obituaries

past, probably in the lifetime of our children."

A man of remarkable insight, he perceived the "hole" in the valence-band structure of a semiconductor—what he called the "defect electron"—as far back as 1929, when he wrote ". . . in a certain sense the places available for conduction electrons are occupied by static electron space charges and the passage of conduction electrons thereby blocked." This anticipated the significance of the "hole" in certain semiconductors two years before Werner Heisenberg (1931) finally clarified the subject by quantum mechanics. Thus was set the first milestone in modern semiconductor engineering.

Schottky selected his objectives so skillfully that his work not only benefitted pure physics but also found practical application as well. He is recognized as the originator of fundamental physical studies on starting-current and space-charge laws in electronic tubes, electron emission in metal and oxide cathodes and shot and flicker effects. He invented the screen-grid tube in 1915 and in 1918, he discovered the super-heterodyne principle with if amplification—this same principle is employed in every radio and television set today. He also explained imperfections in semiconductors and, above all, created the barrier theory of crystal rectifiers (1938). Schottky emission in cathodes, Schottky defects in semiconductor crystals, Schottky diode and Schottky transistor–transistor logic testify to the further milestones he set in modern electronics.

Being a widely versed research scientist, he worked both as a professor of theoretical physics at the University of Rostok, 1923–27, and as industrial researcher at Siemens AG from 1927 until the end of his life.

Despite his fame, Schottky was modest and selfless. He always refused the limelight, but knew how to reach out beyond his immediate circle of colleagues to young people, whom he always encouraged. The work bearing his name will serve as his memorial.

HEINRICH WELKER
Siemens AG
Erlangen, West Germany

Harry Nyquist

Harry Nyquist, a retired Bell Laboratories scientist who was known for his inventions and theoretical studies in communications, died 4 April at the age of 87.

Nyquist was awarded 137 patents during his 37 years with the Bell System and was best known for his discovery of the conditions necessary to keep feedback circuits stable, called the Nyquist Criterion. It is used not only in the study of electronic devices, such as amplifiers, but also in the study of human-regulative processes.

Many of his inventions and theories are widely accepted as fundamental to voice, picture and data transmission. He was responsible for the development of a method of transmission presently used in television broadcasting and also devised a way to correct image distortion caused by delayed transmission. He was the first to establish a quantitative explanation of thermal noise and, through theoretical analysis, determined the minimum band frequencies required for communication signal transmission—these studies laid the foundation for modern information theory and data transmission.

Born in Sweden, 7 February 1889, Nyquist emigrated to the US and received his doctorate in physics from Yale University in 1917. He joined Bell Labs in 1934 and held the position of assistant director of systems studies at the time of his retirement in 1954. He received many awards in recognition of his scientific contributions, including the Rufus Oldenburger Medal of the Society of Mechanical Engineers (1975).

Charles Manneback

Charles Manneback, an internationally known physicist, died 15 December 1975 in Brussels. At the time of his death he was secretary emeritus of the Royal Academy of Belgium. He was a graduate of the University of Louvain and the Massachusetts Institute of Technology where he acquired a PhD in 1922 under Vannevar Bush.

A true humanist with perfect fluency in many languages and interests in philosophy and literature, Manneback was capable of discussing with equal competence Bergson's work, Dante's poetry or the most sophisticated subtleties of modern physics. Electromagnetism was his speciality—in his early years, he was one of the first to clarify a number of difficult problems related to electromagnetic radiation and the skin effect. He was also active in education as a professor of theoretical physics at the University of Louvain (1922–64).

Manneback's frequent travels brought him in contact with many outstanding figures, such as Peter J. W. Debye, whom he met in Zürich in 1926. This was the beginning of Manneback's numerous contributions to the theory of molecular spectra, which are well referenced in "*Der Smekal Raman Effect und Ergänzungsband*," by Karl W. F. Kohlrausch and in "Infrared and Raman spectra of polyatomic molecules," by Gerhard Herzberg. His work in this area cast new light on the effect of anharmonicity and coupling between atoms and the substitution of isotopes. His most recent work in spectroscopy, published in 1969 with Paul

Colmant, concerned the lithium molecule and required a profound knowledge of spectroscopy in combination with a mastery of digital computers. His familiarity with electronic computers was the result of his developmental work in this field, which he began in Belgium in collaboration with Vitold Belevitch (1951).

His talent as a lecturer was greatly appreciated in Europe and the US and resulted in countless invitations, among others, at the Institut Poincaré in Paris, in London and Cambridge, in Zürich and Vienna and in 1950, as visiting professor at the Ohio State University.

As secretary of the Royal Academy of Belgium for many years, he demonstrated his broad knowledge and understanding in all fields of intellectual endeavor, as well as administrative and diplomatic ability. Manneback's unique talent of a Renaissance quality is rare in our present cultural climate. His friends, his pupils, his colleagues and the intellectual community have suffered an irreplaceable loss.

MAURICE A. BIOT
Royal Academy of Belgium

Fraser P. Price

Fraser P. Price, professor of polymer science and engineering at the University of Massachusetts, Amherst, died 25 February. Price was well-known for his contributions to the areas of polymer crystallization and morphology, and was one of the first to demonstrate the important role of heterogeneities in the nucleation of polymer crystals.

His early studies, initiated at the General Electric Research and Development Center in Schenectady, New York, were concerned with the elucidation of homogeneous and heterogeneous nucleation processes and the determination of their kinetic parameters. More recently, he and his students were involved in research on the mechanisms of crystal nucleation, the morphology and kinetics of crystallization under shear, and the morphology of liquid crystals and the thermodynamics and kinetics of their phase transitions. He was also investigating the morphology of polymer blends and the crystallization mechanisms of such materials. As a researcher, Price excelled in the development of ingenious experimental techniques and enjoyed personal involvement in the construction of instrumentation.

Born in New York City 16 August 1917, Price received his BA and PhD degrees (1938 and 1941) from Columbia University, was a Milton Fellow at Harvard University and worked at General Electric for 23 years before coming to the University of Massachusetts in 1968. He was a senior research fellow at the University of Bristol, 1974–75, and had been a member of the Executive Committee of The American Physical Society. □