C. Dwight Prater

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1917–2001

Elected in 1977

"Contributions to chemical kinetic theory which helped delineate the effects of diffusion on chemical reaction."

BY JAMES WEI

CHARLES DWIGHT PRATER, an outstanding research scientist and pioneering industrial research manager in catalysis and reaction engineering, died January 1, 2001, at the age of 83. He was a senior scientist and manager of process and catalyst research at the Mobil Oil Corporation in Paulsboro, New Jersey. He was survived by daughters Anne Marie Breeze and Linda Lee Runyon, both of Phoenix, and Susan Lynn Knight of Las Vegas; seven grandchildren and four great-grandchildren.

Dwight was born January 2, 1917, in the small textile mill town of Sylacauga in Talladega County, Alabama. He grew up in privation during the Great Depression, a far cry from his future life of world-class research and corporate management. After high school he spent a year in the Merchant Marines to earn money and then went to college at nearby Auburn University. There he met and married Millie Lee Miller in 1938 and received a BS in chemistry in 1940. He studied physics at the University of Chicago and then joined the Bartol Research Foundation in Swarthmore, Pennsylvania, during World War II to do research on radar. In 1946 he joined the Johnson Foundation for Biophysics at the University of Pennsylvania, where he did research on bacterial viruses and received his PhD in biophysics in 1951.

He then went to work at Mobil Research and Development in Paulsboro and began a brilliant career in research on catalysis and reaction engineering applied to petroleum processing. After the war Mobil's research management team was inspired by the achievements of the physicists who invented the atomic bomb and radar and decided to hire a cadre of physicists to see what they could contribute to petroleum refining. Most left after a few years, but the few who stayed created a cultural revolution by introducing methods and viewpoints that were new and surprisingly productive.

Oil refining was at the time a qualitative and descriptive subject, and Dwight pioneered the introduction of quantitative and analytical methods. His research is noted both for the sophistication of the mathematics and physics used and for their practical impact on oil refining.

He became well known for his early papers on the role of diffusion to disguise the kinetics of reactions in catalysts and for the Hall effect in catalysis. He made innovative use of harmonic analysis to study the simultaneous diffusion of heat and mass. This led to solution of the problem of maximum temperature rise in porous catalysts during reaction, which can be computed without regard to the reaction kinetics or the shape and size of the catalyst particle. The dimensionless Prater number was named in honor of this discovery. He also created the first mathematical model of a commercial process for the kiln of the thermofor catalytic cracking process, which was used extensively.

His best-known research is on the structure and properties of systems of complex first-order kinetics, using eigenvalues and eigenvectors of the reaction matrix, which yielded several generations of very successful refinery models of catalytic cracking and catalytic reforming and is described in leading textbooks of kinetics in chemical engineering.

He was promoted in 1967 to manager of Mobil's renowned Process Research and Development Division, but played the roles of both research investigator and manager, giving him control of many of the operations to transform petroleum refining. He led the efforts to automate acquisition of detailed information on temperature and concentrations from pilot plants using monitors and digital computers. In an elegant tailored suit, he would crawl on his back in the laboratory to rewire circuit boards—to the inspiration of younger researchers.

The reformer is the catalytic process unit that changes the structure of gasoline molecules from paraffinic to aromatic, with great improvement in octane number. The reformer models developed under his direction not only described the process but also made possible the individual optimization and fine-tuned operations for different feedstock, from the sweet Nigerian crude to the sour California crude. The models were responsible for improving the efficiencies of refining, for reducing the amount of crude oil required, and for improving the octane number produced.

In about 1970 he also managed the Inter-Industry Emission Control (IIEC) program, a research consortium that included Ford Motor Company and other oil and automobile companies to develop catalytic converters to reduce automobile exhaust. The pellet bed catalytic converter was a familiar concept favored by General Motors, but the pellets tended to fracture into powder after shaking on the highway. The IIEC favored the less familiar monolith bed, which has road endurance and is the only method used today.

Prater wrote 60 research papers that were published in scholarly journals such as the *Journal of Chemical Physics*, *Advances in Catalysis*, *Industrial and Engineering Chemistry*, and *Discussions of the Faraday Society*. He received three US patents on catalysis and analytical methods.

For his research contributions he received in 1972 the Alpha Chi Sigma Award of the American Institute of Chemical Engineers (AIChE). In addition to the NAE, he was a member of the American Chemical Society, AIChE, and the Catalysis Society.

Dwight did not come from a family of learning and advantages, but he persevered and achieved far beyond expectations.

He strongly believed in the possibility of self-education even in circumstances with slim resources, and he reinvented himself in fields in which he did not receive much formal education. The world of petroleum refining was inhabited by people with degrees in chemistry and chemical engineering, but not by people with degrees in biophysics and advanced knowledge of mathematics and physics.

Paulsboro did not have a vibrant and creative intellectual environment for learning and original research. No matter, Dwight decided that highly motivated people could learn high-level mathematics and physics on their own, without lectures and tutoring from professors. He organized a study group that met every Wednesday evening from 4:00 to 6:00 in the company cafeteria, with frozen TV dinners brought in. The group went through a series of textbooks and the participants took turns reading chapters and explaining them to their colleagues. The textbooks included *A Survey of Modern Algebra* by Garrett Birkhoff and Saunders MacLane, *Principles of Quantum Mechanics* by Paul A.M. Dirac, and *Differential Equations: Geometric Theory* by Solomon Lefschetz. The knowledge and methods learned in these sessions showed up later in research papers and patents.

At heart an educator, Dwight liked nothing better than the opportunity to mentor younger staff into successful careers. He would take the time to coach younger researchers on how to make better presentations, through not one but several rehearsals, and how to write better papers through more than one rewrite. A number of people consider themselves graduates of "Dwight Prater University," and seven went on to be elected to the National Academy of Engineering.

After his retirement from Mobil in 1982, Dwight moved to Las Vegas, a small city in San Miguel County, New Mexico, and commuted (by plane) two days a week to teach a graduate course on chemical reaction engineering at Caltech.

He was interested in music as a child and played the recorder. Later he took up the oboe and studied with Marcel Tabuteau of the Philadelphia Orchestra. He also managed the Haddonfield (NJ) Symphony Orchestra for many years. In pursuit of another pleasure, when he acquired the means he bought a 42-foot ketch and sailed from Nova Scotia to the Caribbean.

Dwight is fondly remembered not only for his scientific contributions and industrial impact but also for the many lives he brightened.