and storing the results on nuclear structure, which was a rapidly developing field of physics at the time. Eventually, however, his love for New Mexico brought him back to Los Alamos in 1965, where he remained the rest of his life, developing techniques and encouraging others to become interested in parallel computing.

A great architect of computational technique, Metropolis clearly foresaw the use of the computer as an experimental tool in mathematical discovery itself, as illustrated by his 1973 work with Paul Stein and Myron Stein on the universal nature of stable limit cycles associated with maps of the interval. The insight gained through this work would later help guide Mitchell Feigenbaum to the development of models of discrete dynamical systems.

Metropolis also was greatly concerned about problems with the foundations of mathematics itself that were revealed through computer use. He and the late Richard Hamming, friends from undergraduate days, spent hours discussing problems such as the concept of computable numbers. In the second half of his long career, Metropolis and the late Gian-Carlo Rota, renowned professor of mathematics and philosophy at MIT, became friends. This collaboration led to the publication of articles about foundational issues ranging from significance arithmetic, to new viewpoints on real numbers, to new insights into a subject as old as symmetric functions. In 1980, Los Alamos National Laboratory conferred on Metropolis the first senior fellow title. He was awarded the Pioneer Medal by the Institute of Electrical and Electronics Engineers in 1997.

Metropolis was an avid skier and tennis player until his mid-seventies. He also found amusement in creating original names for discoveries. For example, Emilio Segrè asked Metropolis—because of Metropolis's Greek heritage—to suggest names for the two elements Segrè and others had discovered. Metropolis did: "technetium" from the Greek *technetos,* meaning "artificial" for element 43, and "astatine" from the Greek *astatos,* meaning "unstable" for element 85. Metropolis also suggested "Monte Carlo" for the new statistical method of computation. And he created "MANIAC" for the new computer—hoping to end the acronym fad, as he put it—but, as he often lamented, with the opposite effect.

The Metropolis legacy will continue to flourish through the Metropolis Prize in Computational Physics, awarded yearly by the American Physical Society for the best dissertation in computational science. Also, a few years before his death, Metropolis established the Nicholas C. Metropolis Mathematics Foundation, whose purpose is to support and promote mathematics and computational science as exciting and challenging career choices, especially among younger students.

The international scientific community has lost one of its pioneers. His work in mathematics and computer science created much of the modern world large-scale simulation science. He will be sorely missed by his friends and colleagues at Los Alamos National Laboratory and elsewhere.

NANDOR L. BALAZS
State University of New York at Stony Brook
JOHN C. BROWNE
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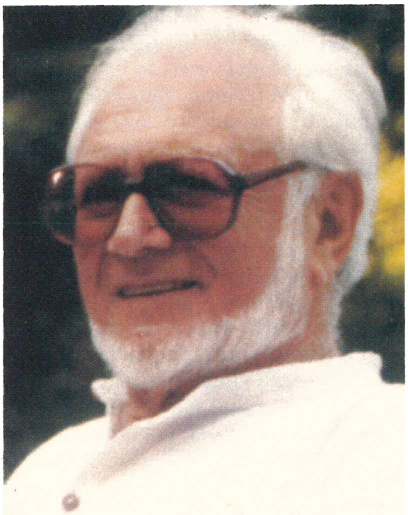
George Abraham Snow

George Abraham Snow, who made major contributions to both the experimental and theoretical aspects of elementary particle physics during the second half of the 20th century, died on 24 June of a stroke while visiting Vancouver, British Columbia, Canada.

Snow was born in New York City on 24 August 1926. After graduating from high school at age 14, he attended the City College of New York, where he received his BS in physics in 1945. A student of Eugene Wigner at


GEORGE ABRAHAM SNOW

Princeton University, Snow obtained his MA in physics in 1947 and, in 1949, earned his PhD in physics.

Snow took research positions at Brookhaven National Laboratory, the Institute for Advanced Study in Princeton, New Jersey, and the US Naval Research Laboratory in Washington, DC. In 1958, he joined the University of Maryland as an associate professor of physics. He became a professor there in 1961 and a professor emeritus in 1992. He assembled from members of the physics department a world-class group specializing in high-energy experimental physics.

Snow's work on the properties of K mesons and hyperons in the late 1950s and 1960s helped lay the groundwork for the quark model of hadrons and for Nicola Cabibbo's theory of weak interactions. In 1959, with Thomas B. Day and Joseph Sucher, Snow wrote a theoretical paper on the dominance of S-state capture for K^- mesons in liquid hydrogen, which helped to identify the spin of the lambda and sigma hyperons. The Maryland group's experiments on the semileptonic decays of the hyperons showed that the lambda and neutral sigma had the same parity and obtained the first good measurements of the decay rates of the charged sigmas. These findings had a direct influence on the work of Cabbibo. Later, measurement of the rare decay mode $\Sigma^{\pm} \rightarrow \Lambda^0 e^{\pm} \upsilon$ helped confirm the Cabibbo theory, which, in its extended form, still plays a key role in electroweak interactions. The Maryland group was the first to confirm the discovery of the omega hyperon.

In the 1970s, Snow was spokesman for a neutrino-scattering experiment at Fermilab's 15-foot bubble chamber in Batavia, Illinois. In this experiment, the researchers studied high-energy neutrino–deuterium interactions and measured the valence d-quark particle distribution functions in the proton and the neutron accurately enough to establish that they differ. This work continued at Fermilab during the 1980s and 1990s with the study of deep, inelastic muon interactions, including a study of particle distribution functions and detailed measurements of particle production.

Snow's theoretical work was reflected in his papers on applying SU(3) predictions to high-energy reactions and on exploiting KN dispersion relations to study $N\Lambda K$ and $N\Sigma K$ interaction strengths. He also proposed a method that was used to separate tau lepton from charm particle production. In 1973, Snow wrote an influential paper on methods for searching for charm particles, which physicists successfully used more than a half a decade later. An example of Snow's exceptionally broad interests is the experiment he devised and carried out with Eric Ramberg in 1990: testing the Pauli exclusion principle with extaordinary accuracy.

Snow guided the Maryland group in joining CERN's OPAL experiment at the Large Electron–Positron collider, which took data from 1989 through 2000. This experiment produced extremely accurate measurements of the mass and width of the Z^0, which established the number of light neutrino generations as three and also confirmed many aspects of the standard model of weak interactions with better than 0.1% accuracy. Snow continued as an active member of OPAL after retiring from the university in 1992, working most notably on searches for R-parity-violating supersymmetric decays, research that he continued until his death.

Snow was chairman of the American Physical Society's division of particles and fields in 1976 and was a member of the board of trustees of the University Research Association, which operates Fermilab. Exemplifying the international character of high-energy physics and his career, he was a visiting professor at the Universities of Rome, Paris VI, and Bologna, and at Tohoku University in Sendai, Japan.

In addition to his research and teaching, Snow contributed greatly to the life of the physics department and the university with his service on committees, boards, and councils. He was a strong proponent of women in science and women's rights in general. He and his wife, artist Lila Snow, jointly taught an honors seminar on women in society in 1972, the first women's studies course at the University of Maryland. Snow took a lively interest in politics and served for four years on the town council of Somerset, Maryland, where he lived.

Snow's forte was his constant attention to the interplay between theory and experiment. He was always searching for ways to confront new theoretical ideas in particle physics with experiment. He had indefatigable intellectual curiosity. He once said that his greatest pleasure in physics came from going around a laboratory, popping into people's research areas, finding out about their experiments, and making suggestions for improvements and extensions. He shared his ideas and sagacity freely with anyone who interacted with him and was remarkably generous to, and thoughtful of, his colleagues. When Snow was asked to give a colloquium at Princeton on his much-cited paper on the S-state capture of K mesons, he invited his younger collaborators to share in the acclaim and provided them with an opportunity to meet some of the famous Princeton physicists.

Snow was remarkably kind, with a delightful, optimistic personality. He is and will continue to be keenly missed by all who knew him.

Joseph Sucher
Nicholas Hadley
University of Maryland
College Park

Bernard M. Abraham

Bernard M. Abraham, a pioneer in the study of liquid helium-3, died on 26 February 1999 at home in Oak Park, Illinois, of complications from the open heart surgery that he had undergone some three years earlier.

Bernard was born in Kansas City, Missouri, on 21 November 1918. His first language was Yiddish, which his parents—both immigrants from eastern Europe—spoke at home; he learned English when he began elementary school. Encouraged by his mother to read widely, Bernard was first introduced to scientists by Paul de Kruif's classic book *Microbe Hunters*, which planted into Bernard's consciousness the thought that one day he might become a scientist. After two years at a community college in Kansas City, Bernard won a scholarship to the University of Chicago, where he earned an SB in physical chemistry in 1940.

During World War II, Bernard was first associated with a group at Northwestern University whose objective was to improve the active materials in gas masks. Later in the war, Bernard joined the Manhattan Project.

When the war was over, Bernard returned to academic studies at the University of Chicago, where he earned a PhD in chemistry in 1946 with a thesis entitled "The Kinetics of the Removal of Arsine from Air by Charcoal." That same year, he joined the newly established Argonne National Laboratory, which was involved in developing the hydrogen bomb. As part of the H-bomb project, Bernard developed the lithium–tritium alloy—for which he held the patent—providing a critical component of the device.