Harry George Drickamer

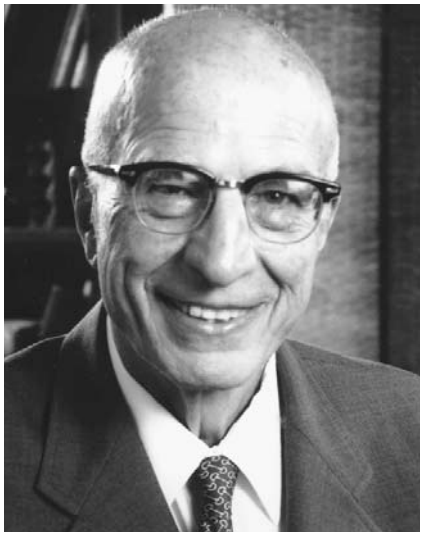
Harry George Drickamer, a pioneer in high-pressure studies of condensed matter and a professor of chemical engineering, chemistry, and physics at the University of Illinois for 56 years, died of a stroke on 6 May 2002 in Urbana, Illinois.

Harry was born on 19 November 1918 in Cleveland, Ohio. After graduating from high school early, he played professional baseball in the Cleveland Indians minor league farm system. He attended Vanderbilt University on a football scholarship and then Indiana University. He then transferred to the University of Michigan, where he received a BS in chemical engineering in 1941 and was president of his engineering college class. In 1942, he received his MS degree in chemical engineering from Michigan.

During World War II, Harry worked for Pan American Refining Corp in Texas City, Texas, as a chemical engineer. Just before leaving for this job, he took and passed the PhD qualifying exam in chemical engineering. In Texas, in addition to his regular duties, Harry was busy nights and Sundays collecting experimental data that he presented for his PhD thesis after the end of the war. He received his PhD in chemical engineering from Michigan in 1946. His thesis, entitled "Vapor–Liquid Equilibria in Phenol–Hydrocarbon Systems and Their Application to a Conventional Toluene Unit," was prepared under the guidance of George Brown and Robert White.

That same year, Harry joined the University of Illinois at Urbana-Champaign. He became a member of both the chemistry and chemical engineering departments in recognition of the breadth of his research. He was later also appointed a professor of physics. In 1963, he was made Professor in the Center of Advanced Study, the highest recognition the university bestows on members of its faculty.

Fifty years ago, Harry conceived the idea that pressure should be a powerful tool for investigating electronic phenomena in condensed phases. The main theme of his work was the concept that pressure can change the properties of condensed matter systems by its effect on the electronic orbitals—a phenomenon he called "pressure tuning" of electronic orbitals. The electrical, optical, magnetic, and chemical properties of solids or fluids depend on the relative



HARRY GEORGE DRICKAMER

energies of the electronic orbitals associated with the ground and excited states of the outer electrons belonging to the atoms or molecules. The effect of pressure is to decrease the volume and thus increase the overlap among the electronic orbitals. Because different orbitals have different radial extent and shape, they are perturbed to different degrees.

Harry showed that the use of pressure gave a powerful and versatile approach to the investigation of electronic phenomena. His concept of pressure tuning has proved to be a tool of great power and versatility and is now used by many research groups worldwide.

Harry provided clear-cut tests for the following theories: the ligand field theory (in the 1950s and 1960s); Van Vleck's theory of high-spin to low-spin transitions (1960s and 1970s); Forster–Dexter theory of energy transfer in phosphors (late 1970s); and Mulliken's theory of electron donor–acceptor complexes (1970s and 1980s). During the 1980s, he also developed successful tests for theories of the efficiency of a variety of phosphors and laser materials including II–VI and III–V compounds that exhibit the zincblende structure, rare earth oxides, chelates, and organic phosphors.

Starting in the late 1950s, he observed electronic transitions, including insulator–conductor transitions for six elements and about 30 compounds and transitions involving the conduction electrons in alkali, alkaline earth, and rare earth metals. He also observed paramagnetic–diamagnetic and ferromagnetic–paramagnetic transitions in ferrous compounds and in iron during the 1970s. In addition, he noticed that radicals were formed in many electron donor–acceptor complexes with high pressure and found that those radicals reacted to form new chemical bonds. Photochromic materials became thermochromic at high pressure. From the 1980s until before he died, Harry's research expanded to protein chemistry, the efficiency of luminescent devices, and organic photochemistry.

Among the 27 major awards Harry received were the Oliver E. Buckley Prize in Condensed Matter Physics (1967) from the American Physical Society, the Irving Langmuir Award in Chemical Physics (1974) from the American Chemical Society, and the P. W. Bridgman Award (1977) from the International Association for the Advancement of High Pressure Science and Technology. In 1989, President George H. W. Bush awarded him the National Medal of Science, and he received an honorary doctorate in 1994 from the Russian Academy of Sciences. The remarkable nature of his work is brought out by the fact that these honors were based both on research and teaching and are from organizations in physics, chemistry, and engineering.

Harry guided more than 100 doctoral students and 20 postdoctoral students. His retirement in 1989 did not change his research schedule; he continued to maintain an active research group and was in his laboratory six days a week. In 1995, Harry's former students contributed money for a professorship in his honor, but, as was typical of him, he decided it should be used to help graduate students. Drickamer Fellowships were instituted in the departments of chemical engineering, chemistry, and physics at the University of Illinois. Harry is sorely missed by his family, friends, and colleagues in the US and abroad.

JIRI JONAS
CHARLES SLICHTER
University of Illinois at Urbana-Champaign

Raymond Webster Hayward

Raymond Webster Hayward, a nuclear physicist and expert in the physics of beta decay in radionuclides, died following a heart attack on 24 December 2001 at his home in Bethesda, Maryland.

Ray was born on 28 July 1921 in Omaha, Nebraska. He received a BS

in electrical engineering from Iowa State College in 1943. During World War II, he served in the US Navy and was stationed at the Naval Research Laboratory in Washington, DC. His work there involved putting connectors on cables, producing the wiring diagram for a captured Japanese fighter plane, and designing antennas.

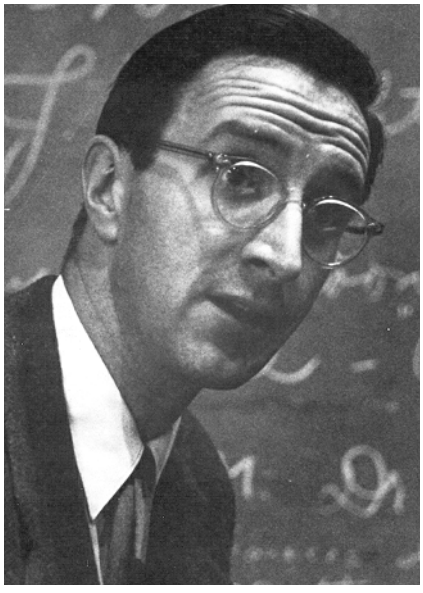
Following his wartime service, he enrolled in graduate studies in physics at the University of California, Berkeley, where he received MA and PhD degrees in 1948 and 1950, respectively. His thesis work under A. Carl Helmholz dealt with construction of a beta-ray spectrometer and its use in studies of nuclear beta decay.

At Berkeley, he met the experimental physicist Evans Vaughan, who became his wife in 1947. Toward the end of their studies, around 1950, Emilio Segrè told her that Ugo Fano (see PHYSICS TODAY, September 2001, page 73) of the National Bureau of Standards in Washington, DC, had an opening suitable for Ray to implement an experimental program in beta spectrometry at NBS. As a result of this exchange, both Ray and Evans obtained positions at NBS.

In 1950, Ray joined Fano's nuclear physics section at NBS (now known as the National Institute of Standards and Technology, or NIST) and began decay-scheme studies. Ray then moved to the radioactivity section under Wilfrid Mann and developed some of the first beta-gamma coincidence techniques for standardizing radionuclides used in nuclear medicine, such as iodine-131. In an article he wrote for *Advances in Electronics* in 1953, he gave a definitive description of the design and construction of beta-ray spectrometers.

In 1956, Ray became an adjunct professor of physics at the University of Maryland, College Park. When a separate nuclear spectrometry section was created at NBS during the mid-1960s, he was appointed its section chief.

Ray's activities led to his participation, in 1956, in the famous fundamental experiment that demonstrated that parity is not conserved in weak interactions. Chien-Shiung Wu (see PHYSICS TODAY, October 1997, page 120) at Columbia University contacted Ernest Ambler in NBS's cryogenic physics section, where one of us (Hudson) was chief, to suggest an experiment involving nonconservation of parity in the beta decay of cobalt-60 nuclei. Ray and his student Dale Hoppes helped design and construct the coincidence system. In 1962, Wu



RAYMOND WEBSTER HAYWARD

and the NBS team received the Franklin Institute's John Price Wetherill Medal for this work. The Department of Commerce bestowed its Gold Medal on the NBS team in 1957.

With assistance from students at Maryland and the Catholic University of America, Ray further investigated correlations among nuclear spin, beta particles and subsequent gamma rays, and probed other fundamental characteristics of beta decay. He spent the year 1961–62 in Copenhagen at the Institute for Theoretical Physics (now known as the Niels Bohr Institute) for the stimulating experience of joining the community of Niels Bohr, his associates, and a transient complement of some 50 distinguished visitors. There, Ray engaged in lively discussions of the problems that, at that time, were at the forefront of nuclear and elementary particle physics. Ray then returned to NBS.

For the next 20 years, Ray delved into various aspects of theoretical physics, including the long-standing difficult problem of the dynamics of fields with intrinsic spin greater than one. In a comprehensive study in 1976 (*NBS Monograph*, number 154), he used the variational methods of classical Lagrangian field theory to develop a relativistic theory of higher-spin fields. Beginning in the late 1970s and continuing through the rest of his career, Ray studied gravitational wave detection; he focused in particular on performing quantum nondemolition experiments and examined in detail the quantum properties of the macroscopic harmonic oscillator. He discussed how to measure certain observables of a harmonic oscillator, without affecting the results of subsequent measurements of the oscillator, to a precision better than the uncertainty imposed by the quantum limit.

After Ray retired from NBS in 1980, he continued to study electromagnetism, quantum mechanics, relativity, weak interactions, and gravitation.

Ray was a courtly, affable man with a wry sense of humor. His hobbies included mountain climbing, hunting, and fly-fishing. He also enjoyed listening to classical music and owned an impressive collection of recordings. The Haywards regularly entertained physicists from all over the world and were famous for the large parties they held when meetings of the American Physical Society were scheduled in Washington, DC.

RALPH HUDSON
Chevy Chase, Maryland
BERT COURSEY
National Institute of Standards and Technology
Gaithersburg, Maryland
SYDNEY MESHKOV
California Institute of Technology
Pasadena, California

Charles Thornton Murphy

Charles Thornton Murphy, who helped build Fermilab, died on 12 October 2001 of complications following a fall at his home in Batavia, Illinois.

C. Thornton Murphy, as he was commonly known, was born in Cambridge, Massachusetts, on 20 May 1938. The son of a classics professor, he traveled as a boy with his family throughout Europe. He eventually became fluent in Italian and French. In 1959, he graduated from Princeton University with a BA in physics. He earned an MS in 1961 and a PhD in 1964, both in physics, from the University of Wisconsin–Madison. His doctoral thesis, which addressed an experimental study of the branching ratios of the decay modes $\Sigma^{\pm} \rightarrow e^{\pm} + \nu +$ hadron(s), was prepared under the guidance of Jack Fry.

As a research associate at Wisconsin, he worked on bubble chamber physics at the Lawrence Berkeley Laboratory. He joined the University of Michigan as an assistant professor of physics in 1964, moving in 1968 to Carnegie Mellon University, where he developed several teaching innovations, including courses in relativity and new approaches to laboratory