His most dramatic application of physics to other fields came with his work bearing on the extinction of species, which he himself considered the most important scientific achievement of his career. (See Alvarez's article in PHYSICS TODAY, July 1987, page 24.) Together with his son Walter, a geologist, Luie discovered an unusually high concentration of an isotope of iridium at the geological boundary between the Cretaceous and Tertiary formations. In association with his colleagues working in radiochemistry at the Lawrence Berkeley Laboratory, Luie determined that this iridium was of extraterrestrial origin and had presumably reached Earth via a meteoric impact. Luie extrapolated that such a massive impact would have raised so much dust into the atmosphere that it would have produced worldwide darkness sufficient to impede biological processes. This he associated with the disappearance of the tiny marine organisms known as foraminifera, as well as dinosaurs and other species, between the Cretaceous and Tertiary periods. While there is little argument about the correctness of the association of the iridium layer with the impact of an extraterrestrial boloid, the details of how this event might be connected to extinctions are still in dispute. Many paleontologists maintain that Alvarez's hypothesis cannot by itself give a satisfactory picture of the Cretaceous–Tertiary extinctions.

Whatever the verdict on this controversy turns out to be, Luie's discovery has induced major changes in thinking about geological and evolutionary processes. Detailed examinations of the soil chemistry of the Cretaceous–Tertiary boundary and other geological strata associated with mass extinctions have been made worldwide. Some studies have correlated apparent periodicities of major extinctions with the frequency of occurrence of meteoric impacts. Luie's findings have triggered interest in the "nuclear winter" phenomenon, which associates danger to life with the dust and soot raised into the atmosphere by nuclear explosives.

Luie's productive life has had its share of controversy, triggered primarily by his attitude that at any one epoch scientific questions have only one best answer and that those who do not accept that verdict are largely wasting their time. Thus when, through his work, the hydrogen bubble chamber became the most productive tool in discovering new hadronic states at high energy, he felt that high-energy physics resources should be almost totally concentrated on bubble chamber work. This caused conflict between Luie and those of his colleagues at the Lawrence Berkeley Laboratory who did not feel that science should be conducted under such a principle of absolute priority. During the period when Lawrence and Alvarez tried to rededicate the resources of the Lawrence Berkeley Laboratory to breeding uranium, not everyone was persuaded that the emergency requiring this action existed. The debate between Luie and the disbelievers in his theory of mass extinctions has at times been acrimonious.

Luie had an amazing knowledge of the entire literature of physics, and he exhibited the opposite of the "not invented here" syndrome: When he felt that others had attacked a problem responsibly, he would not attempt to modify their technique just to prove he might have a better way. For example, when at Los Alamos Luie agreed to assess the yield of nuclear explosions using shock-wave measurements, he ascertained from then-classified reports that Wolfgang K. H. Panofsky had already developed instrumentation he could adapt to that purpose, and he used those devices.

Luie Alvarez, like most academic physicists, immersed himself in military technology during World War II. Unlike many of his academic colleagues he pursued such work intensively (if intermittently) throughout his life. His scientific standards remained high throughout, and he justified his work as the means to peace. He disapproved of SDI. Luie was part of the first wave of US scientists to visit nuclear facilities in the Soviet Union in 1956. He was deeply moved by the occasion and argued that nuclear explosives had made war a thing of the past.

Luie Alvarez was an extraordinarily gifted experimental physicist, an inventor, an investigator and a strong individual who maintained the highest standards of truth in inquiry. The world is poorer without him.

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Ralph P. Johnson

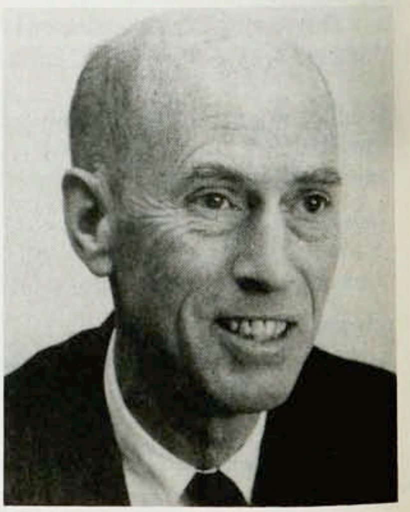
Ralph P. Johnson died 11 February 1988 in Los Angeles at the age of 78. A fellow of The American Physical Society, his career included numerous contributions to physics as well as responsibilities in industry and government.

After completing his undergraduate work at the University of Richmond and receiving his MS from the University of Virginia in 1932, Johnson went to MIT, where he earned a PhD in 1936. Working in physical electronics under Wayne Nottingham, he and William Shockley developed the cylindrical electron microscope for studying electron emission from filaments. The microscope provided the first direct measurements of the variation of electron emission and adsorption with crystallographic orientation. Their paper on this work was the first scientific publication by either author.

Johnson was on the research staff at the General Electric Research Laboratories in Schenectady, New York, from 1936 until 1943. There he continued studying the surface physics of metals and built an electron diffraction camera of his own design. A short study of stereoscopic vision led to an imaginative psychophysics paper titled "Believing Is Seeing." In 1937 he co-authored with Frederick Seitz a series of three review articles in the *Journal of Applied Physics* on the emerging field of solid-state physics. These articles, which stressed how quantum mechanics and band theory offer a unified approach to widely differing types of solids, have been recognized for their seminal influence on the solid-state physics community (see the article by Spencer R. Weart in PHYSICS TODAY, July 1988, page 38). The American Physical Society made him a fellow in 1941.

In the early years of the war Johnson worked on phosphorescent materials for radar applications. In 1943 he joined Lauriston Taylor at the Operational Research Group of the US Tactical Air Command in England, where his efforts were di-

Ralph P. Johnson



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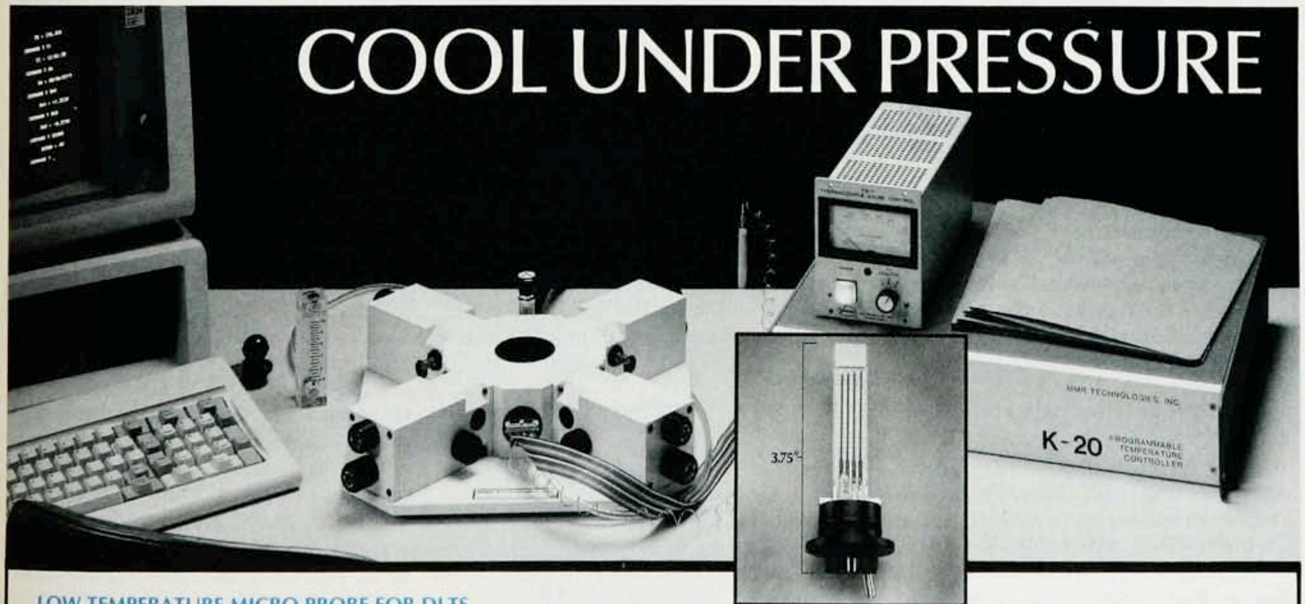

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rected toward measuring actual combat performance of fighter planes and communicating the results in a form useful to pilots. He also helped plan the program for bombers to overfly Germany and land in the USSR. He was called back to the US in 1944 and assigned to the uranium isotope separation project at the Radiation Laboratory of the University of California, Berkeley. He spent the year 1946 working in the Pentagon as Special Assistant to General Curtis LeMay, who had recently relinquished command of the 20th Air Force and who would soon become the first head of the Strategic Air Command. Appointed director of research of the Atomic Energy Commission in 1947, Johnson worked with James B. Fisk to establish the research division of the newly formed agency. As assistant director of the division, he played an instrumental role in the program for exporting radioisotopes to foreign countries for research purposes.

From 1950 onward, Johnson worked in the aerospace industry, starting at the Hughes Aircraft Company. As a vice-president and the director of the research and development laboratories, he was one of the people most responsible for making Hughes a nationally recognized producer of electronics and guided missiles. He joined the Ramo–Wooldridge Corporation in 1953, as associate director of the guided missile division, and later became corporate vice-president of science and technology and a member of the board of directors of the parent company (now TRW Inc).

Johnson was a member of the visiting committee of the MIT physics department during the 1950s, and cochaired the Administration Panel of the Study Committee on the National Institutes of Health, which was established by President Lyndon Johnson in 1965.

After Ralph Johnson's retirement in 1962, he and his wife Phyllis traveled adventurously. Their most extensive trip took them from Los Angeles to the Strait of Magellan in a Karmann-Ghia two-seater. On a trip to China in 1985, he suffered a heart attack that required a protracted hospital stay in Shanghai. He returned to the US in improved condition, but did not fully recover.

Johnson had a warm sense of humor that was enhanced by a gift for understatement. He was admired and loved by colleagues for thoughtfulness, tolerance, clarity of thinking, and communication skills, both written and verbal. His broad wisdom, when perceived behind his propensity for self-effacement, caused us and many others to seek and prize his advice.

David B. Langmuir
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Simon Ramo
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Dean E. Wooldridge
Santa Barbara, CA

Bernard A. Lippman

Bernard A. Lippman, an emeritus professor of physics at New York University, died on 12 February 1988 at the age of 73. Despite a debilitating final illness, he continued to do research and publish his results until the very end.

Lippman was born in Brooklyn, New York, in 1915. He got his bachelor's degree in electrical engineering from the Polytechnic Institute of Brooklyn in 1934, his MS in physics from the University of Michigan in 1935 and his PhD in physics from Harvard in 1948. In his thesis, written under the supervision of Julian Schwinger, he developed the Lippman–Schwinger integral equation for scattering processes—his best-known work. Thereafter he was frequently asked, "Are You the Lippman of the Lippman–Schwinger equation?" On one such occasion, an amused Lippman strolled over to Schwinger, who happened to be nearby, and asked, "Are you the Schwinger of the Lippman–Schwinger equation?"

After holding various engineering jobs from 1935 until 1941, Lippman joined the MIT Radiation Laboratory, where he stayed until the end of World War II. There he did both experimental and theoretical work on 3-cm (X-band) and 1-cm (K-band) microwave circuit components, and he did basic work on the application of equivalent circuit techniques to directional couplers and to microwave junctions. From 1946 until 1948, while working toward his PhD at Harvard, he led the radar receiver group at the Submarine Signal Company in Boston.

Bernard A. Lippman

For the next few years Lippman studied the motion of charged particles in magnetic fields at the Naval Research Laboratory. Then, in 1953 and 1954—about the same time as his work on reactor physics with Nuclear Development Associates—he made an important contribution to the theory of scattering by periodic surfaces. In 1957, after a year's work on magnetohydrodynamics at NYU's Institute of Mathematical Sciences and another year spent heading a solid-state group at the Polytechnic Institute of Brooklyn, Lippman accepted a position at the Lawrence Radiation Laboratory, where he studied electromagnetic and quantum-mechanical scattering. He remained at LRL until 1962. Lippman directed the physics division of General Research Corporation in Santa Barbara, California, for the next four years, and in 1968–1969 he worked as a senior research associate at the NASA Goddard Institute for Space Studies in New York City. He began his physics professorship at NYU in 1969, and took an early retirement in 1977, in order to move to California. There Lippman became manager of the theoretical physics department at Physics International Company in San Leandro, California, a manufacturer of intense electron beam generators.

Lippman's work covered a broad range of theoretical physics—classical, quantum mechanical and relativistic. Because his physical insight and analytical skill enabled him to resolve difficulties in diverse areas, he was also successful in a variety of fields of applied physics. He was particularly adept at finding simple methods to treat problems that were traditionally solved in difficult or cumbersome ways. As a consequence, many of his publications are short didactic papers. He wrote a great number of classified reports, so his published work represents only a small part of his total accomplishment.

Bernard Lippman will be remembered by his friends, colleagues and students for his open and engaging personality and his willingness to provide helpful and insightful support when needed. His insistence on simplicity in analyzing a wide range of physics problems was his hallmark, and will be missed.

Joseph B. Keller
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