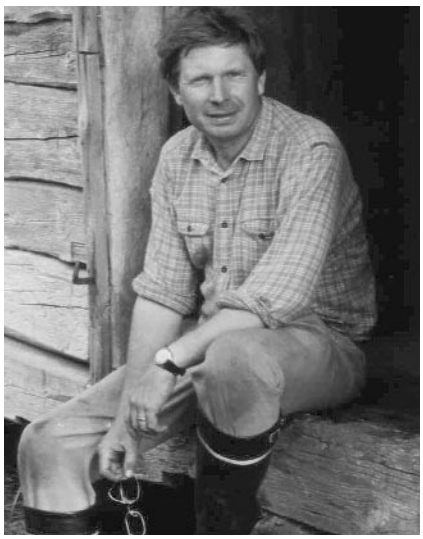
degrees at the University of Helsinki: a Nat. Cand. (BSc) in physics and mathematics (1959); Phil. Cand. (MSc) in astronomy (1960); Phil. Lic. (CSc) in physics and mathematics (1967); and Phil. Doc. (PhD) in physics (1969). Subsequently, he held a Nordita fellowship (1969–70) at Uppsala University in Sweden and a postdoctoral fellowship (1971) at the University of Chicago under the late Ugo Fano.

In 1971, Teijo was appointed an associate professor of physics at Helsinki University of Technology, where he spent the remainder of his career, with the exception of periodic visiting professorships at the University of Uppsala; University of Oregon; University Pierre and Marie Curie (University of Paris VI); Kansas State University; and KEK, the High Energy Accelerator Research Organization in Tsukuba, Japan.

Teijo's work has influenced the understanding of electron processes and dynamics in molecular science and in solid-state systems. His scientific work was characterized throughout by deep insight into atomic dynamics, symbiotic integration of theoretical advances with experiment, and an uncanny ability to unify seemingly diverse processes by a common theoretical explanation.

In the early 1960s, work by Manfred Krause and Tom Carlson at Oak Ridge National Laboratory added to evidence that more than one electron can be emitted on absorption of a photon by an atom. Because the photon–electron interaction is described by a one-electron operator, the central-field frozen-core model available at the time did not predict changes of state of more than one electron. It became known only subsequently that direct multiple-excitation processes arise from electron correlation. Teijo was intrigued by this puzzle, which could also lead to an explanation of the origin of long-observed x-ray "satellites" that accompany regular "diagram" lines if the emitting atom is multiply ionized. This question dates as far back as Felix Bloch's work in 1935. Teijo was thus led to formulate a general theory of x-ray excitation, based on the sudden approximation and imperfect wavefunction overlap between initial and final states, calculated invoking closure. This theory, with later elaboration, applies to a wide range of atomic and molecular processes, including radiationless (Auger) transitions.

Teijo expanded upon this comprehensive approach in 1972. Three years later, at an Advanced Study Institute in Carry-le-Rouet, France, Teijo reported on progress in a talk described as "visionary" by Werner Mehlhorn. Mehlhorn recalled that he "was convinced that Teijo had taken a decisive new step, the second most important since Gregor Wentzel's." In his role as editor, Mehlhorn invited Teijo to write a monograph on the theory of the Auger effect for the *Handbuch der Physik*. The monograph, coauthored by G. Howat, was published in 1982 and still is widely used.



TEIJO ERIK VILHELM ÅBERG

In subsequent years, with assistance from collaborators including Jaakko Juhani "Jukka" Tulkki, Mau Hsiung Chen, and members of the Oregon group, Teijo generalized what started as simple "shake theory" to a comprehensive time-independent resonant-scattering theory. According to the latter theory, the creation of x rays and Auger electrons by photon impact on atoms is treated as a one-step resonant scattering process in which the number of electrons is conserved. The transition matrix amplitude is expressed by what Teijo affectionately called the "Grandfather formula." The comprehensive scheme and its relativistic generalization compose a range of phenomena, including processes previously considered disparate; it thus has become a powerful unifying approach. The theory—the crowning achievement of Teijo's scientific career—elucidates aspects of multiphoton processes, multielectron excitation, postcollision interaction, and resonant inner-shell Raman transitions.

Teijo influenced his students and younger collaborators, who continue to conduct important research. Those who knew and worked with Teijo will recall the clarity of his thinking and exposition, incisiveness, enthusiasm, personal warmth, informality, and patience in helping students and colleagues alike. They will remember happy times working on tough problems or skiing in the Cascade Mountains, where he would amaze them with Telemark turns taught to the Finnish ski troops. Teijo will be missed very much.

BERND CRASEMANN
University of Oregon
Eugene

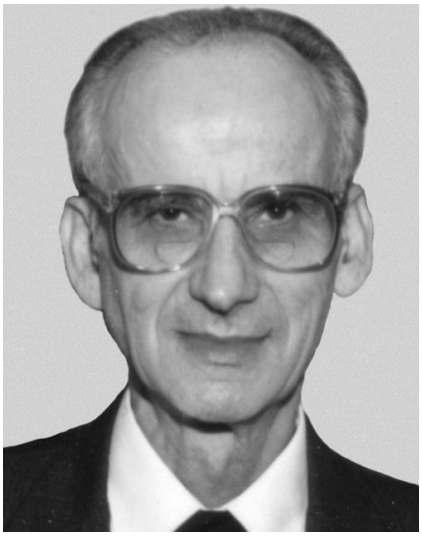
Samuel Newton Foner

Samuel Newton Foner, a pioneer in the science of very short-lived free radicals and highly reactive molecules, died from prostate cancer on 14 October 2000 in Tampa, Florida.

Born in New York City on 21 March 1920, Foner entered the Carnegie Institute of Technology at age 16, obtaining a double BS in physics and mathematics in 1940 and an MS in physics a year later. Before receiving his DSc in physics in 1945, under the direction of Nobel laureate Otto Stern and coadviser Immanuel Estermann, he was an instructor and worked with Stern from March 1944 to July 1945 on a secret program that was a part of the Manhattan Project.

Foner had an exceptional ability for developing simple experiments to resolve complex issues. He brought this talent to the Johns Hopkins University Applied Physics Laboratory (APL), then located in Silver Spring, Maryland, which he joined in July 1945 and where he worked for his entire professional career. For most of that time, he was a member of the research center, founded in 1947. Among his colleagues at the center were Ralph Alpher, Robert Herman, and James Van Allen. Foner conducted and led research in mass spectrometry, trapped free radicals, electron impact ionization, solid propellant combustion instability, and underwater sound.

In the article "Neutral Beam Kinetics," *Nature* (volume 229, page 374, 1971), drew attention to the prolonged and painful evolution of the field, aided not so much by theoretical advances as by exquisitely subtle experimentation that emphasized direct observation. The article credited Foner and his colleague Richard Hudson for ingeniously combining two instruments—the molecular beam apparatus and the mass spectrometer—and using a novel scatter-



SAMUEL NEWTON FONER

ing geometry to complete the first successful study of neutral atom–molecule reactions. Foner, who had learned the molecular beam techniques from their developer, Stern, had by then been working on refining mass spectrometers for at least two decades. He was the first to identify the elusive molecule hydroperoxyl (HO_2) by mass spectrometry in 1953, nearly two decades after its existence was theoretically deemed essential for fully understanding the hydrogen–oxygen system.

By 1962, Foner had found a way to increase the concentration of HO_2 by more than two orders of magnitude so that one could actually study, using a plethora of techniques, the molecule in the gas phase and as trapped in low-temperature solid matrices. Foner and his colleagues Chih Kung Jen, Edward Cochran, and Vernon Bowers had already pioneered techniques for trapping free radicals. The results of one such experiment, the trapping of hydrogen atoms in a solid hydrogen matrix at liquid helium temperatures and their study by electron spin resonance techniques, allowed Norman Ramsey to infer the lifetime of hydrogen atoms bouncing around in the maser chamber and to conclude that the system will not be too lossy. Ramsey could therefore confidently proceed with the building of the hydrogen maser.

Foner had great enthusiasm for science and was cognizant of its role in addressing national security problems. He also often judged science projects at local schools, served as science coordinator of the US science exhibit at the Seattle World's Fair in 1962, and was adviser to NATO's scientific affairs division (1973–82). He was the founding member of the *APL Technical Digest*; he served on the editorial board (1961–63) and was later the chairman (1963–79). He also served as vice chairman of APL's Milton S. Eisenhower Research Center (1975–83). He retired from APL in December 1990.

Foner was a reserved and unassuming man who was truly embarrassed by praise. My attempts to recount Estermann's high opinion of Foner, as expressed by Estermann to me, met with a quick change of subject. Used to doing first-rate research at an institute where such research was internally funded, he never took to proposal writing and seeking outside funds, even when it became de rigueur. He often said that such actions would soon lead the funding agencies to dictate the problems on which one could work. He was not entirely wrong. Foner was an exemplary scientist who leaves a strong scientific legacy.

KISHIN MOORJANI
Applied Physics Laboratory
Johns Hopkins University
Laurel, Maryland

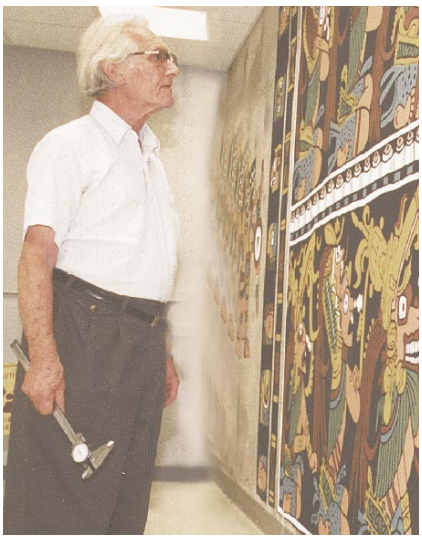
Stanley Kronenberg

Stanley Kronenberg, a nuclear physicist and authority on nuclear-radiation technology and detectors, died from a heart attack at his home in Skillman, New Jersey, on 9 December 2000.

Born on 3 May 1927 in Krosno, Poland, Kronenberg received his PhD in physics from the University of Vienna in 1952. His thesis was on atomic weapon design; at that time, such information and work in the US was classified by the US government.

In 1953, the US State Department offered Kronenberg a position as a nuclear research scientist at the US Army's Nuclear Radiation Laboratory in Fort Monmouth, New Jersey. Subsequently, he commenced a productive 47-year career at Fort Monmouth, during which he published nearly 100 papers on nuclear radiation detection and measurement. He also was awarded 22 patents for work in that field.

Kronenberg was one of the few people in the US who could design, arm, and disarm a nuclear weapon. From the 1960s through 1970, he devised and carried out radiation experiments for every atomic bomb test in the Pacific, then at most of the aboveground nuclear tests in Nevada, and at some of the underground tests. In one aboveground bomb test in Nevada, he actually climbed the tower on which a nuclear weapon had misfired and disarmed it.



STANLEY KRONENBERG

His most significant contribution to US atomic bomb research was the experiment he designed in 1968 to measure the radiation in the environment following a nuclear explosion. The design covered a timescale from a fraction of a nanosecond to hours after the event. The experimental setup involved 100 Tektronix oscilloscopes with 0.3-ns rise times that were arranged to trigger at various times after the event to cover the total timescale. He used a SEMIRAD detector, which he invented specifically for this experiment, to measure the nuclear environment. The data, still highly classified, significantly contributed to the US effort in nuclear weapons design. It was not widely known that Kronenberg was responsible for designing this experiment and successfully acquiring such important data.

From 1962 to 1983, Kronenberg served as the director of the Evans Laboratory nuclear radiation division at Fort Monmouth. He then abdicated the management position and turned his attention solely to radiation research, which was his first love.

Kronenberg received numerous honors and awards, among them the Meritorious Civil Service Medal (1966); four Department of the Army Research and Development Achievement Awards (1968, 1971, 1972, and 1976); and the Federal Emergency Management Agency Outstanding Public Service Award (1986).

Among his many talents, Kronenberg was an expert watchmaker, machinist, and mechanical designer who could operate any machine shop equipment with high precision. He