designed and fabricated his experimental setups in a matter of a few days. His second love was collecting Polish postage stamps. Kronenberg was an international expert who determined, for collectors and auctioneers, whether stamps were genuine or forgeries. About 100 publications about stamps and related subjects bear his name.

Kronenberg was also quite an artist. The photograph accompanying this obituary shows him standing in front of a 30-foot-wide by 9-foot-high mural that he painted on his concrete laboratory wall; he completed the work in February 2000. The mural depicts seven Mayan gods creating the universe. His inspiration was a vase found in the Mayan ruins, and the original painting was in black and white.

Kronenberg was a gentle man who had affection and concern for others. He was available with help or advice on any problem or project, whether private or official. We will sorely miss him.

GEORGE BRUCKER
Fort Monmouth, New Jersey
CARL ACCARDO
Massachusetts Institute of Technology
Cambridge, Massachusetts

Louis Leprince-Ringuet

Louis Leprince-Ringuet, an expert in cosmic rays and a great French scientific figure, died on 23 December 2000, a few months before his 100th birthday.

Leprince-Ringuet was born on 27 March 1901 in Alès, a mining town in southern France. In 1920, he graduated from Ecole Polytechnique in Paris and completed his engineering studies, specializing in telecommunications, at the French telecommunication school Ecole Supérieure d'Electricité in Paris before beginning, in 1925, a career as an engineer laying and servicing submarine cables.

In 1929, he decided to switch fully to conducting research in the laboratory of Maurice de Broglie, the brother of Louis de Broglie. The lab's main activity was shifting from x rays to nuclear physics, and Leprince-Ringuet started to develop the relevant instrumentation. He received his doctorate in physics from the University of Paris and soon collaborated with Pierre Auger's group on cosmic-ray studies in the high mountains, happy, as he said, to "leave for the open skies after work carried on in a basement."

In 1933, Leprince-Ringuet joined Auger on a ship sailing from Hamburg, Germany, to Buenos Aires, Argentina, with 100 particle detectors onboard. At that time, the nature of cosmic rays was unknown. Charged particles, unlike gamma rays, are deflected by Earth's magnetic field, which varies with latitude. Auger and Leprince-Ringuet hoped, therefore, that studying the variation of cosmic-ray intensity with latitude would reveal what cosmic rays consisted of. The experiment favored particles and was Leprince-Ringuet's first main involvement in the field of cosmic rays, in which he eventually acquired a worldwide reputation.

LOUIS LEPRINCE-RINGUET

After several experiments with Auger on mountain peaks and with balloon flights, Leprince-Ringuet developed his own laboratory for cosmic-ray research in 1936, when he became a professor, with a chair of physics, at Ecole Polytechnique. He attracted to his laboratory a host of young and brilliant researchers, among them Bernard Gregory, who became the director general of CERN in the late 1960s, and André Lagarrigue, famous for the discovery of the neutral current interaction in the early 1970s. Leprince-Ringuet played an important role in the revival of physics research in France after World War II.

Even though his mountain work with cosmic rays was slowed down by the war, Leprince-Ringuet continued his research, which bloomed and had culminated by the time of the Bagnères-de-Bigorre conference in 1953. At that watershed conference, he presented the summary of a talk covering the important results obtained with the many surprising particles discovered. He is credited for finding evidence for a heavy particle and also for coining the term hyperon.

Leprince-Ringuet was also saying farewell to cosmic-ray research at that conference. Realizing the impending and overwhelming competing power of accelerators in the GeV range, he decided to reorient his laboratory toward accelerator physics. He effectively argued for the construction of bubble chambers at Saclay, which resulted in a plan for two French bubble chambers, one filled with hydrogen and the other with heavy liquid, to be installed at CERN as the proton synchrotron was commissioned in 1959. Commonly heard at the time was this: "There are 13 CERN members, those with a flag at the entry and Ecole Polytechnique!" This effort eventually led to the development of the giant Gargamelle chamber in the late 1960s and the discovery there of the neutral-current weak interactions in 1973.

In 1959, Leprince-Ringuet succeeded Frédéric Joliot-Curie at the Collège de France as professor and became head of two large laboratories, there and one at Ecole Polytechnique. He retired as the Collège de France's chair of physics and as head of the lab at Ecole Polytechnique in 1972.

In 1991, still remembered as a physicist on mountaintops, Leprince-Ringuet was one of the two guests of honor at the dedication of the newly established "Refuge des Cosmiques" (Cosmic Refuge) near Mont Blanc in the Alps in remembrance of the cosmic-ray work done during the 1940s in the old refuge, which the new one replaced. He shared the honor of dedicating the refuge with author Roger Frison-Roche.

Leprince-Ringuet was a man of many interests. As a member of the French Academy of Sciences and of the French Atomic Energy Commission's governing board, he had the means to exert his influence. He advocated strongly for the creation of CERN and remained its indefatigable supporter. He was vice chair (1956–69) and chair (1964–66) of CERN's scientific policy committee. He was elected to the French Academy in 1966. He also was a champion of outreach, engaging in activities involving ecology and sustainable sources of energy.

When a special symposium was held at Ecole Polytechnique to celebrate Leprince-Ringuet's 96th birthday, it took not less than six contributors to do justice to his achievements in many fields, ranging from science, to art, to tennis. Many physicists are much indebted to him for his guidance, for developing very good research con-

ditions, and for making fundamental research a popular enterprise and for helping to popularize physics and science through the media.

Leprince-Ringuet was a devoted Christian, and a painter who presented several exhibitions. On one such occasion, he had to compare the creative work of the artist to that of the scientist. It seems proper to conclude with his view of science, his first and main love all along, which he repeated at the celebration of his 96th birthday:

> Our work is part of a never-ending study of natural phenomena, of their understanding, and of finding their relationship through a formalism that we have to invent for that purpose. Even if our work relies on imagination, critical thinking, tenacity, and creative spirit, it reveals little and very seldom the deepest and most private reality of our own self. In that sense we are not poets but we sing in wide choirs the greatness of nature and the power of humankind.

MAURICE JACOB
CERN
Geneva, Switzerland

Harold Walter Lewis

Harold Walter Lewis, a former vice provost and dean of arts and sciences at Duke University, died from cancer in Durham, North Carolina, on 17 October 2000.

Lewis was born in Keene, New Hampshire, on 7 May 1917. He obtained his bachelor's degree in physics in 1938 from Middlebury College, received his master's in physics at the University of Buffalo in 1940, and then continued graduate studies at Duke University. At the beginning of World War II, he joined the Naval Ordnance Laboratory and the Navy Bureau of Ordnance as an expert on magnetic fields and mine detection, dividing his time between Washington, DC, and Pearl Harbor, Hawaii.

Lewis returned to Duke in 1946. He obtained his PhD in physics in 1950; his thesis was on cosmic-ray bursts in ionization chambers. That same year, he also became assistant project leader for Duke's nuclear physics program, directed by Henry Newson. He joined the Duke faculty in 1949 as an assistant professor.

In 1953, Lewis realized that nuclear accelerators and nuclear physics detection techniques could be used for the first accurate, absolute cross-section measurements of characteristic atomic x rays produced after inner-shell ionization of high-Z atoms by protons in the MeV range. This work advanced the growth of accelerator-related atomic physics and eventually gave rise to a much-used analytical tool: proton-induced x-ray emission, or PIXE. In a 1958 review entitled "X-Ray Production by Heavy Charged Particles" in the *Encyclopedia of Physics* (Springer, 1958), Lewis gave a comprehensive account of the results that he and his graduate students had obtained in a series of benchmark measurements. The atomic x-ray measurements proved to be valuable in the analysis of gamma-ray yields from the early nuclear Coulomb excitation experiments, to which Lewis contributed. Lewis also collaborated at Duke with Willy Haeberli (later of the University of Wisconsin); this collaboration led to publication of the experimental determination of the nuclear levels of phosphorus-29 in *Physical Review* in 1959.

HAROLD WALTER LEWIS

In 1959, Lewis became a professor of physics at Duke. From 1960 to 1961, he served as a visiting professor at the American University of Beirut in Lebanon under a Smith–Mundt Fellowship. He was appointed in 1961 as associate director of the Nuclear Structure Laboratory at Duke; the lab later was renamed the Triangle Universities Nuclear Laboratory (TUNL).

After a very productive period of research in nuclear physics, Lewis was appointed vice provost and dean of arts and sciences in 1963, and was named dean of faculty in 1969. He returned to the physics department in 1981 as chairman and was named University Distinguished Service Professor. He was also a trustee of the Southeastern Universities Research Association and a councilor of the Oak Ridge Associated Universities.

After he retired from teaching and university administration in 1986, Lewis joined a team of TUNL physicists, led by Thomas Clegg and William Hooke, to construct a new high-intensity polarized ion source using atomic beams of hydrogen and deuterium. Lewis's efforts centered on the design, fabrication, and testing of a system of electromagnetic sextupoles for this source. He worked closely and patiently with several students and young technical staff as their mentor who, by his example, assured that their measurements were carefully made and meticulously logged. Their sextupole designs are still used today at TUNL and were later adapted for an ion source at the Indiana University Cyclotron Facility.

Lewis was a quiet but exceedingly effective leader in his field of research who contributed significantly to physics even after a long term in university administration. As an experimental physicist, he was hardworking and resourceful. As an administrator, both at the university and the physics department levels, he was a respected and beloved person. He was deeply and genuinely concerned for people and respected for his fairness and honest approach to problems. His contributions to science and to Duke, his gracious personality, and his cooperative nature will long be remembered by those who knew him.

HORST MEYER
EDWARD G. BILPUCH
Duke University
Durham, North Carolina
EUGEN MERZBACHER
University of North Carolina at Chapel Hill

Emanuel Maxwell

Emanuel Maxwell, widely known for his research on superconductivity and low-temperature physics, died of heart failure in Cambridge, Massachusetts, on 6 October 2000.

Maxwell was born in Brooklyn, New York, on 16 December 1912 of parents who had emigrated from Russia. As a child, he built radios and became an amateur radio operator; he credited his teachers at Erasmus Hall High School for stimulating his interest in science. He received a BS (1934) and an MS (1935), both in electrical engineering, from Columbia University.

In the depression year of 1935, Maxwell's first job was with RCA at the telegraph receiving station on Long Island, New York, where he