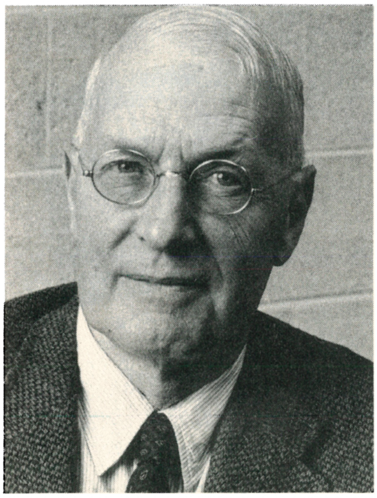

Francis Birch

geophysics in 1952. This work was not only a research paper: He presented the material so lucidly that it is a valuable teaching resource even now. In this paper he demonstrated that the outermost mantle and the lower mantle are basically homogeneous and are separated by a transition zone that is compressed with depth more than a homogeneous material would be. His interpretation was that the transition zone is associated with phase transitions in silicates from fourfold- to sixfold-coordinated silicon. Subsequent measurements have supported this general picture of the structure and state of the mantle.

In 1961 Birch pointed out that sound speeds could be plotted as simple functions of density and that the curves would spread out according to atomic weight (mean atomic weight for compounds). This observation became known as Birch's law. Because velocities and densities are the principal data from seismic models, this approach helped determine the Earth's bulk chemical composition. In particular it is the most sensitive indicator that the fluid outer core cannot be iron or an iron–nickel alloy, as studies of meteorites would suggest, but instead must include a lighter element such as oxygen, sulfur or silicon. Such advances inspired the development of the field of mineral physics for understanding Earth materials and for interpreting geophysical measurements.

From the start of his work in the Dunbar Lab, Birch was interested in thermal properties. Measurements of terrestrial heat flow had their beginnings in England and South Africa, and Birch had measured thermal conductivities of rocks in the 1930s. In 1947 he determined the conductivity of the same rocks from the Colorado Front Range in which temperature gradients also had been measured. This result helped establish continental heat flow as one of the boundary values of terrestrial geophysics. Birch recognized heat flow and its regional distribution as primary information about the Earth's interior, and today we see them as revealing the thermal engine responsible for plate tectonics.

Francis Birch was elected to the National Academy of Sciences in 1950, and he was president of the Geological Society of America in 1964. He was a gracious man with a wry sense of humor, and his colleagues, friends and former students will feel his absence.

THOMAS SHANKLAND
Los Alamos National Laboratory
Los Alamos, New Mexico
RICHARD O'CONNELL
Harvard University
Cambridge, Massachusetts

Herman F. Mark

Herman Francis Mark was born in Vienna on 3 May 1895, and he died in Austin, Texas, on 6 April 1992.

After a distinguished four years in the Austrian army during World War I and a year as a prisoner of war in Italy, Mark studied chemistry at the University of Vienna under the guidance of Wilhelm Schlenk. His thesis, dealing with the synthesis and characterization of the pentaphenylethyl free radical, influenced his lifelong interest in the relation between structure and physical properties.

In 1921 Schlenk moved to the University of Berlin, and he asked Mark to come with him as his assistant. In the following year Schlenk recommended Mark for a position at the Kaiser Wilhelm Institut. Mark remained at the KWI, then one of the foremost centers of scientific research, for five years. With Michael Polanyi, Karl Weissenberg and Rudolf Brill as his colleagues, Mark embarked on a study of the crystal structure of a broad variety of materials, encompassing metals and low-molecular-weight compounds. Particularly important was his study of the crystal structure of graphite, since it demonstrated to him that the covalently bonded structure need not be limited by the size of the crystallographic unit cell, as was then widely believed. He also carried out pioneering work on x-ray physics, publishing papers on the natural breadth of x rays, their indices of refraction and their polarizations.

Herman F. Mark

In 1926 Kurt H. Meyer, a director of Germany's largest chemical company, I. G. Farbenindustrie, persuaded Mark to become head of a laboratory charged with the clarification of the structures of cellulose, starch, rubber and silk and the use of this knowledge for the synthesis of technically useful materials. The collaboration of Mark and Meyer led in 1928 to the first successful crystallographic characterizations of cellulose, silk fibroin and chitin, clearly establishing them as long-chain molecules. In a most innovative paper, published in 1932, Mark used crystallographic and spectroscopic data to estimate the mechanical strength of an "ideal" cellulose fiber. Somehow in his "spare time" Mark pioneered the determination of molecular structures by electron diffraction of gases. (The young Linus Pauling visited Mark's laboratory and was given an early instrument used in this research.)

With the rise of Hitler, the position of Mark—whose father had been Jewish—at IG Farben became increasingly precarious, and in 1932 he moved to the University of Vienna as a professor. There he created the first academic curriculum in polymer science. His Vienna years were marked by some important advances in the understanding of polymers, most notably the first statistical theory of rubber elasticity, developed with Eugene Guth.

It is impossible to review Mark's European career without touching on the bitter attacks to which he was subjected by Hermann Staudinger. Staudinger regarded himself, justifiably, as the originator of the concept of polymer chain molecules, but insisted that they should be visualized as stiff rods—a concept unacceptable to Mark, who understood that hindered rotation around bonds in a chain molecule would necessarily lead to a flexible coil structure.

After Germany's annexation of Austria, the International Paper Company invited Mark to head their research at Hawksbury, Ontario. He remained there only two years, though, since he was not willing to restrict himself to the study and technology of cellulose. He moved to the Polytechnic Institute of Brooklyn (now Polytechnic University), where he founded in 1941 an Institute of Polymer Research, the first of its kind in America.

Mark's influence was felt in many areas. He bridged academia and industry to an unusual extent. His books, starting with *Der Aufbau der hochpolymeren organischen Naturstoffe* (coauthored with Meyer in 1928), had a profound influence on the development of the polymer field. He was instrumental in the founding, in 1946, of the *Journal of Polymer Science.* Last but not least, he was the guiding spirit in the organization of a polymer section of the International Union of Pure and Applied Chemistry and IUPAC's yearly International Polymer Symposia.

HERBERT MORAWETZ
Polytechnic University
Brooklyn, New York

Paul M. Raccah

Paul M. Raccah died on 4 February 1992 at the University of Illinois at Chicago Hospital from complications associated with a recent liver transplant. He was 58 years old.

Raccah was head of the department of physics at UIC from 1976 until his resignation due to illness in 1991. His career there was marked by intensive efforts devoted to his research and to strengthening the department. During his tenure, the department greatly increased its research activities and achieved ranking at the national level. Raccah was named Research Professor in 1987 and served on many committees within the university.

Raccah was born in Tunisia and educated in France, where he received a baccalaureate from the Sorbonne in 1953, a national engineering degree from the University of Lyon in 1959 and a PhD in physics from the University of Rennes in 1962. He became a member of the solid-state division of MIT's Lincoln Laboratory in 1964 and then a group leader at CAE, a European subsidiary of Thompson–Ramo–Woolridge. In 1972 he became a professor of physics and director of the Maxwell R. Maybaum Institute for Material Sciences and Quantum Electronics at the Belfer Graduate School of Science of Yeshiva University in New York.

Raccah's specialties were the characterization of electronic materials and electro-optic devices using modulation spectroscopic techniques, such as electrolyte electroreflectance, photoreflectance and spectroscopic ellipsometry, as well as light-scattering techniques such as Raman scattering, photoluminescence and Brillouin scattering. One of his goals was to carry out the investigation of device structures at the atomic level. He made outstanding contributions to the understanding of the electronic properties of heterointerfaces, which are the active areas of advanced optoelectronic devices such as lasers.

Raccah served as a consultant to several companies. His administrative and research activities included guiding many graduate students and postdoctoral research associates.

Raccah was also a scholar in other fields. In particular, he was a noted student and teacher of the Torah and was held in the highest esteem by the Orthodox Jewish community of Chicago, of which he was a devout member.

Paul Raccah is remembered with love by his many colleagues and former students around the world.

UDAY SUKHATME
JEAN-PIERRE FAURIE
JAMES W. GARLAND
SEYMOUR MARGULIES
University of Illinois, Chicago

Albéric Boivin

Albéric Boivin, physics professor emeritus at Laval University, died in Quebec City, Canada, on 8 August 1991, after several months' illness. His passing marks the end of one of the most prolific and prestigious scientific careers in French Canada.

Born in Baie-St.-Paul, Quebec, on 11 February 1919, Boivin in 1940 entered Laval, where he obtained his BSc, MSc and PhD degrees in physics. Immediately after completing his undergraduate studies he started teaching at Laval. He became a full professor in 1955 and was named an emeritus professor in 1988.

Boivin gained his reputation mainly through his research activities in optics. A true visionary, he was the instigator and pioneer of the field's development in the Quebec milieu. He began a lifelong interest in optical diffraction in the years immediately following World War II. The initial impetus came from his theoretical investigation of Fresnel diffraction through concentric arrays of annular apertures. This investigation was quickly followed by microwave experiments he undertook with collaborators.

Young physics graduates from Quebec and abroad gravitated toward the nucleus formed by Boivin, and by the mid-1960s they had grown into a group of scientists competent in all aspects of optics. The group organized itself formally as the Laboratoire d'Optique et Hyperfréquences, with Boivin as its director–founder. The LOH later became the Laboratoire de Recherches en Optique et Laser and is now known as the Centre d'Optique, Photonique et Laser. The presence of Laval University's optics center was a determining factor in the Canadian government's decision to locate the National Institute of Optics in Quebec City.

Boivin wrote a monumental treatise on scalar diffraction, *Theorie et calcul des figures de diffraction de révolution*, and the vivid description he and Emil Wolf provided in a paper on the field structure about the focus of a wide-aperture aplanatic system will remain a classic in the optical literature.

Boivin was also responsible for the birth and growth at Laval of teaching and research in astrophysics. Passionately fond of astronomy since boyhood, he led a group at Laval that long promoted the development of that field of research at Laval. Their efforts were rewarded in the late 1960s, when the university decided to build an observatory at St.-Elzéar de Beauce. This observatory was inaugurated in 1971. In 1978 it was annexed to the Observatory of Mont Mégantic, administered jointly by the University of Montreal and Laval University.

Boivin was vice president of the Canadian Association of Physicists in 1969.

Besides his scientific achievements and legacy, Boivin will be remembered for his rich personality. Well versed in the humanities and always aware of the historical perspective on his subject, he wrote and taught with a unique flair and clarity. His devotion and patience toward his students were exemplary. Dogged throughout his career by health problems, he maintained nonetheless a cheerful, ever witty and enthusiastic disposition, thus inspiring all who knew him. He will be sorely missed.

FERNAND BONENFANT
Laval University
Quebec City, Canada ■