Bill's record of contributions to science, technology, and country was outstanding. He had much more to contribute, and his death in an outrageous terrorist attack was a terrible waste. We were proud to know him and, with his many other colleagues and friends, will sorely miss him.

CURTIS G. CALLAN JR
Princeton University
Princeton, New Jersey
FRANK WILCZEK
Massachusetts Institute of Technology
Cambridge, Massachusetts

John Edward 'Jack' Estes

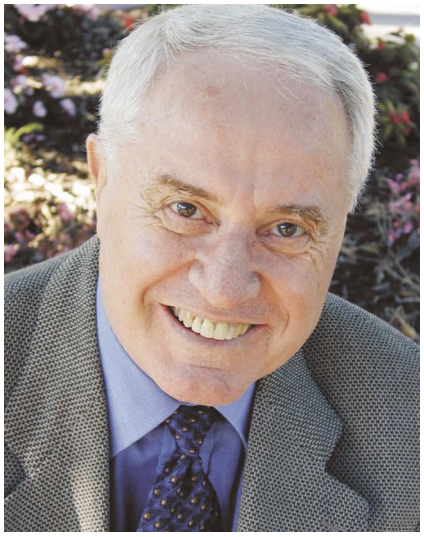
John Edward "Jack" Estes died of cancer in Santa Barbara, California, on 9 March 2001. Like the geographers of old, Jack, a pioneer in the fundamental and applied aspects of remote sensing and geographic information systems, helped us see the world in new and more complete ways.

Born in San Diego, California, on 21 July 1939, Jack earned his degrees in geography: his BA in 1962 and his MA in 1963 from San Diego State University and his PhD in 1969 from UCLA. His doctoral thesis, completed under Norman Thrower, was on multi-image systems for geographic research.

Jack began his faculty career as an assistant professor of geography at the University of California, Santa Barbara, in 1969 and, with David Simonett, formed the nucleus of what has become one of the nation's outstanding geography departments. Jack founded the department's geography remote sensing unit in 1972 and served as the unit's director throughout his tenure.

He was a pioneer in promoting innovative applications of space-based Earth observations and geospatial information by cartographers and geographers. Jack had extensive experience in the federal government, mainly with NASA and the US Geological Survey (USGS). The 1969 oil spill in the Santa Barbara Channel led him to work on the detection of marine oil pollution, and from the early 1970s to the time of his death, he conducted studies for NASA on land-use change, crop identification, water-demand modeling, and soil moisture conditions. Initially, in the 1970s, his primary regional focus was the southern San Joaquin Valley, but the work was of such wide applicability that, during the 1980s, he and his students extended it worldwide. He also applied remote sensing technology to fire fuels monitoring and modeling, hazard and pollution detection, and resources management.

SUSAN BAUMGART, UCSB



JOHN EDWARD "JACK" ESTES

Jack had an exceptional ability to lead and guide graduate students, rather than direct them, in pursuit of their education and research objectives. More than 50 of his students received degrees and are now employed in prominent positions in various professional fields. His strength in teaching both undergraduate and graduate students lay in his thorough knowledge of his subject, his ability to organize and present complex materials, his sense of humor, and his sincere interest in his students' well-being. He had a splendid sense of loyalty to his colleagues and students, and he made many lifelong friends.

Jack's significant, generous contributions to the remote sensing and geographic information systems communities went far beyond academia. In the 1990s, he took extended assignments of several years' duration with both the USGS and NASA to assist in formulating national and international programs and policies for space-based Earth observations. Before his death, he had been the chair of the international steering committee for global mapping since its establishment by the United Nations in 1996, and he served on NASA's international space station science utilization advisory committee. On the NASA committee, he successfully worked to secure the Window Observation Research Facility, an optical-quality window in the space station that allows Earth remote sensing and that was successfully tested on a space shuttle mission in 2000.

As an outgrowth of his research, Jack published widely in a variety of venues. His work covered such fields as monitoring marine oil spills, analyzing agricultural crop identification and water demand, preserving biological diversity, and integrating remote sensing information with expert systems. He was the editor of the interpretations and applications volume of the *Manual of Remote Sensing* (2nd edition, American Society of Photogrammetry, 1983). With Daniel Botkin, he edited *Changing the Global Environment: Perspectives on Human Involvement* (Academic Press, 1989), and with Jeffrey Star he wrote *Geographic Information Systems: An Introduction* (Prentice Hall, 1990).

Jack received the 1999 William T. Pecora Award, presented jointly by NASA and the US Department of the Interior to recognize outstanding contributions by individuals or groups toward an understanding of Earth by means of remote sensing. In 2001, NASA awarded Jack the Distinguished Public Service Medal in recognition of his pioneering achievements.

For more than three decades, Jack helped those who study and manage the Earth to realize the tremendous potential of emerging geospatial and information system technologies, and he promoted this goal through his teaching and practice in modern geography. Jack will be missed greatly, though his legacy lives on through his numerous valuable national and international scientific contributions and his students.

JEFF DOZIER
University of California, Santa Barbara
GHASSEM ASRAR
NASA Headquarters
Washington, DC

Leslie Lawrance Foldy

Leslie Lawrance Foldy, Institute Professor Emeritus of Physics at Case Western Reserve University, whose pioneering work elucidated the theory of the multiple scattering of waves and the nonrelativistic limit of the Dirac equation, died on 18 January 2001 in Cleveland, Ohio, after suffering a heart attack on the previous day.

Les was born in Sabinov, Czechoslovakia, on 26 October 1919, into a family with Hungarian roots. His parents named him Laszlo Földi. In the turbulent times following World War I, he immigrated with his parents to the US in 1921. His father changed the family's last name and Les's first

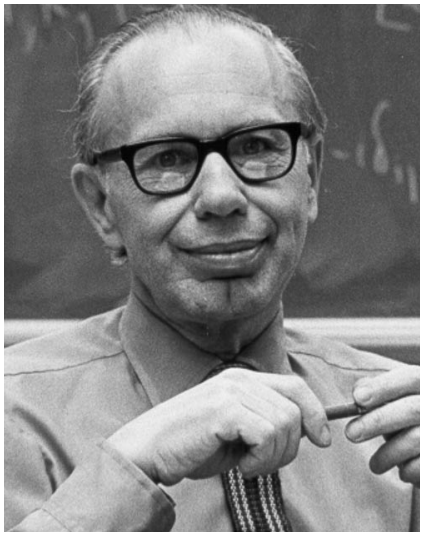
name; Les later added his middle name, unaware of its more common spellings. He attended the Case School of Applied Science (which later was named the Case Institute of Technology, the forerunner, with Western Reserve University, of Case Western Reserve University), where he received his BS in physics in 1941. He took one year of graduate study at the University of Wisconsin–Madison with Leon Brillouin, and was awarded a physics master of philosophy degree in 1942.

That same year, Les joined Columbia University's Underwater Sound Laboratory, where he participated in research associated with the war effort. It was there that he published, in 1945, his first, and perhaps most influential, paper on the behavior of waves in the presence of a disordered array of scatterers. Originally developed to treat the multiple scattering of sound from the cloud of cavitation bubbles in the wake of a submarine, this theory was found to have a wide application in areas as diverse as neutron scattering and the behavior of electrons in disordered alloys. Les's fundamental insights were subsequently rediscovered many times by later workers who were unaware of his paper.

His time at Columbia was eventful, and is especially poignant now in light of the World Trade Center airplane disasters on 11 September 2001. Working one Saturday on the 64th floor of the Empire State Building, he was startled to hear the sound of a rapidly approaching airplane. A tremendous noise signaled that it had crashed into the building a few floors above him, resulting in some loss of life. Considerate, but also sparing with his words, Les sent a telegram to his wife, Roma, in Florida with this simple message: "Don't worry. I'm all right!" She was unaware of the accident and, on receiving his telegram, worried!

In 1945, Les went to the University of California, Berkeley, to pursue his PhD in physics in the group of J. Robert Oppenheimer. After two years there, during which he also worked with Luis Alvarez and David Bohm, he followed Oppenheimer to the Institute for Advanced Study in Princeton, New Jersey, where he completed his doctoral degree in 1948. Les then returned to the Case Institute of Technology as an assistant professor of physics.

The paper for which Les is most widely recognized arose from a collaboration with another former student of Oppenheimer, Dutch physicist



LESLIE LAWRANCE FOLDY

Siegfried Wouthuysen. During the summer of 1949 at the University of Rochester, where they worked with Robert Marshak, Les and Wouthuysen wrote a preprint on the nonrelativistic limit of the Dirac equation. At a summer school in Michigan, a French physicist vigorously criticized this work, claiming to have found an error in it. This criticism stimulated Les and Wouthuysen to reformulate their calculation in such a completely clear and elegant way that all objections crumbled. The approach they adopted was to make use of a canonical transformation that has now come to be known as the Foldy–Wouthuysen transformation. Before their work, there was some difficulty in understanding and gathering all the interaction terms of a given order, such as those for a Dirac particle immersed in an external electromagnetic field. With their procedure, the physical interpretation of the terms was clear, and it became possible to apply their work in a systematic way to a number of problems that had previously defied solution.

Les's work in the four decades that followed covered an extraordinarily rich variety of topics, ranging over particle, nuclear, many-body, atomic, and solid-state physics, as well as acoustics, and scattering and accelerator theory. With Fred Milford, he developed, in 1950, the theory of nuclear magnetic moments in distorted nuclei. He was also the first (1952) to realize that the magnetic field of the neutron had to be considered in the theory of electron–neutron scattering; this realization led to what is now called the Foldy term. This idea came to him while he was brushing his teeth one night; he developed the formalism and sent off his paper to the *Physical Review* the very next day! On another occasion, in 1954, he gave a proof that there could exist no charged particle lighter than the electron, because if there had been such particles, they would have modified the Lamb shift.

Les was revered by his students and colleagues for more than his intellectual gifts. His gentle modesty concealed a firm core of moral principle that led him to refuse government support for his research during the Vietnam War. When four students were killed by the Ohio National Guard at the nearby campus of Kent State University, Les was an influential voice in his university's decision to suspend classes.

Les will be most remembered for the generosity he showed in sharing his knowledge, insight, and wisdom to all who sought his advice. If one approached Les for scientific help because of his reputation as a fount of wisdom (and he indeed was so besieged by students and senior faculty alike), then one stayed because of his kindness. For a celebration of Les's 80th birthday, Case Western Reserve University physics department received hundreds of enthusiastic letters and e-mail messages from well-wishers; the outpouring of affection and admiration was stunning. His death, coming so soon after this celebration of his life, will not diminish the memory of his impressive scientific achievements and his unique goodheartedness.

ROBERT W. BROWN
LAWRENCE M. KRAUSS
PHILIP L. TAYLOR
Case Western Reserve University
Cleveland, Ohio

Howard Thomas Powell

Howard Thomas Powell, a noted laser physicist and contributor to the inertial confinement fusion (ICF) program at Lawrence Livermore National Laboratory (LLNL), died suddenly of an apparent heart attack on 15 November 2000 while attending to laboratory business in Washington, DC. A leader in the development of high-power gas and solid-state laser systems for almost three decades, Howard was internationally renowned for his contributions.

Howard came from humble beginnings. Born on 2 October 1944, he was reared in Woodland, a small logging town in Washington State. The son of