250-MeV synchrotron. The latter became the basic instrument, for more than a decade, of the Lebedev Institute's Photo-Meson Laboratory, which Cherenkov headed from 1959 to the end of his life. Studying the electromagnetic interactions of particles became his main occupation. In the 1970s he improved the facilities of the laboratory by directing the construction of a new 1.2-GeV synchrotron. Cherenkov's laboratory collaborated successfully with many centers for research on electromagnetic interactions at high energies, among them Dubna, Serpukhov, CERN and DESY.

Cherenkov's full scientific career could be described in more detail, but I would like to concentrate here on one outstanding feature, one "hour of destiny"—the discovery of Cherenkov radiation. The phenomenon was not and probably could not have been discovered earlier by somebody more experienced in physics than Cherenkov was in the 1930s. To determine the nature of the faint blue light produced in different liquids by gamma rays from a radioactive source seemed to require a young fellow from a rural area, inexperienced but with immense patience and vigor.

It took a long time for Cherenkov and his colleagues, the brilliant physicists Frank and Tamm, to find the right explanation for the phenomenon. Cherenkov was certainly lucky to perform his extremely difficult experiments at the Lebedev Institute, with its creative atmosphere and the favorable attitude of its staff. He was constantly encouraged by Vavilov, who clearly recognized that the phenomenon under investigation was not luminescence but a new effect deserving thorough study. Frank enthusiastically took part in some experiments and suggested many ideas, including the analogy between the Cherenkov effect and an acoustic shock wave, emphasizing that the electron should move through matter with a velocity greater than the velocity of propagation of electromagnetic waves in the same matter.

But the majority of Cherenkov's colleagues did not show particular interest in his results. Nobody recollected the calculation by Arnold Sommerfeld in 1905 of the energy losses of an electron whose velocity exceeds the velocity of light, or the incredible intuition of Oliver Heaviside, who actually predicted the Cherenkov effect in 1888. Even as distinguished a physicist as Leonid I. Mandelstam did not show much interest in Cherenkov's results, being quite sure that an electron moving with constant velocity could not emit radiation.

Only Cherenkov's discovery of the asymmetry of the radiation, made (partly by chance) in 1936 after several years of intense experimenting, assured him and his fellow researchers of the reality of the phenomenon and gave them the key to understanding it. The angle between the electron trajectory and the emitted light was found to be in agreement with the Huygens principle. Finally in 1937 Tamm developed a theory, based on classical electrodynamics, that perfectly predicted the experimental data on the angle and intensity of Cherenkov radiation.

But acceptance of the effect did not come easily. In the middle of 1937 the editor of *Nature* declined to publish Cherenkov's paper, entitled "Visible Radiation Produced by Electrons Moving in a Medium with Velocities Exceeding That of Light." Later in 1937 *Physical Review* published the paper, and soon the phenomenon was confirmed and accepted. In the same year Cherenkov noted the possibility of using the effect for measurement of the velocities of relativistic charged particles. This possibility was realized much later, with the improvement of the technique of recording the feeble flashes of light using photomultipliers or image intensifiers.

The Cherenkov technique is now the main tool for distinguishing particles of different masses in accelerator experiments. The momentum of the particle is measured by magnetic deflection and its velocity by using the angle or intensity of the Cherenkov light. The technique of measuring Cherenkov radiation in gases works up to energies of more than 100 GeV.

Another widely used application is the Cherenkov calorimeter, or total absorption spectrometer. The whole field of gamma-ray astronomy and important underground experiments—in particular those detecting neutrinos from natural sources—are now based on this technique. Cherenkov detectors are also a customary part of satellite- and balloon-borne instruments for studies of primary cosmic rays.

But the importance of Cherenkov radiation is not exclusively connected with its extensive practical applications in experiments in high-energy physics. It is also remarkable for its universal general nature. It may have been the last important basic phenomenon in classical electrodynamics that remained to be discovered.

How did Cherenkov react to the tremendous delayed resonance in the application of his discovery? Always a modest individual, he was extremely scrupulous not to pretend to be involved in the developing applications just because of his contribution to the effect's discovery. He even may have avoided using the Cherenkov technique in his own experiments.

When the Nobel Physics Prize was awarded in 1958 to Cherenkov, Frank and Tamm, it was not Cherenkov but Tamm who asked me to acquaint him with the recent developments of the Cherenkov technique. Limiting his own contribution to the period of the 1930s, Cherenkov at the same time always emphasized the crucial role of Vavilov, Frank and Tamm in the discovery.

Nevertheless, when considering the glorious development of the Cherenkov technique in experimental physics, I imagine a young and enthusiastic fellow who for several years started his working day by spending an hour in a totally dark room to prepare his eyes to observe faint light, and who scrupulously repeated the observations again and again, varying the liquids and the geometry of the experiment, trying to find the clue to the nature of the puzzling radiation that now bears his name.

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Fred H. Schmidt

Fred H. Schmidt, an emeritus professor in the physics department of the University of Washington, died on 17 January 1991 in Seattle, Washington.

Fred was born on 12 September 1915 in Detroit, Michigan. He received his BSE degree in engineering physics from the University of Michigan, and after a brief period as an engineer with AT&T he realized that his deeper interest lay in physics. He entered graduate school in physics at the University of Buffalo and continued at the University of California. During World War II he worked on the Manhattan Project at Berkeley, Oak Ridge and Los Alamos. In 1945 he was awarded a PhD for a study of ion sources under Ernest O. Lawrence.

Fred joined the faculty of the University of Washington in 1946 and became a full professor in 1956. He was the prime mover in the construction and development of its accelerators, a 60-inch cyclotron and later a three-stage tandem Van de Graaff facility. The strong program at Washington's Nuclear Research Laboratory owes much to his many technical contributions and to his insistence on democratic management.

In parallel with building the cyclotron, Schmidt and his students made early studies of correlations between the polarization and the emission direction of beta particles. His interest in nuclear alignment and polarization led to a productive series of experiments on angular correlations between particles and photons emitted in nuclear reactions and on the probability of projectile spin flip.

Later Fred's interests turned to accelerator mass spectrometry using the university's tandem facility. The sensitivities achieved as a result of his improvements of the transmission and stability of the accelerator enabled him and his colleagues to measure, for example, the variation of carbon-14 concentrations within a single annual tree ring and to extend their ^{14}C researches into a wide range of problems in environmental science.

In the early 1970s Fred developed a strong concern about energy issues. Largely because of what he believed to be its environmental advantages, he became a vigorous proponent of nuclear power. He spoke and wrote extensively on energy issues, including coauthoring the 1976 book *The Energy Controversy: The Fight Over Nuclear Power*.

Fred had wide-ranging interests and often found intriguing examples of physics in them, especially in his favorite sports, skiing, climbing and swimming. In addition, as his friends came to expect, he kept careful records of his exploits and could quote dates, weather conditions, altitudes and other details. He was ever eager to teach what he had learned, whether from these activities or his research. His students in first-year physics remember him on his skis in the lecture hall, illustrating angular momentum conservation.

Fred Schmidt was a vibrant, intense person with exceptionally high standards for precision in thought and deed. Withal, however, he was a warm, thoughtful human being who often would chuckle at his own foibles. For 45 years he was a forceful and enterprising member of our department. His colleagues, students and friends everywhere remember him with fondness and respect.

DAVID BODANSKY
RONALD GEBALLE
ISAAC HALPERN
University of Washington, Seattle

Constantine Neugebauer

Constantine A. Neugebauer, a physical chemist at General Electric Research and Development Center, died at his Schenectady home on 1 February 1992, after a long illness. He was 61 years old.

Born in Dessau, Germany, Connie moved to the US in 1945 and settled in Schenectady in 1950. He received a bachelor's degree in chemistry from Union College in 1953 and was awarded a doctorate in physical chemistry from the University of Wisconsin in 1957. He then joined GE, where he worked for 34 years.

Connie is credited with inventing the direct-bond copper process, now used worldwide. He was considered an expert in superconductivity, kinetics, integrated circuit technology, and the structures and properties of thin films. He also did extensive research on large-scale memory and logic arrays for application in information and communication systems.

Connie founded and served as chairman of the thin film division of the American Vacuum Society, was American editor for the *Journal of Electrocomponent Science and Technology* and was an editorial board member of the *Journal of Solid Thin Films*. In 1976 he was named manager of the semiconductor packaging program at the GE R&D Center. He was also active on committees of a number of professional societies.

Connie was known internationally as well as personally revered by people at the GE R&D Center. He was widely recognized for his comprehensive knowledge of all aspects of semiconductor packaging and materials technology and was frequently in demand as an invited technical speaker. An extremely warm and generous person, he served as a mentor to many, both at GE and elsewhere in industry. His legacy lives on through the people he taught and inspired.

JIM BURGESS
HOMER GLASCOCK
General Electric
Schenectady, New York

Jan Popielawski

Jan Maria Popielawski, an outstanding physical chemist and director of the Institute of Physical Chemistry of the Polish Academy of Sciences, passed away suddenly on 9 February 1992. He was 52 years old.

Popielawski was educated at Warsaw University. His work covered a wide range of topics in physical chemistry, such as irreversible processes in adsorbed phases (the subject of his PhD dissertation, completed in 1966 and obtained from the Polish Academy of Sciences), electronic properties in disordered systems (a subject he researched in 1967 during his postdoctoral stay with Stuart A. Rice at the James Franck Institute at the University of Chicago) and kinetic theory of chemical reactions in the gas phase as well as in dense media. His contributions were recognized internationally. In particular, his work in the last ten years of his life on the deviation from the Maxwellian distribution in chemical reactions under nonequilibrium constraints stimulated new developments and international collaborations. The work has potentially important repercussions for the microscopic foundations of chemical kinetics.

In addition to his research, Popielawski stimulated various scientific activities in Poland as head of the postgraduate school in the Institute of Physical Chemistry of the Polish Academy of Sciences from 1974 to 1981, through his activities in the Polish Chemical Society and by organizing domestic and international meetings on timely subjects in the broad areas of statistical mechanics and physical chemistry. Elected associate professor of chemistry in 1972 and professor of chemistry in 1986, he held various offices with the Institute of Physical Chemistry before being elected its director in April 1990, following the end of the Communist regime.

Jan was an accomplished and devoted scientist. We both remember his pragmatic and straightforward approach to research, which was already apparent during his postdoctoral year in Chicago. After a preliminary discussion he would disappear into the library for several weeks, work in isolation by trial and error, and finally come up with a personal, almost definitive solution. In his everyday relations he will be remembered as a low-key but intense person full of generosity, courtesy and care for his colleagues and his coworkers. He guided several young chemists to productive research careers. His sudden death, at the height of his capabilities and his career, is a great loss for Polish chemistry and for his numerous friends all over the world.

GREGOIRE NICOLIS
University of Brussels
STUART A. RICE
University of Chicago

Lawrence E. Nielsen

Lawrence E. Nielsen, noted for his research in polymer rheology and the mechanical behavior of polymers, died in Bend, Oregon, on 15 February 1992.

Born on a ranch in central Oregon, Nielsen received his early education