low point in his career.

Fuson won a coveted National Research Council fellowship, which allowed him to work on his own research problems. He took the fellowship to Harvard under the sponsorship of Professor Elmer Peter Kohler. The first experiments he attempted gave unexpected results that challenged his intellectual and experimental skills. Success in that research was an epiphany for Fuson.

> The smoldering spark I have brought from Minnesota seemed to burst into flames. I had found what I was looking for. From then on the controlling interest (in my life) was to be research. The only comparison that comes to mind is with the person who "gets religion" and abandons the old life for the new. I was to spend the rest of my life as a missionary bringing the research cult to students.

In later reflection he noted:

> Doing research with students brought me two-fold satisfaction, to my obsession with chemistry was added a personal interest in the student. We were engaged in a process of co-learning. I never tired of discussing their problems, chemical or otherwise, many of them I coached for examinations in foreign languages. As always I took pleasure in helping them with the writing of the thesis or any papers that were prepared for publication.

With the transforming experience of accomplishment in research, Fuson's previous dislike for teaching evaporated. At Harvard, Fuson worked closely in teaching with Professor Kohler, who was an outstanding lecturer and was regarded as one of the deans of organic chemists. Kohler was very shy. He declined to give lectures outside of Cambridge, never accepted an award, and was somewhat remote from his students. Kohler knew of Fuson's burning interest to do research and recommended him to the University of Illinois. Fuson joined the Department of Chemis-

try at the University of Illinois at a time when that department, under the sequential leadership of Professors W. A. Noyes and Roger Adams, was beginning a rise to prominence in U.S. organic chemistry.

Fuson's training as a graduate student was somewhat different from most, and he appreciated the independence that Professor G. E. K. Branch at Berkeley, W. H. Hunter at Minnesota, and E. P. Kohler at Harvard gave him. He noted,

> To begin with I had more or less sidestepped the apprentice system as a graduate student. Two papers reporting (my) research were published at Minnesota under my name alone. Then I added five more papers from my work at Harvard and my name appeared on one of Kohler's papers.

His experience set his own style; as a research director Fuson was notable for giving his students exceptional independence. He selected research problems to fit the student, and the student was given a laboratory and helpful colleagues. When the first report was written, Fuson would provide a thorough criticism and the student was expected to respond with effort and accomplishment. Under his guidance, students developed a scientific maturity and self-confidence that served them well; many became leaders in their own right. Being known as a Fuson student became a mark of distinction, indicating a chemist who was independent in research and capable in written communication. Fuson was not an intrusive research director, but he had a high level of interest in the personal development of his students, which extended well beyond their graduate careers.

Fuson focused his energies on his research, teaching, and interactions with students. He never held a formal administrative role, although he was known for good judgement, and was quite influential. While his interest in research was based on inherent scholarly attributes, Fuson's skill in teaching required effort.

When I came to Illinois I had behind me three years of teaching in one room schools in Jasper County and two years in high school at Corvallis. My dissatisfaction with teaching was one of the reasons I chose chemistry as a major rather than mathematics or modern languages. The chemist doesn't have to teach. The cause of my difficulty (with teaching) was shyness, which had plagued me from childhood. My mania for doing independent research changed all of that and committed me to a life of teaching.

Fuson was proud of the teaching award he received from the Manufacturing Chemists Association in 1960. His lectures were always extraordinarily well prepared and presented. He felt this came from his need to overcome his reserve and the models of Kohler and Howard.

If I am a good teacher it is because I have always worked hard at it. The person that thinks he has arrived usually hasn't; if you don't prepare for the classroom and only wait for God to fill your open mouth with words of wisdom you cannot be a good teacher.

In Fuson's first semester at the University of Illinois he was assigned to teach organic chemistry to agricultural students, most of whom had little interest in the topic. He taught the course with such concern for the students that the dean of agriculture, who previously had apparently nothing good to say about chemistry, wrote a letter to Roger Adams praising Fuson and urging Adams to keep Fuson in that line of work. When Fuson learned of this letter some thirty-eight years after it was written, he provided an interesting analysis. He was, he said, so overcome with shyness that he felt the only way to appeal to the students was to make a personal approach; he learned every student's name, asked them about their high school, and helped them if they had difficulty. He noted that this approach, which was designed to win the students to his side, boomeranged. He found that his interest in the students was in fact genuine, and throughout his career, he maintained a remarkable level

of personal interest in students. When photographs were required as part of the application for admission to graduate school, Fuson would memorize names of the incoming students and then at the first meeting of students he was able not only to recognize a student by name but also to introduce the students to one another. Fuson's interest in students and colleagues was both individual and collective; he later wrote a history of the chemistry department at Illinois, which emphasized the roles of many individuals in the accomplishments at Urbana.

At the time that Fuson began his independent research career, the understanding of organic chemistry was at an early stage. In two early papers, Fuson showed that a recently revived idea—that an aromatic ring was composed of puckered tetrahedral carbon atoms—was incorrect. This presaged a lifelong interest in aromatic compounds.

Fuson sought understanding of the relationship of structures to reactions. A major contribution was the principal of vinylogy in which he noted that functional groups separated by a carbon-carbon double bond took on the reactive characteristics of groups lacking the double bond. In an influential review article in 1935, Fuson pointed out this principle, which is still useful, albeit taught today in terms of resonance theory. He subsequently published a number of examples, as did many chemists around the world, after the explicit recognition of this structure-reactivity correlation.

His interest in molecular architecture was to be a cornerstone of many of Fuson's scientific contributions. Fuson explored the limits of structure by seeking to test limits. He would design molecules so they could not react in normal ways and would look for new and interesting reactions. This led him to discover that ketones with heavily substituted aromatic groups could form stable enols. In his

work on reactions of conjugated sterically hindered systems, he discovered conjugate additions of Grignard reagents. In later years, he clarified rearrangement reactions of mustard gases. He also investigated coupling of Grignard reagents, ring closures, reversibility of Friedel-Crafts reactions, and unusual displacements in aromatic compounds. Many of these topics, which Fuson investigated over half a century ago, are still subjects of research in the 1990s. Fuson was awarded the Nichols Medal in 1953 for research that contributed to strengthening the foundations of organic chemistry.

Fuson's interest in research and teaching was reflected in an influential text on the qualitative identification of organic compounds. The book *Systematic Identification of Organic Compounds*, which R. L. Shriner and Fuson first published in 1935, was based on a systematic approach to identifying compounds, which had been developed by Oliver Kamm, an Illinois faculty member. This text set the standard for courses that brought attributes of research to student laboratories. The course required deductive logic, careful experimental observations, and a thorough knowledge of reaction chemistry. It allowed the student, often for the first time, to build and test hypotheses and to learn the pleasure of scientific accomplishment in a research mode.

Many of Fuson's students became important contributors to industrial chemistry in this country. His principle consulting arrangement with the Rohm and Haas Company lasted thirty years and was a forerunner of many of the consulting arrangements that have become common.

After retirement from the University of Illinois, Fuson spent fourteen years at the University of Nevada in a second career, first as a distinguished visiting professor and then as a professor emeritus. He was drawn to Reno by his love of the American West and its high mountains, engen-

dered perhaps during his days as a young man in Montana. Fuson brought to Nevada a wealth of knowledge and a dedication to high standards. He continued teaching graduate as well as undergraduate organic chemistry, which afforded him an opportunity to continue his long association with students. Although he no longer continued active research, he was instrumental in guiding the research of graduate students in the newly founded chemistry Ph.D. program. Fuson served as wise counsel to the university community. He gave time generously to others, contributed to the building of chemistry at Nevada, and invited numerous distinguished friends and former students to visit. At a distinguished lecture series, which he initiated, he spoke to the students:

> At our Centennial Symposium in 1964, we had as speakers the President of the American Chemical Society, two members of the National Academy of Sciences and a representative of our largest industrial firm. In the subsequent four years, we managed to engage a continuing flow of similarly able and inspiring speakers. The formation last year (1967) of the Sierra Nevada Section of the American Chemical Society made it possible to attract additional distinguished guests. Their lectures are not only open but are provided primarily for your inspiration by giving you examples of excellence.

Nevada presented Fuson with another opportunity for historical scholarship, and he researched the history of chemistry in the state and in the university with thoroughness and vigor. He traveled to every site of historical interest and delved into archives to learn and catalog and then offer commentary on the rich legacy of chemistry in Nevada. He was a serious student and thorough documentarian, noting with relish that one of the first two professors at the university was hired to teach chemistry.

Fuson was instrumental in advancing and persistent in advocating the study of chemistry. Some thirty years ago, he spoke what is still true today:

State-supported universities with their now traditional three-fold programs of teaching, research and public service enjoy a privileged position in our society. Yet, they are exceedingly vulnerable as becomes evident whenever unfavorable political winds arise. Students, who should be the best critics and who have every right to express their opinions seldom get a fair chance to do so because of a built-in weakness of our system.

The scientific contributions that Bob Fuson made are imbedded in the idiom of organic chemistry. These contributions were at the forefront of the field and revealed fundamental relationships about structure and reactivity. Fuson's greatest contribution, perhaps, was through his influence as a teacher, both of research students and of the many students who benefited from his lectures and books.

Bob Fuson was a lifelong bachelor who thought of his students and colleagues as family. His will divided his substantial estate between the Universities of Illinois, Montana, and Nevada. The endowment has been used at each university to support students and lecturers and to provide professorships, which were then named in his honor. The R. C. Fuson professors at the University of Illinois have been Nelson J. Leonard, David Y. Curtin, and Scott E. Denmark. The R. C. Fuson professor at the University of Nevada is David A. Lightner.

THE PREPARATION OF this biography was based on autobiographical notes, reflections of former students and colleagues of R. C. Fuson, and material from the archives of the University of Illinois.

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