more than 20 years at RAND, Latter, together with his brother and most of RAND's physics department, founded R&D Associates (RDA). He served as RDA's vice president and headed its Washington office from 1974 to 1979. RDA was bought in the early 1980s by Logicon, which is now a subsidiary of Northrup Grumman.

Latter made several important contributions to arms control. With his RAND colleagues, he performed in 1957 an early analysis of the proposed 20-station "Geneva-net" of seismic stations that were intended to monitor underground nuclear explosions for the proposed Comprehensive Test Ban Treaty. He concluded that the detection capability of Geneva-net was seriously limited in some respects.

In 1959, he went to Geneva to attend the conference on the discontinuance of nuclear weapons tests as a member of the US delegation. That same year, he was a science adviser to the first round of strategic arms limitation talks (SALT I). He was influential in convincing the US negotiators that monitoring and policing a comprehensive treaty that banned all underground tests was impractical given that seismic and other signals could be hidden by conducting the explosion in a cavity.

What would probably be Latter's most important contribution to the strategic balance of the cold war began in the early 1960s when he conceived MIRV—the idea of carrying multiple, independently targeted reentry vehicles on a single ballistic missile. In the US, MIRV remained an idea at first. But when he analyzed missile guidance data gleaned from observing the Soviets test their SS-9 missiles, Latter found evidence suggesting that the Soviets were equipping their SS-9s with MIRV. He alerted the White House and the US defense community about the tests, and his brother carried the idea forward through the US Air Force Scientific Advisory Panel. As a result, the US developed its own MIRV capability on its Minuteman III missiles.

With Mission Research Corp's Conrad Longmire, Latter determined that the electromagnetic pulse that follows a nuclear explosion could adversely affect electronic systems on the ground even when the explosion took place above or high in the atmosphere. He coauthored a RAND report that predicted the radar and communication blackout that follow such bursts, a finding that was confirmed by high-altitude tests over the Pacific in 1958 and 1962.

He also made important contributions to the physics of high-temperature and high-pressure matter by deriving equations of state and opacities for bomb materials essential to the design of nuclear weapons.

Latter was an ingenious theoretical physicist, but he made his most notable contributions as an adviser to various bodies, including the Defense Intelligence Agency, the Defense Atomic Support Agency, the Defense Nuclear Agency, the Defense Science Board, the President's Scientific Advisory Committee, and the Atomic Energy Commission's Plowshare Committee. In that capacity, he participated in deliberations of silo hardness, missile accuracy, weapons effects, detecting and confirming nuclear tests, and numerous other studies.

Latter was an engaging and persuasive researcher whose logical and active mind and analytical talents were widely recognized. He was generally able to help solve any problem that came under his scrutiny. He had numerous collaborators, but he did not take kindly to those peers whose high self-regard outstripped their less impressive intellectual capacities. With considerable skill, he punctured the pomposity of those whom he found to have been sloppy in their physics or mathematics.

**HAROLD L. BRODE**
*Pacific-Sierra Research Corp*
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# Barbara Hope Cooper

BARBARA HOPE COOPER

Barbara Hope Cooper, a leader in surface science and the first woman to be appointed a professor of physics at Cornell University, died of lung cancer on 7 August 1999 in Ithaca, New York.

Born in Lancaster, Pennsylvania, on 1 September 1953, Barbara graduated from Cornell in 1976 with a BA in physics and went on to earn a PhD in physics from Caltech in 1982. She remained at Caltech as a postdoctoral fellow until 1983, when Cornell's physics department recruited her to be an assistant professor. She became a full professor in 1995.

Barbara is best known for her innovative experimental studies of the scattering and trapping of low-energy ions at metallic surfaces. She began as a novice in this research field in 1983, with an empty laboratory and relatively little support, but within a few short years she had created one of the leading laboratories. She and her students designed and built a versatile ion scattering apparatus that could operate at ion energies from 10 to 1000 eV. With this apparatus, detailed information about the scattering potentials, energy transfer processes, scattering mechanisms, and the role of surface adsorbates was obtained from measurements and simulation of the energy and angular distribution of alkali and oxygen ions scattered from copper (100) and (110) surfaces.

She obtained particularly important results from scattering processes in which electron transfer occurred when the ion was near the surface. In addition to carrying out the experiments, she launched a parallel program in large-scale trajectory simulation using accurate potentials and systematically incorporating many-body effects. This initiative gradually led to a new understanding of the role of correlation effects in charge transfer processes and to a far deeper appreciation of these inherently complex dynamical phenomena.

More recently, Barbara extended her research program to investigate the manner in which low-energy ion bombardment affects the erosion and growth of metal surfaces and in thin film deposition. She used an *in situ* scanning tunneling microscope to gain atomic-resolution images coupled to real time and *in situ* synchrotron x-ray scattering to gain low-angle diffraction data for the surface structure during ion bombardment. She was able to observe pattern formation during sputtering of a gold surface and then to probe the competition between roughening and smoothing mechanisms during sputtering and annealing.

Throughout her career, Barbara

had a keen eye for potential technological opportunities resulting from her research. However, always closest to her heart was a deep devotion to fundamental science. She was a superb research supervisor and successfully guided a dozen students through their doctorates at Cornell.

Her impact went far beyond her own research group. In recent years, her scientific leadership talent for organizing large, diverse groups was increasingly vital to two of Cornell's multidisciplinary research centers, the Cornell Center for Materials Research (CCMR) and the Cornell High-Energy Synchrotron Source (CHESS). She was also a key leader in an initiative now under way to build a new facility at Cornell's CHESS that will provide a unique, dedicated x-ray facility for materials research.

Barbara's talents were widely recognized in the national and international physics communities. She received a Presidential Young Investigator Award from the National Science Foundation (1985–89), and faculty development awards from IBM and AT&T. She received the American Physical Society's Maria Goeppert-Mayer Award in 1992.

A truly dedicated teacher, she worked to develop more hands-on investigation of fundamental scientific concepts in several introductory physics courses at Cornell. Her eight-year-old daughter, Katie, inspired her to take a special interest in educational outreach programs introducing elementary school students to the wonders of science.

Barbara will be enduringly remembered for her dedication to science, her quiet and effective leadership skills, and her insight and courage to invent and develop new experimental methods. Her untimely death continues to affect all of us who had the great privilege of knowing her.

**NEIL ASHCROFT**
**DOUGLAS FITCHEN**
**WILSON HO**
*Cornell University*
*Ithaca, New York*

## Charles Edward Swenberg

CHARLES EDWARD SWENBERG

Charles Edward Swenberg died at the Mayo Clinic on 19 October 1999 from pulmonary failure caused by the debilitating effects of a 30-year battle with Crohn's disease. Over his career in science, Swenberg contributed to several fields, including chemical physics, solid-state physics, radiation biology, radiation chemistry, and biophysics.

Born on 11 March 1940 in Meriden, Connecticut, Swenberg earned his BS and MS degrees in physics at the University of Connecticut in 1962 and 1963, respectively. He earned his PhD in physics at the University of Rochester in 1967. After spending the years 1967–69 as postdoc at the University of Illinois, he moved to New York University, where he remained until 1981.

Some of Swenberg's early and notable scientific contributions were in the field of excitonic processes in organic crystals. In 1968, he and William T. Stacy originated the concept of exciton fission of one electronically excited singlet state into two triplet states of lower energy—a then novel mechanism of radiationless energy dissipation. That concept explained the anomalously low fluorescence efficiency of organic solids, such as tetracene and pentacene. The phenomenon of exciton fission has since been used as a tool to determine the energetics of triplet states and to study recombination processes in restricted domains.

The fission process is sensitive to the effects of an external magnetic field, and Swenberg was one of the pioneers in using the magnetic field effect to provide theoretical underpinnings for the triplet exciton as a probe for charge carriers, for deciphering photoexcitation relaxation mechanisms, and for analyzing the kinetics of recombination in restricted domains.

In 1976, Swenberg, Nicholas Geacintov, and Martin Pope called attention to the phenomenon of exciton–exciton collisions in photosynthetic membranes and provided the first quantitative explanation of nonlinear quenching of fluorescence in photosynthetic systems within the context of a continuum model of exciton diffusion. At the same time, he, Roberto Dominijanni, and Geacintov advanced theories on the effects of pigment heterogeneity and exciton percolation and their impact on fluorescence of chlorophyll and exciton trapping in photosynthetic unit.

Swenberg's scientific career had begun in solid-state physics. Working on his master's degree with Ralph Bartram, Joseph Fournier, and Sung Yun La, he interpreted radiation-induced effects in ionic crystals. In his PhD work, he turned to van der Waals solids, contributing to the then-young theory of exciton annihilation. And as a research associate, he collaborated with Charles Duke on the theory of transport in narrow channels on semiconductor surfaces.

In 1978, Swenberg moved to the Armed Forces Radiobiology Research Institute (AFRRI). Located in Bethesda, Maryland, AFRRI is the only government laboratory devoted to in-depth research on the mechanisms associated with the impact of ionizing radiation on biological systems. At AFFRI, he headed the division of physical radiobiology and was the project manager of the radiation biochemistry department. His research interests centered primarily on the mechanisms of DNA radiolysis, designing improved radioprotective agents based on fundamental principles, and comparing the impact of neutrons and gamma rays on biological model systems and cells.

Beyond contributing to basic science, Swenberg played a major role in organizing and publishing the results of a number of international conferences. He was also an excellent teacher and presented graduate and undergraduate courses at New York University and George Mason University. And in the 1990s, his interest in topology and wavelets led him to plan on completing a doctorate in mathematics.

Swenberg's scholarly contributions were made under severe physical handicaps. In 1970, he suffered his first of a series of bouts with Crohn's disease. After five operations (which left him with less than three feet of intestines), years of medication, and being forced to rely on potent nutritional supplements, Swenberg succumbed to a number of side effects that increased gradually in severity. In the last five years of his life, he was