Hospitals in Detroit and a professor of radiation oncology and radiology at Wayne State University School of Medicine, also located in Detroit. AAPM cited him for the invention of the time–dose factor and for his role in "achieving a greater professional recognition for the medical physicist [in] the medical community."

The Sylvia Sorkin Greenfield Award, given to the authors of the best paper published in the AAPM journal *Medical Physics* in the preceding year, was presented to **John F. Schenck, Charles L. Dumoulin, Rowland W. Redington, Herbert Y. Kressel, Robin T. Elliot** and **Ian L. McDougall**. They coauthored the paper "Human Exposure to 4.0-Tesla Magnetic Fields in a Whole Body Scanner," which appeared in the March–April 1992 issue. Schenck, Dumoulin and Redington all work at the General Electric Corporate Research and Development Center in Schenectady, New York. Kressel is a professor in the department of radiology at the University of Pennsylvania Hospital, in Philadelphia. Elliot works at Oxford Magnet Technology in Oxfordshire, England. McDougall is employed by Oxford Instruments in Oxford, England.

The Farrington Daniels Award, presented to the authors of the best paper on radiation dosimetry published in *Medical Physics* in the preceding year, went to **Anders Ahnesjo, Mikael Saxner** and **Avo Trepp**. Their prizewinning paper, "A Pencil-Beam Model for Photon Dose Calculation," appeared in the March–April 1992 issue. Ahnesjo works in the department of radiation physics at the Karolinska Institute in Stockholm. Saxner and Trepp work for Helaz AB, in Uppsala, Sweden.

BEAN AND MINSTRELL RECEIVE AAPT HONORS

One of the highlights of the 1993 summer meeting of the American Association of Physics Teachers, held in Boise, Idaho, in August, was the presentation of two awards.

Charles P. Bean, Institute Professor of Science at Rensselaer Polytechnic Institute, in Troy, New York, was the recipient of the 1993 Klopsteg Memorial Lecture Award. "In addition to work in superconductivity and biophysics," the award citation said, Bean "has worked with undergraduate students in performing simple experiments to elucidate common phenomena such as osmosis, capillary action, evaporation and the patterns of sunlight on rippled waters."

The Robert A. Millikan Lecturer Award was presented to **James Minstrell**, a teacher at Mercer Island High School on Mercer Island, Washington. AAPT cited Minstrell for "sincere devotion to the profession of teaching physics, for . . . many activities that have created a positive impression of physics and physics teaching for thousands of students and teachers, for . . . numerous articles that have helped many students and faculty better understand and better convey the thoughts of physics [and] for . . . service on many AAPT and physics community committees."

IN BRIEF

Alan G. Marshall has joined Florida State University, in Tallahassee, as a professor of chemistry and director of the ion cyclotron resonance program at the National High Magnetic Field Laboratory.

The 1993 State Award of the Russian Federation in Science and Technology—formerly the Lenin Prize—was presented on 8 June to five members of the Russian Academy of Sciences: **Viktor-Andrei Borovik-Romanov, Yuriy M. Bunkov, Vladimir V. Dmitriev** and **Yuriy M. Mukharskiy** of the Kapitza Institute for Physical Problems, in Moscow, and **Igor Fomin** of the Landau Institute for Theoretical Physics, also in Moscow. The recipients are being honored for their experimental and theoretical studies of spin supercurrents in the B phase of superfluid ^{3}He.

OBITUARIES

Donald Kerst

Donald William Kerst, E. M. Terry Professor Emeritus at the University of Wisconsin, Madison, died of a brain tumor in Madison, Wisconsin on 19 August 1993 at the age of 81.

Kerst made important contributions to the design of particle accelerators, to nuclear physics, to medical physics and to plasma physics. In addition to his scientific and technical contributions, his deep understanding, his know-how and his enthusiasm were a source of education and inspiration both to his students and his colleagues. He was an effective mentor who worked hard and expected his students to do likewise—and they did. Many of the leading

Donald Kerst

scientists over the past 40 years in the fields of accelerator physics, nuclear physics, medical physics and plasma physics received their degrees under Kerst's direction.

Kerst was born on 1 November 1911 in Galena, Illinois, and was educated at the University of Wisconsin, where he received a BA degree in 1934 and a PhD in 1937, both in physics. His thesis research involved the development and application of a 2.3-MeV electrostatic generator for a seminal experiment on the scattering of protons by protons. After receiving his degrees and spending one year working on x-ray tubes and machines at the General Electric X-Ray Corporation in Chicago, Kerst found himself challenged by high-energy electron and x-ray research, which required energies not yet available. In 1938 he accepted an instructorship at the University of Illinois, Urbana–Champaign, where the prescient chairman of the department of physics, F. Wheeler Loomis, encouraged him to develop his ideas for a new type of electron accelerator that Kerst later named the "betatron."

Among the investigators who attempted to accelerate electrons by magnetic induction, none was successful until Kerst produced 2.3-MeV electrons in a betatron at the University of Illinois on 15 July 1940. That tabletop machine is now at the Smithsonian Institution in Washington, DC. His success was due to a very careful theoretical analysis of the orbit dynamics in circular accelerators, including a study of the requirements for injection; a preliminary analysis of all conceivable effects relevant to the operation of the machine, in particular, electrostatic charge buildup on the vacuum chamber; and a careful and detailed

design of the magnet structure, vacuum system and power supply. Indeed, this accelerator was the first to be constructed on the basis of a careful scientific analysis and a completely engineered design. All later accelerators, including the newest high-energy synchrotrons, have been influenced by the early work of Kerst. The betatron was thus not merely a valuable instrument in itself but a milestone in the development of particle accelerators generally. For example, the radial and vertical oscillations of the beam in a circular accelerator are now universally called betatron oscillations, after the pioneering work of Kerst and Robert Serber, who in 1941 published the first theoretical analysis of such oscillations as they occur in the betatron.

Kerst went on to construct a series of betatrons of successively higher energies, culminating in the 300-MeV flux-biased betatron at Illinois, with its 400-ton magnet. Kerst and his students used these machines to carry out much of the earliest research in the multi-MeV energy range. The betatron was the first accelerator to provide megavolt x rays for photonuclear studies. In the late 1940s and early 1950s, much of the experimental research on photonuclear reactions, including the discovery of the giant dipole resonances, on photodisintegration of the deuteron, on photoproduction of mesons and on nuclear structure from electron scattering was carried out using the Illinois betatrons. Kerst was also responsible for the first use of megavoltage radiation in the treatment of cancer.

At the time that Kerst was building the 300-MeV betatron, V. I. Veksler in the USSR and Edwin M. McMillan at Berkeley, working independently of each other, discovered phase focusing. They published articles in 1945 proposing the addition of a radiofrequency cavity along the circular path of an electron orbiting in a magnetic guide field to provide the potential to accelerate the electrons to high energies. Accelerators incorporating this principle are called synchrotrons, and most high energy circular accelerators built since then have been synchrotrons. A number of betatrons that had been constructed in laboratories in the US and in England were converted to synchrotrons by the simple addition of rf accelerating cavities.

From 1943 to 1945, Kerst was the leader of the P-7 group at Los Alamos which developed the first homogeneous fission reactor (a "water boiler"). He also used the betatron to study the implosion method for igniting nuclear weapons. One history of Los Alamos calls Kerst's technical achievements among the most impressive at Los Alamos.

On leave from the University of Illinois from 1953 to 1957, Kerst served as technical director of the Midwestern Universities Research Association in Madison, working on advanced accelerator concepts. His vigorous leadership and deep understanding of the physics of electric and magnetic fields and of mechanics were responsible in large part for the many contributions to accelerator technology made by the MURA group during the period. The spiral-sector focusing principle was originated at MURA by Kerst and under his leadership the MURA group invented and analyzed the process of beam stacking by means of radio-frequency acceleration in fixed-field machines. The beam-stacking technique opened the possiblity of achieving intense circulating beams and led Kerst to realize that it was now practical to achieve greatly increased center-of-mass energies through the use of colliding beams. Electron and proton storage rings are a direct outgrowth of the MURA work.

After 19 years at Illinois developing accelerators, Kerst accepted in 1957 a five-year appointment to work on plasma physics in the fusion program at the General Atomics division of the General Dynamics Corporation in La Jolla, California. He brought to this field not only his deep physical insight into magnetic field structures but also his understanding, gained from his accelerator experience, of the importance of careful attention to detail in the design of magnetic structures. These qualities of Kerst are largely responsible for the success of the various toroidal machines that were built under his direction, including a toroidal pinch device at General Atomics and a number of multipole machines. (While at General Atomics, he coinvented, with Tihiro Ohkawa, the latter type of device.)

In 1962 Kerst returned to the University of Wisconsin, Madison, to establish a plasma physics program. The first multipole machines were the toroidal octupoles completed at the University of Wisconsin under his direction and the toroidal octupole begun by him and Ohkawa and completed by Ohkawa at General Atomics. These were the first magnetic confinement devices to achieve a quiet plasma, undisturbed by the instabilities that had plagued previous machines, and to exhibit lifetimes exceeding the Bohm diffusion limit.

Donald Kerst was a well-rounded person. He was a sportsman who enjoyed skiing, deep-sea fishing, white-water canoeing and ocean sailing. He had a low-key sense of humor that often delighted his friends and colleagues.

KEITH R. SYMON
University of Wisconsin, Madison
H. WILLIAM KOCH
University of Denver
Denver, Colorado

Jean Paul Mathieu

Jean Paul Mathieu, former professor of physics at the Université Pierre et Marie Curie in Paris, died on 18 January 1993 at the age of 84.

Mathieu's father, a physician, insisted that he study pharmacy, but he earned degrees in physics, both from the Faculté des Sciences de l'Université de Paris in 1930. He soon returned to this university to work on his docteur ès sciences physiques, which he earned in 1934.

Mathieu was interested primarily in two aspects of physics: the use of symmetry properties to understand optical effects, and the use of the inelastic scattering of light by molecules discovered by C. V. Raman in 1928. Mathieu's thesis work led to understanding of circular dichroism in some complexes of transition metals and of the configuration of ligands. In this work he drew on the chemistry he had learned as a student of pharmacy. It was his curiosity about the physical origin of symmetry breaking that triggered his interest in circular polarization.

Mathieu was among the first to recognize that the selection rules for the molecular vibrations of a molecular liquid are not the same as those for its corresponding molecular crystal. He became a pioneer in the use of symmetry properties to predict selection rules, and his first book on the subject, *Spectres de Vibration et Symétrie des Molécules et des Cristaux*, was published in 1945. Some 25 years later, together with Henri Poulet, he wrote a much enlarged second edition, which was translated into English by Gordon and Breach.

After earning his doctorate, Mathieu became a maître de conférences at the University of Lille, Belgium. In 1947 he returned to Paris, joining the Faculté des Sciences. He became a professor in 1950 and worked at the university for the next three decades, testing in detail the selection rules he had de-