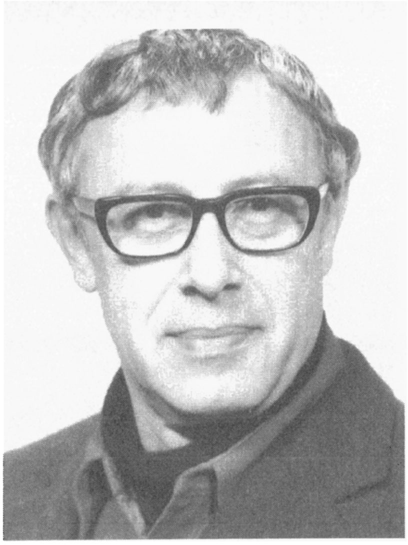

BERNARD M. ABRAHAM

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.

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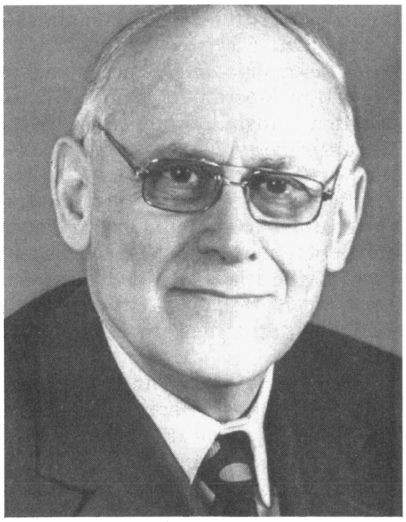
Alexander Il'ich Akhiezer

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

neutrons in crystal lattices.

In 1937, Landau fled Kharkov to escape Stalinist purges. Following a one-year imprisonment, he found a relatively safe base in Moscow under the protection of Piotr Kapitza at the Institute of Physical Problems. The bulk of Landau's students also relocated to Moscow, except Akhiezer who remained in Kharkov. Akhiezer maintained close contact with friends and colleagues in Moscow and taught his own students, eventually establishing a Ukrainian branch of the Landau school. He became head of the theory division at the Physico-Technical Institute in 1938 and chair in theoretical physics at Kharkov State University in 1940. He was elected to the Ukrainian Academy of Sciences in 1964.

In 1948, Akhiezer and Pomeranchuk published the book *Nekotorye Voprosy Teorii Yadra (Some Problems of the Theory of the Nucleus)* (OGIZ, 1948), which included their pioneering theory of resonance nuclear reactions. They further developed the theory of diffraction scattering of fast particles by nuclei; based on this theory, Akhiezer would later predict the diffraction decay of the deuteron. Also during 1948, Akhiezer with Yakov B. Fainberg predicted—independently from David Bohm and Eugene Gross—the effect of beam instability in plasma physics and formulated the evolutionary condition and the stability criteria for magnetohydrodynamical waves. In solid-state physics, he developed the concept of interacting magnons and the microscopic theory of magnetic relaxation, and in 1956, he predicted magnetoacoustical resonance. Akhiezer's study of the absorption of ultrasound in metals in 1957 initiated the field of electron acoustics. The first textbook on renormalized quantum electrodynamics—*Kvantovaia Elektrodinamika (Quantum Electrodynamics)*, published by GITTL in Moscow in 1953, with the English translation published by the Atomic Energy Commission in 1957—was written by Akhiezer and Vladimir B. Berestetsky and served several generations of students as the classic introduction to the field. Akhiezer's work in the 1960s included a series of papers on the electrodynamics of hadrons and generalized quark model.

Akhiezer's style and approach reflected many distinctive features of the Landau school: the idea of theoretical physics as a unified discipline, the mastery of apparatus to help find the most direct solutions to seemingly insoluble problems, and a particular emphasis on working with students and writing textbooks. He trained several dozen prominent theoretical physicists and, alone or with coauthors, published books on many diverse topics, including spin waves, electrodynamics of plasmas, physical kinetics, and quantum field theory. Some of Akhiezer's numerous textbooks supplemented the classical Landau–Lifshitz Course of Theoretical Physics. Together with Landau and Lifshitz, Akhiezer also began to write a course on general physics; the first volume—on mechanics and molecular physics—appeared in 1962. Akhiezer completed the entire course by himself during the 1980s. On several occasions, he courageously defended physicists' interpretations of relativity and quantum theory against ideological critiques by official Soviet philosophers. Toward the end of his life, Akhiezer's own views on the history of science—to which he had contributed so much—were published in *Razvivaiuschaiasia Fizicheskaia Kartina Mira (The Developing Physical Picture of the World)* (Kharkov Physico-Technical Institute, 1998).

Akhiezer suffered a severe blow in 1989 with the death of his son Il'ya, a talented theoretical physicist. He stoically withstood the difficulties of the last years and continued working until his death, despite almost complete blindness. With the death of Akhiezer, theoretical physics has lost one of its last remaining universalists.

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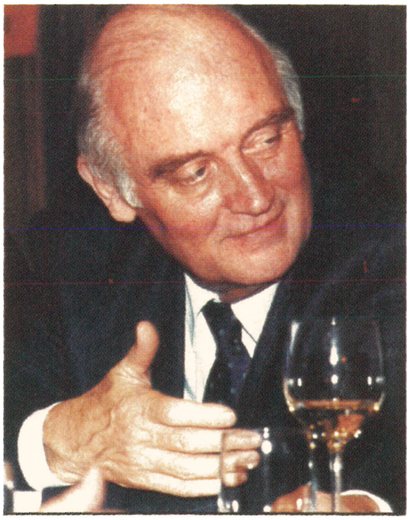

CHRISTOPH HEIDEN

Christoph Heiden, a distinguished low-temperature physicist, died on 28 March in Giessen, Germany, after a long fight with cancer.

Christoph was born on 27 April 1935 in Kirchen/Sieg, Germany. He studied physics at the University of Münster, earning his *diplom* in 1961 and—three years later to the day—his PhD under the supervision of Heinz Bittel. His dissertation was on interactions between irreversible magnetization processes. He then went to the University of California, Berkeley, to work with Art Kip, who steered Christoph's career toward low-temperature physics and superconductivity. After returning to Münster in 1968, Christoph organized a group to investigate flux transport in type-II superconductors and became one of the pioneers in the use of superconducting quantum interference devices (SQUIDs) in Germany. Shortly after earning his *habilitation* in 1971, he was promoted to associate professor. In 1976, he became full professor and director of the Institute of Applied Physics at the University of Giessen, where he spent the remainder of his career, apart from leaves at other institutions.

In 1983, Christoph went on sabbatical at Berkeley to work with John Clarke. He then returned to Giessen, where he developed thin-film SQUIDs made from Nb_3Ge that could be operated at temperatures above 20 K, a world record at the time.

In 1988, following the discovery of the high-T_c superconductors, Christoph was appointed director of the newly founded Institute for Thin Film and Ion Technology at the Jülich Research Center. Christoph applied his extraordinary energy, enthusiasm, and vision to high-T_c thin films and devices, attracting some of Germany's brightest young scientists to his group. At an early stage of this field, the group developed a radio frequency SQUID made from bulk $YBa_2Cu_3O_{7-x}$ (YBCO) that was so easy to operate that the German research minister demonstrated it during a press conference. They also built a gradiometer that could be operated in an unshielded environment and that measured magnetocardiograms with a good signal-to-noise ratio. This system was exhibited at several conferences and trade fairs, where it was used to monitor visitors' magnetocardiograms. Christoph's