tum between spacecraft; that effort opened new methods of orbit changing. Cables carrying electrical currents can raise or lower orbits by using the $\mathbf{J} \times \mathbf{B}$ force, available from Earth's magnetic field. Forward believed that antimatter could provide the most fundamental method of containing energy. In the 1980s, he published 18 issues of his privately circulated journal, *Mirror Matter Newsletter*, to stimulate the field. He saw how magnetic traps could make antimatter useful in medicine, principally in tumor treatment.

Forward lived up to his name: His thinking was well ahead of his time, and he was known for a positive, supportive, and playful manner. We knew him primarily as a pioneer of beam-driven sails, but he had a thousand other interests. Some of his papers have amusing titles, such as "Laser Weapon Target Practice With Gee-Whiz Targets." He fancied wearing colorful vests to go with his exciting ideas, concepts nonetheless developed with full conservative scientific rigor. Knowing of his fatal illness, he devoted his last months to writing out his newest, partially explored scientific ideas.

Of Forward's many innovations, some were realized in his life, but most will likely emerge in 21st-century space propulsion and gravitational wave detection. Now that the first solar sails are about to be launched and plans are being made to beam microwaves at them to demonstrate photon propulsion, Forward's ideas are starting to become real. He was fond of saying that he wrote science fiction to advance ideas that he couldn't get into the scientific journals. He usually coupled his science-fiction writing to his science papers and thus gave concepts a wider publicity and advanced public understanding of what the consequences of these ideas could mean.

Gregory Benford
University of California Irvine
James Benford
Microwave Sciences Lafayette, California

Frank Slagle Ham

Frank Slagle Ham, a theoretical solid-state physicist best known for his many contributions to the understanding of the Jahn–Teller (JT) effect in condensed matter, died on 12 December 2002 in Schenectady, New York. While being treated for a stroke he had suffered in May 2002, Frank—though never a smoker—was diagnosed with lung cancer, which eventually led to his death.

Frank Slagle Ham

Born in Bronxville, New York, on 15 August 1928, Frank grew up in Washington, DC, and obtained both his AB (1950) and PhD (1955) in physics at Harvard University. His doctoral dissertation, under Harvey Brooks, represented an early application of the quantum defect method to the study of the electronic structure of solids.

After a postdoctoral period at the University of Illinois, he joined the General Electric Research Laboratory in Schenectady in 1955; he was employed at the lab until his retirement in 1988. During that 33-year period, he spent a year (1971–72) on a Guggenheim fellowship at Oxford University's Clarendon Laboratory in England and a year (1976–77) as visiting professor at Clemson University. He also held adjunct and visiting professorships at Rensselaer Polytechnic Institute (1968–69, 1980–91) and at Lehigh University, where he was active in research from 1983 until his death.

At GE, Frank expanded his energy-band calculations to provide the first practical application of the KKR (Korringa-Kohn-Rostoker) Green's function method to such problems. He subsequently published several articles that contained analytic solutions for the diffusion and aggregation of impurities in crystalline solids and made contributions to the interpretation of luminescence energy-transfer mechanisms in crystals.

In the mid-1960s, Frank, like other theorists at the time, was concerned about electron paramagnetic resonance (EPR) spectra of many impurity ions that have orbitally degenerate ground states. The states appeared to show no evidence of the symmetry-lowering JT distortions predicted by theory. Frank was the first to recognize that the JT effect was actually present all along—not static but dynamic—with rapid tunneling from one distortion direction to another. Hence, an average was being observed in the EPR spectrum and the system superficially appeared undistorted. Frank showed that predictable telltale changes in the spectra's parameters provided a direct quantitative determination of the distortions' symmetry and magnitude. In subsequent years, he further demonstrated that the dynamic JT effect can have important consequences in all forms of spectroscopy. Terms such as the "Ham effect" and the various "Ham reduction factors" for spin–orbit interaction, orbital angular momentum, and magnetic and strain perturbations are now essential parlance among spectroscopists.

Throughout his career, Frank was interested in the vibronic coupling between the surrounding lattice and an impurity ion or lattice defect. He made important contributions to a number of problems, including the relaxed excited state of the F-center in alkali halides; the EPR, acoustic, optical, and Mössbauer spectra of transition element ions in a variety of ionic and semiconductor hosts; and the unusual EPR spectra of interstitial lithium and the negatively charged states of the lattice vacancy and substitutional platinum in silicon. He also worked on the inverted level ordering for double acceptors and acceptor-bound excitons in semiconductors, the Zeeman effect on double-donor spin–triplet levels in silicon, and the effect of Berry's phase on the sequence of vibronic states for a defect.

Frank made many important but less visible contributions by generously sharing his knowledge and guiding others in interpreting their data. If one was wrong, Frank's criticism was incisive, but he delivered it with such patience and courtesy that one's pleasure in finally seeing the point was unclouded by any feeling of inferiority. Whether graduate student or senior scientist, one would emerge grateful, more knowledgeable, and much closer to the correct interpretation.

Frank served on the executive committee of the American Physical Society's division of condensed matter physics from 1976 to 1978 and on APS's Apker Award committee from 1983 to 1985. He was a member of the editorial board for *Physical Review B* from 1978 to 1982.

Aside from his scientific career, Frank was an enthusiastic environmentalist. In the early 1960s, he played a major role in raising the money to purchase and protect an undeveloped 112-acre tract of natural forest in Niskayuna, a suburb of Schenectady. Named the Lisha Kill Natural Preserve, this lovely natural haven stands today as an appropriate monument to Frank, who had been the official steward of the preserve from its inception.

Throughout his life, Frank set for himself the highest standards of honesty and integrity and produced work of the utmost reliability. This gracious, likeable person is missed by the many scientists whose research he has strongly influenced and particularly by those of us who were lucky enough to have known him personally.

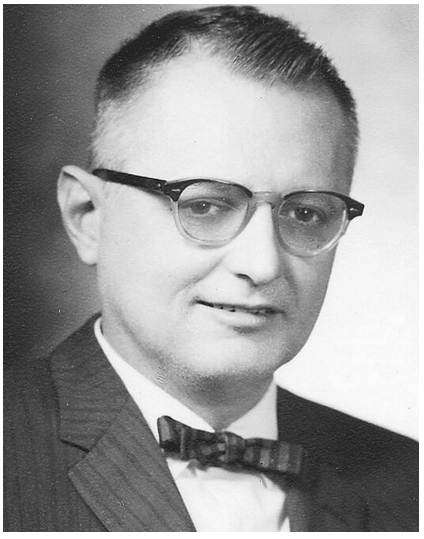
George D. Watkins
W. Beall Fowler
Lehigh University
Bethlehem, Pennsylvania
Michael D. Sturge
Dartmouth College
Hanover, New Hampshire

Charles Earle Mandeville III

Charles Earle Mandeville III, educator, administrator, and experimentalist in low-energy nuclear physics, died in Socorro, New Mexico, on 14 January 2003 of complications from a stroke.

Born on 3 September 1919 in Dallas, Texas, Mandeville was valedictorian of his class at Adamson High School. He served as a private in the Texas National Guard 112th Cavalry band from 1936 to 1937 while attending Rice University, where he received a BA in 1940, MA in 1941, and PhD in 1943, all in physics. His PhD thesis, "The Energies of Some Nuclear Gamma-rays," was under the supervision of Harold A. Wilson. He was a fellow in physics at Rice while a graduate student. Until the end of World War II, he was a staff member at MIT's Radiation Laboratory, where he assisted in the advancement of American military radar. He returned to Rice as an instructor after the war, continued his earlier research involving gamma-ray sprectroscopy, and expanded his pursuits to include neutron scattering.

In 1946, Mandeville began his professional research career as a nuclear physicist with the Bartol Research Foundation of the Franklin Institute in Swarthmore, Pennsylvania. He participated in a unique program that allowed students from India who had an MSc in physics to conduct their doctoral research at Bartol and then submit their theses to their respective universities in India. More than a dozen students under his guidance benefited from that program. From 1950 to 1956, Mandeville was a visiting lecturer in radiological physics at the Philadelphia College of Osteopathic Medicine; he spent the summer months consulting with the US Naval Ordinance Test Station in China Lake, California. He served as an assistant director of Bartol from 1953 to 1959.



Charles Earle Mandeville III

His research interests involving alpha-, beta-, and gamma-ray spectroscopy led to his determination of properties of nuclear energy levels. His early pioneering work on beta decay of nuclei, from low Z to high Z elements, helped in calculating comparative half-life values, which were important in the formulation in 1949 of the single-particle shell model of nuclei. One aspect of his research was the use of photosensitive Geiger–Mueller counters to detect scintillation induced by gamma and beta rays, a precursor to the sodium iodide–photomultiplier combination for gamma-ray spectroscopy. Other work along that line included storage of energy in some activated alkali halide phosphors, luminescence of beryllium oxide, and phosphorescence of thorium oxide.

Yearning to return to his beloved South, he accepted the position of head of the physics department at the University of Alabama at Tuscaloosa in early 1959. For the next two years, he concurrently served as a consultant to the Army Rocket and Guided Missile Agency at Redstone Arsenal in Huntsville.

Mandeville subsequently took a job as a professor of physics at Kansas State University in Manhattan, working in that position until 1967. His research group used the university's Triga teaching reactor to produce short-half-life radioactive sources from isotopically enriched materials. While at KSU, he initiated efforts that culminated in the acquisition of a tandem Van de Graaff accelerator. He consulted during summers with the US Naval Radiological Defense Laboratory in San Francisco and with Kaman Nuclear, a division of Kaman Aerospace, in Colorado Springs, Colorado.

Mandeville then joined Michigan Technological University in Houghton as head of the physics department and, in 1975, became the director of special projects of the MTU energy research committee. At MTU, he continued his lifelong research interest in gamma-ray emissions. He also worked on a semiclassical model of ferromagnetism and taught basic physics until his retirement in 1984. Following his retirement, Mandeville and his wife relocated to Houston and later moved to Phoenix, Arizona, for three years before finally settling in Socorro.

A fellow of the American Association for the Advancement of Science, Mandeville served as a consultant, at various times, to a congressman, a nuclear power utility, and several other energy-oriented companies. He received a patent in 1957 for a device that determines the intensity of nuclear radiations.

Throughout his life, Mandeville enjoyed playing the piano and was an accomplished percussionist who was proficient in all the section instruments, including the xylophone and the spoons. He was lead percussionist of the Swarthmore Symphony Orchestra for eight years. His other interests included collecting coins; precious and semiprecious stones; 19th- and 20th-century American art glass; antique buttons; European hard-paste porcelain; art objects of gold, silver, and platinum; and original Japanese woodblock prints by Hokusai. He was an avid collector of Bakelite jewelry in his later years. He was also a budding novelist; his book *University* (Exposition Press, 1973) was based on his academic experience.

For both of us, he was our teacher and guide. We remember him as a man of high ethical standards.

Vasant R. Potnis
Gary P. Agin
Michigan Technological University
Houghton ■