in metals and of the quantum mechanics of dissipative systems."

ICTP PRESENTS DIRAC MEDALS

The International Centre for Theoretical Physics in Trieste, Italy, presented the three 1993 Dirac Medals on 8 August. The winners were **Sergio Ferraro**, a member of the senior research staff at CERN and a professor of physics at the University of California, Los Angeles, **Daniel Z. Freedman**, professor of applied mathematics at MIT, and **Peter van Nieuwenhuizen**, Leading Professor of Physics at the Institute for Theoretical Physics of the State University of New York, Stony Brook.

The three were honored for "their discovery of supergravity theory in 1976 and their major contributions in the subsequent developments of the theory." The citation continues, "Their discovery led to an explosion of interest in quantum gravity, and it transformed the subject, playing a significant role in very important developments in string theory as well as Kaluza–Klein theory. Currently any grand unified theory incorporating gravity is based on a supergravity theory coupled to matter in four dimensions, which naturally emerge from the compactifications of the ten-dimensional heterotic string."

MACARTHUR WINNERS NAMED

Of the 31 individuals who received MacArthur Fellowships, ranging from $160 000 to $375 000 over five years, six work in physics or physics-related areas. **Demetrios Christodoulou**, professor of mathematics at Princeton University, works at the boundary between physics and mathematics. The MacArthur announcement stated that "his work is characterized by rigorous mathematical analysis combined with geometric and physics intuition. His approach places him in a unique position to achieve important results in the field of general relativity." **Maria Luisa Crawford**, the William R. Kenan Jr Professor of Geology at Bryn Mawr College in Pennsylvania, was cited by the foundation for "work that involves the reconstruction of past geologic processes in order to study their effect on the Earth's crust and to better understand the Earth's resources." Another recipient of MacArthur largesse is **Stephen Lee**, professor of chemistry at the University of Michigan. The citation says that "his research combines theoretical and experimental approaches to solid-state chemistry and electronic structure theory. He . . . is currently researching such areas as covalent bonds, topology effects on metal–insulator transitions and synthesis of various new materials." **Amory Bloch Lovins**, director of research for the Rocky Mountain Institute in Aspen, Colorado, was given the award for work "to reshape the energy policy of the US and other nations by advancing strategies that focus on nonpolluting and economically competitive sources of energy."

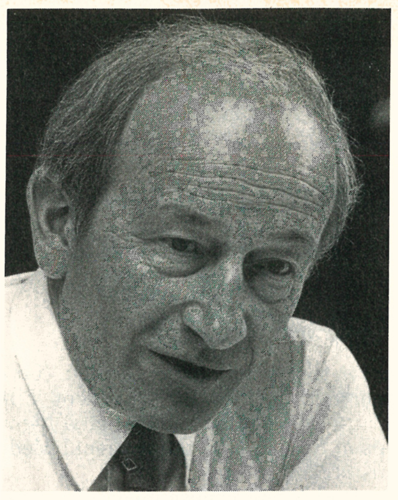
Frank von Hippel, professor of public and international affairs at Princeton University, "has made contributions to the study of proliferation-resistant nuclear fuel cycles, cooperative approaches to nuclear disarmament, nuclear test bans and warhead dismantlement, and improvements in automobile efficiency." In September von Hippel was appointed assistant director for national security in the President's Office of Science and Technology Policy. The MacArthur Foundation cited **Robert Williams**, senior research physicist at Princeton University's Center for Energy and Environmental Studies, for work that has "caused energy analysts and policymakers in the US and elsewhere to address the possibilities for decoupling energy consumption and economic growth. Over two decades he has documented the possibilities for cost-effective, environment-sparing, prosperity-enhancing energy futures in industrialized and developing countries based on efficiency improvements and innovative energy supply technologies."

OBITUARIES

Solomon J. Buchsbaum

Solomon J. Buchsbaum, who died of complications from multiple myeloma on 8 March 1993, was one of the true statesmen of science—and of technology—in his generation. Known as Sol throughout the US science and technology community, he served his science, his company and his nation in exemplary fashion, and he will be much missed.

Sol was at heart a fighter; he no more gave in to his illness in recent years than he had as a youth to seemingly hopeless situations during World War II. In 1941, two years after the Nazi invasion of Poland,



Solomon J. Buchsbaum

Sol's father, Jacob, together wit other businessmen of his home city Stryj, was "removed" and never hear from again. Two years later, just before Sol's 13th birthday, the remaining Jewish residents were assembled for transfer to one of the concentration camps, but in the confusion, Sol's mother persuaded him and his older sister to try to escape; she and his younger sister were killed by the Nazis.

Having reached Warsaw by "jumping" freight trains, Sol managed, because he was blond, to obtain false papers, a Christian name and the opportunity to work in a Christian home. But when his employers discovered that he was Jewish, they turned him out into the streets. He found refuge in a Catholic orphanage, where he eventually was promoted to altar boy! Sol never wanted to talk about these war years, saying simply, "I read, I learned Latin and I survived."

After the war, Sol immigrated to Canada, just two weeks before his 18th birthday, which would have ended his eligibility for the program that sponsored his move. Without prior formal education, he taught himself English and obtained his high school equivalency diploma as well as a scholarship from McGill University—all within a year—while supporting himself by working in a hat factory. After completing his undergraduate study in physics, he remained at McGill one more year to earn a master's degree.

With a scholarship from MIT, Sol then moved to the US, where he became interested in plasma physics and worked with Sandy C. Brown on Project Sherwood—one of the earliest plasma fusion experiments. Interested in the physics of plasma interactions with microwave fields, they did a whole series of pioneering measurements on plasma parameters, ion resonances, diffusion coefficients and ionization rates.

After receiving his PhD in 1957, Sol taught briefly at MIT before Dave Rose recruited him for Bell Laboratories. There Sol quickly established a broad-ranging program focusing on collective waves in both gaseous and solid-state plasmas. With Philip Platzman, whom he had attracted to the laboratory, he studied the effect of collisions on Landau damping and wave propagation along a magnetic field; with John Galt, Chuck Hebel and others, he studied various waves and excitations in bismuth, a material that was very popular at the time because of its long mean free paths for carriers. Buchsbaum and Galt first observed Alfvén waves in a solid-state plasma, and with Hebel, Sol examined many aspects of the complex cyclotron resonances that occur in this compensated material. He then attracted Akira Hasegawa to Bell Labs, and together they measured the longitudinal plasma oscillations that later became known as Buchsbaum–Hasegawa modes.

The management of Bell Labs was quick to recognize that Sol had exceptional managerial and leadership talents. He moved rapidly upward in the management structure—with a three-year absence while he served as vice president for research at Sandia National Laboratories—to become in 1979 senior vice president of technology systems. In that position he was responsible for product planning and engineering, government systems and the architectural framework for AT&T products, systems and services. He was the driving force behind AT&T's collaborative work with Zenith on high-definition television, and he played a major role in AT&T activities in digital signal processing, communication satellite systems and advanced telephone terminals, as well as a wide range of military systems.

By dint of his own efforts and intelligence, Sol moved rapidly into the nation's meritocratic elites in science, business and politics. He was devoted to his adopted country and over some three decades served as an adviser to five US Presidents and their Administrations. Sol's broad scientific and technical knowledge, his wisdom and common sense, and his outstanding ability to work effectively with others led to increasing demands for him to serve in advisory roles. In 1971 President Nixon appointed him to the President's Science Advisory Committee; in 1981

President Reagan chose him as chairman of the White House Science Council, a position that he held with distinction for eight years; and in 1990 President Bush named him to the newly created President's Council of Advisers on Science and Technology. It was typical of Sol that he participated fully and effectively, via a phone link, in PCAST's last meeting with President Bush, in December 1992, despite the fact that he was in a hospital bed in Boston undergoing a very high-risk medical procedure.

In parallel with these Presidential appointments, Sol found time to serve on the Defense Science Board, the Energy Research Advisory Board and a wide range of other more specialized governmental panels, boards and committees.

A loyal MIT alumnus, Sol served on several committees of the MIT Corporation and was a director of the Draper Laboratory Corporation. He was a trustee of the Rand Corporation and a member of the National Academies of Sciences and of Engineering and of the latter's council.

Truly a self-made man, Sol was urbane and well read. He was tough-minded and warmhearted by turns: He could dismiss with a barbed retort a statement he considered wrong-headed but could also remember a colleague's work in detail and any infirmities with sympathy.

Those of us who had the pleasure of working with Sol remember him particularly for the precision and clarity with which he analyzed very complex issues, both technical and managerial. He was characterized by crisp logic, solid principles and unquestioned integrity. And quite apart from all that, he was fun to work with. He was a role model for generations of young scientists both at Bell Labs and in Washington, and the physics community and the nation are the poorer because of his early and untimely death.

William F. Brinkman
AT&T Bell Laboratories
Murray Hill, New Jersey
D. Allan Bromley
Yale University
New Haven, Connecticut

Jan H. Oort

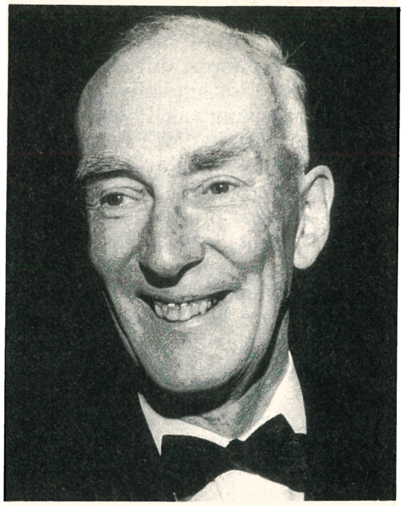
After a research career spanning 70 years, the Dutch astronomer Jan Hendrik Oort passed away on 5 November 1992 at the age of 92. At the time of his death he was still fully active in studying the large-scale distribution of matter in the universe. With an infallible intuition as to the most promising lines of research and the ability to make others follow where he led, he exercised a profound influence on the development of 20th-century astronomy.

Oort studied at the University of Groningen in the Netherlands and obtained his PhD in 1926. He then joined the University of Leiden, where he was professor of astronomy and director of the observatory from 1945–70.

Oort's first research dealt with the rotation of our Galaxy. He concluded that the rotation was unlikely to be at constant angular velocity, and from the available observations of stellar velocities he determined the rotational velocity near the Sun and its gradient, still characterized today by the "Oort constants." From these, Oort later obtained the mass of the Galaxy.

The main problem in determining the overall structure of our Galaxy was the absorption of starlight by interstellar dust. When Grote Reber in 1942 made the first map of radio noise, which demonstrated its Galactic origin, Oort immediately understood the importance of radio waves that could penetrate the dust clouds unhindered. But Oort wanted more, namely radial velocities, and this led Hendrik van de Hulst to search for spectral lines that would allow their determination. A result of this research was van de Hulst's prediction of the 21-cm spin-flip line of atomic hydrogen. As soon as possible after World War II, Oort organized a campaign to develop the instrumentation needed for the observation of this hydrogen line. Though the first detection of the line was made elsewhere, Oort was the first to use it to map out the distribution of the gas in our Galaxy and to delineate its spiral structure. Soon it became clear that the 7.5-m radiotelescope at Kootwijk in the Netherlands (left over from the war) had insufficient resolution and sensitivity for detailed studies of our Galaxy, and Oort took the initiative to build in the Netherlands first the 25-m telescope at Dwingeloo (1956) and subsequently the Westerbork Radio Synthesis Telescope (1970)—an array of fourteen 25-m telescopes—both of which are still very much in use today.

The study of the interstellar gas naturally led Oort to consider its dynamics, and he brought together hydrodynamicists and astronomers for this task. He studied the effects of supernova explosions and their input of energy into the interstellar gas. Of particular interest were his studies of the Crab Nebula, the remnant of



Jan H. Oort

the supernova of 1054, in which he determined (with Fjeda Walraven) the polarization of the optical synchrotron radiation and thereby the distribution of relativistic electrons and magnetic fields, now known to be produced by the rotating neutron star (pulsar) at its center.

In 1932 Oort made a comparison between the local mass density in our part of the Galaxy inferred from its gravitational effects and that determined by adding up all the visible mass in the form of stars, gas and so forth. On the basis of the available data he concluded that not much "dark matter" was present; 30 years later, with improved data, he concluded that as much as one-third of the local mass was dark. Today the question is still open, but the prevalence of dark matter in galaxies and in the universe is generally uncontested, partly on the basis of the rotational velocities of galaxies determined at Westerbork.

Oort was one of the few astronomers to have seen Halley's Comet twice. His studies of the orbits of "new" comets—those that come near the Sun for the first time—led him to the conclusion that there must be a reservoir of comets, now called the "Oort cloud," far outside the orbit of Pluto. Oort showed that passing stars might occasionally perturb the orbits of these comets and direct them toward the inner solar system.

Oort had a strong belief in the benefits of international cooperation. He was general secretary (1938–50) and president (1958–61) of the International Astronomical Union. His wish to complete the data on our Galaxy obtained mainly in the Northern Hemisphere with corresponding data from the south led him to en-