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 $\Sigma^{\pm} \rightarrow \Lambda^0 e^{\pm} \nu$ 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

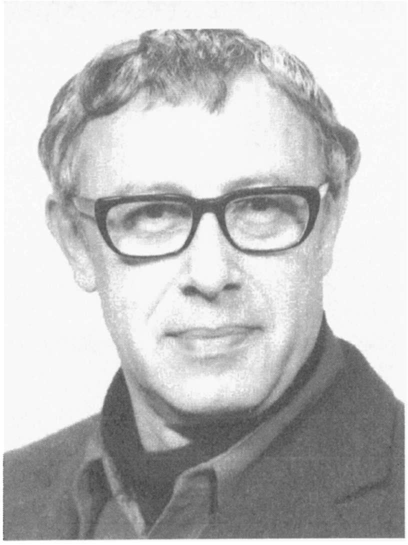
Bernard M. Abraham

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.



BERNARD M. ABRAHAM

Part of Bernard's early unclassified scientific work at Argonne involved thermodynamic studies of a variety of chemical compounds. His most important work, however, focused on pioneering studies of liquid ^{3}He. Although ^{3}He occurs naturally in the ^{4}He derived from natural gas wells, it is present only in extremely minute quantities. On the other hand, tritium decays into ^{3}He with a halflife of about 11 years. Because tritium was an ingredient of the hydrogen bomb, appreciable amounts of ^{3}He became available to groups at Los Alamos and Argonne. Serious study of its properties, particularly its low temperature behavior, then became feasible.

The Argonne group, consisting of Bernard, Bernie Weinstock, and Darrell Osborne, made several historically important discoveries. In one experiment in 1949, they searched for superfluidity and found it to be absent at temperatures above 1 K. At that time, there were two competing views of superfluidity in ^{4}He: Fritz London viewed it as a Bose–Einstein condensation, whereas Lev Landau ascribed it to a particular property of the excitation spectrum. Although the Landau phenomenological theory was formally correct, it did not appear to require the known condensation property associated with Bose gas particles, which implied that ^{3}He might also be a superfluid. London, impressed by the apparent lack of superfluidity in ^{3}He, emphasized this point in his well-known book on the helium liquids *Superfluids* (volume 2). Ultimately, superfluidity was observed in ^{3}He in 1972 by Douglas Osheroff, Robert Richardson, and David Lee—but at 1000 times lower temperatures than for ^{4}He, and for reasons that are not directly connected to Bose–Einstein condensation.

Although Weinstock left Argonne for the Ford Motor Co and Osborne returned to thermodynamic studies of solids, Bernard continued his work on ^{3}He, and, in collaboration with Yakov Eckstein and John Ketterson, extended it to ^{4}He and ^{3}He–^{4}He solutions. Many of those studies involved ultrasound as a probe, and thermodynamic studies were also pursued. The acoustic work in ^{4}He ultimately led in to a revision of the structure of the Landau phonon–roton spectrum at long wavelengths. In 1966, the solution studies confirmed theories involving the mixed Fermi–Bose character of that system. Bernard's later work involved studying how sound propagates in superfluid ^{3}He.

In about 1980, Bernard stopped working on helium and began to study Langmuir films. Much of this work was carried out at Northwestern University, to which he moved in 1985 as a research professor. Langmuir films were known to exhibit many two-dimensional phases, the nature of which was poorly understood. Bernard was one of the first to clarify this situation through his studies of the shear modulus, which distinguished solid and liquid phases. Later, other workers, including Pulak Dutta at Northwestern, confirmed and extended the understanding of solid, liquid, and intermediate phases using x-ray techniques.

In addition to his scientific work, Bernard successfully ran for a seat on the school boards of his community, Oak Park, several times. He was later elected to a seat on the village board, serving as a trustee until his death. He was also a strong supporter of the Israel Institute of Technology (the Technion) in Haifa, Israel, where he was a visiting professor. The low temperature laboratory at the Technion was named after Bernard in 1998.

When Bernard was in a room full of people, he often became the focal figure. He enjoyed argument, had strong opinions, and could maintain his views against any challenger. But at the same time, he was willing to listen and learn. He was a man with a keen sense of humor, broad interests, and very wide knowledge, and he was highly respected by all who knew him. He will be sorely missed.

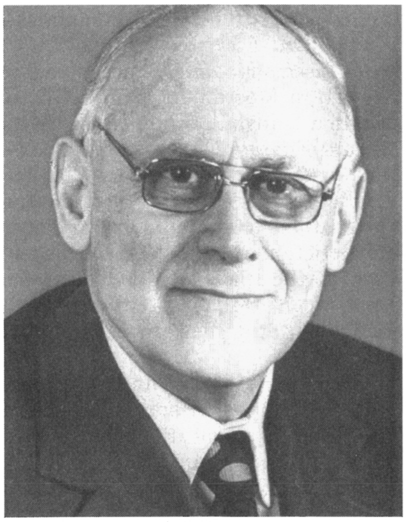
YAKOV ECKSTEIN
Technion
Haifa, Israel
JOHN KETTERSON
IRVING KLOTZ
Northwestern University
Evanston, Illinois

Alexander Il'ich Akhiezer

Alexander Il'ich Akhiezer, one of the pioneers of many-body quantum theory, died of cardiovascular disease on 4 May in Kharkov, Ukraine.

Akhiezer was born on 31 October 1911 to the family of a local physician in the town of Cherikov, now in Belarus. After graduating from Kiev Polytechnic Institute in 1934, he began graduate research with Lev D. Landau at the Ukrainian Physico-Technical Institute in Kharkov. With Alexander S. Kompaneets, Evgeny M. Lifshitz, Isaak Ya. Pomeranchuk, and Laszlo Tisza, Akhiezer formed the first generation of Landau's students who passed the demanding *Teorminimum* exam and established the core of the famous Landau school of theoretical physics. Distinguished by its strong esprit de corps, style, and universality of approaches to problems arising in diverse areas of physics, the Landau school exerted tremendous influence on the discipline of theoretical physics in the Soviet Union, and later in the entire world. Always true to the school's spirit, Akhiezer produced groundbreaking studies in quantum electrodynamics, as well as solid-state, plasma, and nuclear theories.

Akhiezer received his PhD-equivalent Soviet degree in 1936 with a thesis on the photon–photon scattering in quantum electrodynamics, and the second, more advanced degree, in 1940, for the theory of sound absorption in metals and dielectrics. His other works of the 1930s—many done in collaboration with Pomeranchuk—included the theories of the coherent scattering of photons by a nucleus and of the scattering and "cooling down" of



ALEXANDER IL'ICH AKHIEZER