HARRY GEORGE DRICKAMER

1918–2002

Elected in 1979

"For contributions in the development of high pressure techniques, and in the elucidation of new properties of solids, and of diffusion in liquids."

BY THOMAS J. HANRATTY

HARRY G. DRICKAMER played a unique role among chemical engineering educators by championing the role of modern chemistry and physics in engineering research. For example, long before quantum chemistry and physics gained their current acceptance in the graduate chemical engineering curricula, Drickamer insisted that his students master those disciplines at a level of proficiency equal to that of their peers in the basic sciences. In so doing, he helped produce an outstanding cadre of scholars who have gone on to universities and research laboratories to demonstrate the modern chemical engineering approach to the understanding and design of new materials. (From the presentation of the John Scott Award at the 1985 meeting of the Division of Chemical Physics of the American Chemical Society.)

During his long tenure at the University of Illinois (1946–2002), Harry Drickamer dominated the field of high-pressure research, and its present status in chemistry, physics, geology, and materials science is due largely to his efforts and those of his students. Their adaptation of virtually every kind of spectroscopy to high-pressure studies led to many discoveries and to the invention of pressure-tuning spectroscopy.

Harry Drickamer was born Harold George Wiedenthal to Louise and Harold Wiedenthal in Cleveland, Ohio. His father

died when he was very young, and after his mother remarried, Harry's stepfather, George Drickamer, adopted him. Harry was active in sports and played in the farm system of the Cleveland Indians. He attended Vanderbilt University on a football scholarship, transferred to Indiana University, and, a short time later, to the University of Michigan, where he was elected president of his class in the Engineering College. He received B.S. and M.S. degrees in 1941 and 1942.

In 1942, he took a position at the Pan American Refinery in Texas City, Texas, where, in his "spare time," he carried out measurements on vapor-liquid equilibrium. The University of Michigan agreed to accept these studies and the results from a plant test on an extractive distillation tower (the first of its kind in the world) as a Ph.D. thesis. His publications on tray efficiency received considerable attention. With Harry Hummel, a colleague at Pan American, he published "Application of Vapor-Liquid Equilibria to an Analysis of a Commercial Unit for Toluene Purification," which was recognized with the Colburn Award of the American Institute of Chemical Engineers in 1947.

Harry returned to the University of Michigan in February 1946 to complete course work requirements for the Ph.D. degree. His growing interest in scientific issues in engineering was a factor in his accepting a position later that year at the University of Illinois as an assistant professor in the chemical engineering curriculum, which was then part of the Chemistry Department. Of the 105 doctoral theses he directed, 86 were on chemical engineering. His research is described in 478 publications.

Harry Drickamer recognized that the most interesting properties of matter are determined by the outer shell electrons of atoms ("valence" electrons), which form the bonds that hold atoms together in molecules and materials. They also give rise to a material's optical (e.g., color, phosphorescence, etc.), electrical, and magnetic properties. He understood that if one changed the distance between atoms by applying external pressure, interactions between the valence electrons of the constituent atoms in a molecule must change and that this would be manifested by alterations in physical and chemical properties.

He discovered that the application of pressure causes a change

of insulators into conductors for six elements (e.g., iodine) and more than 30 compounds. He observed paramagnetic-to-diamagnetic and ferromagnetic-to-paramagnetic transitions in ferrous compounds and in iron. He discovered that radicals are formed in many electron donor-acceptor complexes (under pressure) and found that these radicals react to form new chemical bonds. He showed how the conduction band of metals (e.g., cesium, rubidium, and potassium) and of rare earth atoms exhibit a different character at high pressure; metals like calcium, strontium, and ytterbium become semiconductors. Starting in the 1980s, Harry's research expanded into studies of protein chemistry, the efficiency of luminescent devices, and organic photochemistry. Together with Professor Gregorio Weber, he demonstrated that one can reversibly change protein conformation and modify enzymatic activity, thus opening a new approach to protein folding.

In the process of making these discoveries, Harry provided tests of a number of important theories, including Bethe's ligand field theory, Van Vleck's theory of the high-spin to low-spin transition, the Förster-Dexter theory of energy transfer in phosphors, Mulliken's theory of electron-donor complexes, the Marcus theory of electron-transfer reactions, and the rigid-band model for deformation-potential analysis in semiconductors. Insights from these research studies have contributed to advances in the engineering of materials, such as lasers, phosphors, semiconductors, polymers, catalysts, and proteins. Harry's work led to discoveries of the first organic superconductor and of the chemical reactivity of charge-transfer complexes (the basis for the recognition of new types of bonds between molecules). He provided a new understanding of metallic hydrogen and the interior of the Jovian planets. His very early work on diffusion in liquids had an impact on the design of a thermal diffusion process that was used to separate hydrogen isotopes.

Harry Drickamer's contributions were recognized by his peers in his election to the National Academy of Engineering, National Academy of Sciences, American Academy of Arts and Sciences, and American Philosophical Society. He received the Robert A. Welch Prize from the Welch Foundation in 1987 and the Na-

tional Medal of Science in 1989. He was awarded a Doctor of Chemical Science *honoris causa* from the Russian Academy of Sciences in 1994.

The breadth of Harry's research is reflected in the variety of honors he received: the Colburn (1947), William H. Walker (1972), and Alpha Chi Sigma (1967) research awards, and the Warren K. Lewis Teaching Award of the American Institute of Chemical Engineers (1986); the Bendix Research Prize of the American Society of Engineering Education (1968); the Ipatieff Prize (1956), the Irving Langmuir Award in Chemical Physics (1974), and the Peter Debye Award in Physical Chemistry (1987) from the American Chemical Society; the Buckley Solid State Physics Award of the American Physical Society (1967); the inaugural P.W. Bridgman Award of the International Association for the Advancement of High Pressure Science and Technology (1977); the Chemical Pioneers Award (1983) and the Gold Medal Award (1996) from the American Institute of Chemists; the Michelson-Morley Award of Case-Western Reserve University (1978); the John Scott Award for "Ingenious Inventions" from the city of Philadelphia (1984); the Elliot Cresson Medal from the Franklin Institute of Philadelphia (1988); Awards for Outstanding Materials Chemistry (1985) and for Outstanding Sustained Research (1989) from the U.S. Department of Energy; the Alexander van Humboldt Award from the Federal Republic of Germany (1986); and the Distinguished Professional Achievement Award from the University of Michigan (1987).

Professor Drickamer had a profound effect on the academic environment at the University of Illinois, where he collaborated with faculty in the departments of physics, electrical engineering, chemistry, and biochemistry. In addition to his appointment in chemical engineering, he held professorships in physical chemistry in the School of Chemistry and in chemical engineering, chemistry, and physics in the Center of Advanced Study of the University of Illinois.

His impact on the university went beyond his research, his service on numerous committees, and his role as head of chemical engineering (1955 to 1958). With his broad range of scientific knowledge, his extensive reading in Greek, Roman, and

English history, his love of humor, especially of Mark Twain, W.C. Fields, and the Marx brothers, and his penchant for quoting Shakespeare, he was a delightful companion and had a wide range of friendships. His wisdom and his ability to judge human character were reflected in his impact on the affairs of the university as a mentor and as an advisor. His own earthy humor and often repeated stories are part of the lore of the School of Chemical Sciences.

On the occasion of a symposium honoring Harry Drickamer on March 15, 2004, his colleagues at the University of Illinois had this to say:

> Complementing his greatness as a scientist, Drickamer's persona was noteworthy. He was fiercely dedicated to his scholarship and outspokenly suspicious of all things that might distract his students and colleagues from research. He had little patience for mere competence but an abiding admiration for the experiment well done and concisely described. His colleagues and students remain grateful for the years that he shared with us, years filled with great science, colorful anecdotes, and clear excellence.

Harry met Mae Elizabeth McFillen, a nursing student, while he was at the University of Michigan, and they were married in New Orleans on October 28, 1942. Mae Elizabeth, the first family-planning nurse practitioner in East Central Illinois, worked for many years at Planned Parenthood. The couple had two sons and three daughters. The oldest son, Lee, recently retired from the chairmanship of the Department of Biology at Northern Arizona University at Flagstaff. Kurt is a professor of biochemistry at The Imperial College in England. Lynn works in the Law Library at the University of Michigan and is active in training groups about tolerance and acceptance of gays. Margaret is an M.D. and associate professor of medicine (geriatrics) at the Yale University School of Medicine. Priscilla is a reference librarian and poet at Hope College in Holland, Michigan.