field. **John B. Goodenough**, Virginia H. Cockrell Centennial Chair in Engineering at the University of Texas at Austin, was acknowledged for his "discovery of environmentally benign electrode materials for high-energy density rechargeable lithium batteries," according to the foundation. He received a cash prize of ¥50 million (about $432 000).

In February, the Royal Society honored **David Sherrington** as the presenter of the 2001 Bakerian Lecture, the society's premier annual prize lecture in the physical sciences, given under the title "Magnets, Microchips, Memories and Markets: The Statistical Physics of Complex Systems." Sherrington is Wykeham Professor of Physics and Head of Theoretical Physics at the University of Oxford, and a fellow of the Royal Society.

The Heinz Family Foundation in Pittsburgh announced the winners of the five Heinz Awards in February. Of those awards, two are related to the physical sciences. The Heinz Award for Public Policy went to **John Holdren**, Teresa and John Heinz Professor of Environmental Policy at Harvard University. According to a foundation spokesperson, Holdren was honored for "the significant role he has played over the years in such complex issues as arms control, global energy resources, and sustainable development. A rare scholar who inspires colleagues, students, and world leaders alike, he has participated in the formation of public policy at the highest levels." The Heinz Award for the Environment was given to **James Hansen** for showing "exemplary courage and leadership by going public with his concerns over the threat of global climate change. His dogged pursuit of this pressing problem has attracted supporters as well as critics, and he continues to serve as a lightning rod in this often-contentious debate." Hansen is head of the NASA Goddard Institute for Space Studies in New York. Each recipient received a medallion and a cash prize of $250 000.

The National Academy of Sciences has elected **James Langer** as its new vice president for a term running July 2001 through June 2005. Langer is a professor of physics at the University of California, Santa Barbara, and immediate past president of the American Physical Society.

The Natural Sciences and Engineering Research Council of Canada awarded its first Gerhard Herzberg Canada Gold Medal for Science and Engineering to **Howard Alper** last December. Alper, a professor of chemistry and vice-rector of research at the University of Ottawa, was recognized for, among his other accomplishments, "his work in developing tools to synthesize and modify molecules," said the citation. The medal, NSERC's highest honor, is awarded to an individual who has demonstrated sustained excellence and influence in research for a body of work conducted in Canada that has substantially advanced the natural sciences or engineering fields. NSERC will provide Alper with Can$1 million (about US$651 000) for his research over the next five years.

Barry Taylor, manager of the Fundamental Constants Data Center at NIST in Gaithersburg, Maryland, is the first recipient of the CODATA Prize, which was awarded last fall by the Committee on Data for Science and Technology (CODATA) of the International Council for Science. Taylor was cited for "major contributions to the advancement of our understanding of the physical world through critically evaluated values of the fundamental physical constants." The CODATA secretariat, located in Paris, serves a worldwide network of national committees, scientific union members, and other supporting organizations.

In Calcutta last September, the Indian Association for the Cultivation of Science in Calcutta awarded its first Professor K. Banerjee Endowment Lecture Silver Medal to **John R. Helliwell** during a centenary celebration of Banerjee's birth. At that celebration, Helliwell delivered the lecture "New Opportunities in Biological and Chemical Crystallography," which was published in the January 2001 issue of *The Indian Journal of Physics*. He is the professor of structural chemistry at the UK's University of Manchester and editor-in-chief of *Acta Crystallographica*.

OBITUARIES

Cornelius Anthony 'Toby' Tobias

CORNELIUS ANTHONY "TOBY" TOBIAS

Cornelius Anthony "Toby" Tobias, a pioneer in radiation biology who was known as the "Father of Hadron Therapy," died of cancer on 2 May 2000 in Eugene, Oregon.

Born in Budapest, Hungary, on 28 May 1918, Toby earned his BS in physics at the Hungarian University of Electrical and Technical Sciences in Budapest. In 1939, he went to the University of California, Berkeley, to work in Ernest Orlando Lawrence's laboratory on a fellowship. That one-year visit extended to a 45-year distinguished teaching and research career at Berkeley and Lawrence Berkeley National Laboratory (LBNL). At Berkeley, Toby received his PhD in nuclear physics in 1942; Emilio Segrè and Louis Alvarez were his academic advisers. As part of his dissertation research, Toby was the first to accelerate carbon nuclei in a cyclotron and one of the first to apply accelerated ions to the study of biology and medicine.

In 1955, Toby teamed with John H. Lawrence to work at the Donner Laboratory at Berkeley. Because of its proximity to the 60-inch cyclotron, this laboratory became the birthplace of nuclear medicine. The synergy of the Lawrence brothers and Toby ushered in a remarkable era for nuclear medicine, fundamental radiobiology research, and hadron therapy.

At Berkeley, Toby became a professor of medical physics (1955) and chair of medical physics (1967–71), and was advanced to Professor-Above-Scale (1978). He also became a professor of electrical engineering at Berkeley, a professor of radiology at the University of California, San Francisco (UCSF), and a professor emeritus of medical physics (1985) at Berkeley.

Toby was a valuable member of the Donner group, which first (in 1945) began to use radioisotope tracers to study various human physiologies. Within that group, Toby led the team that administered a radioactive isotope to humans using carbon-11–labeled carbon monoxide. The ^{11}C tracer was used to investigate, among other phenomena, how pilots developed the "bends" at high altitudes. In 1945, Toby also formulated an analysis of tracer turnover in the human body, which led to methods for quantitating local blood perfusion and to the discovery in 1946 that inert xenon gas, under subatmospheric pressures, can be an effective anesthetic.

As soon as Ernest Lawrence completed the 184-inch synchrocyclotron in 1947, Toby performed the first biology experiments using protons. When the Bevatron was completed in 1954, Toby investigated human therapeutic exposure to accelerated protons, alpha particles, and deuterons. In 1958, he published in *Cancer Research* a rationale for the use of heavy charged particles for radiation therapy of human cancer. Toby's group at LBNL also made the first heavy-ion exposures of unicellular organisms (1957), laminar cerebral lesions by accelerated protons (1958), and corpus callosum cut by accelerated alpha particles in animals (1964). These data led to clinical trials at LNBL for treating arteriovenous malformation (AVM) using accelerated protons and alpha particles, a modality now used to treat AVM at several accelerator facilities.

Soon after the 1947 discovery of high-*Z* primary cosmic rays in high-altitude balloon flights, Toby wrote an article in 1952 in the *Journal of Aviation Medicine* on the potential hazards of these rays in spaceflight. He predicted that individual heavy ions passing through the retina might produce visual effects and that a very heavy particle could kill or modify a row of cells in its path. In 1969, Edwin Aldrin and the other Apollo-11 astronauts did observe mysterious visual stars and streaks during the first lunar mission. Toby began a series of experiments at the 184-inch synchrocyclotron, and later at the Bevalac, in which he introduced individual accelerated heavy ions to eager scientists' eyes to reproduce the peculiar flashes and streaks of light. Only Toby and a few scientists enjoyed the light show, because a human-use committee stopped the experiment.

When low-energy accelerated heavy ions became available at the SuperHILAC in 1961, Toby and coworkers began a series of heavy-ion radiobiology experiments with yeast cells and bacterial spores. These inquiries showed that the cross section for heavy-ion effects increased proportionally with the square of the linear energy transfer (LET). When dry spores were irradiated, many low-LET effects could be annealed or chemically reversed, whereas high-LET radiation appeared to produce irreversible damages. The radiobiological oxygen effect (that well-oxygenated healthy tissues are more radiosensitive than anoxic tumor cells) was eliminated when argon beams were used. Those findings provided the foundation for heavy-ion radiotherapy to treat human cancer. Toby was honored for his contributions to cellular radiation biology in 1963: He received the Ernest Orlando Lawrence Memorial Award from the US Department of Energy (DOE).

When the Bevatron and SuperHILAC were integrated to form the "Bevalac" in 1975, Toby's group became an active center of basic radiobiological research. Their investigations culminated in an intensive heavy-ion cancer treatment program in collaboration with physicians at UCSF in 1976. Toby retired from LBNL in 1987 as a faculty senior scientist.

In addition to his work at LBNL, Toby was instrumental in the development of hadron treatment facilities in many countries, including Sweden, Russia, Japan, and Germany. Toby also was a member of the radiobiology committee of the National Research Council, president of the Radiation Research Society in 1962, and founding member of the Biophysical Society.

His recent book *People and Particles* (San Francisco Press, San Francisco, 1997), which he wrote with his wife Ida Lanning Tobias, is full of anecdotes and a personal account of the historical development of LBNL and the Donner Lab. An oral history of Toby's human radiation studies can be found at the DOE Web site http://tis.eh.doe.gov/ohre/roadmap/histories/0480/0480toc.html.

Toby's life's work applied to many scientific disciplines, from physics to biology to medicine. The results will continue to touch the lives of the many patients who are treated at proton and heavy-ion cancer treatment centers worldwide. We will all miss Toby greatly.

WILLIAM T. CHU
University of California, Berkeley

George Irving Bell

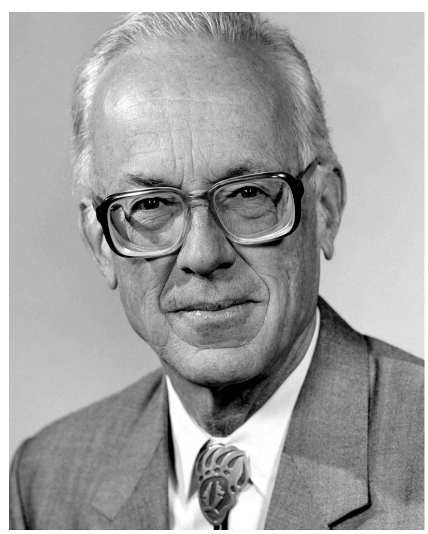
George Irving Bell, a pioneer in the applications of physics and modeling to problems in immunology and cell biology, died on 28 May 2000 in Los Alamos, New Mexico, from complications of leukemia after routine surgery.

Born on 4 August 1926 in Evanston, Illinois, Bell received his BS in physics from Harvard University in 1947 and his PhD in theoretical physics in 1951 from Cornell University. At Cornell, he worked under the supervision of Hans Bethe on the capture and loss of electrons by fission fragments.

In 1951, he joined the theoretical division of Los Alamos National Laboratory (LANL), where he spent the remainder of his scientific career as a staff member (1951–70), associate division leader (1970–76), group leader (1974–90), alternate or acting division director (1976–80), division director (1980–89), and senior fellow until his retirement.

Initially, as a member of the division's neutronics group, Bell applied neutron transport methods to nuclear reactors and nuclear weapons. He also helped with the planning and analysis of experiments on nuclear explosions; discovered the Bell–Plesset instability that occurs in imploding systems as a result of material granularity; and published, with Samuel Glasstone, the definitive text in nuclear reactor physics and safety, *Nuclear Reactor Theory* (R. E. Krieger, Huntington, N.Y., 1979).

During the 1960s, he was one of a small number of physicists who began to do theoretical work in biology. He first focused on cell biology and developed quantitative models of cell growth and division. This research rapidly led



GEORGE IRVING BELL