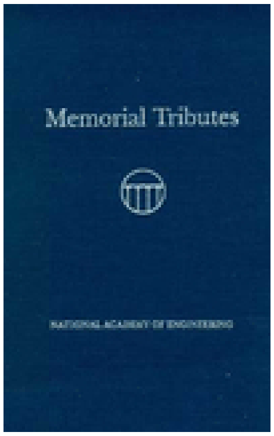

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National Academy of Engineering of the United States of America

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Contents

Foreword

This is the fifth volume in the series of *Memorial Tributes* issued periodically by the National Academy of Engineering to honor the deceased members and foreign associates of the Academy and to recognize their achievements. It is intended that these volumes will stand as an enduring record of the many contributions of engineers and engineering to the benefit of humankind. In all cases, the authors of the tributes are contemporaries or colleagues who had personal knowledge of the interests and the engineering accomplishments of the deceased members and foreign associates.

The National Academy of Engineering is a private organization established in 1964 to share in the responsibility given the National Academy of Sciences under its congressional charter signed by President Lincoln in 1863 to examine and report on questions of science and engineering at the request of the federal government. Individuals are elected to the National Academy of Engineering on the basis of significant contributions to engineering theory and practice and to the literature of engineering or demonstrated unusual accomplishments in the pioneering of new and developing fields of technology.

ALEXANDER H. FLAX
HOME SECRETARY

Memorial Tributes

National Academy of Engineering


H. Allen

Herbert Allen

1907–1990

By Virginia D. Bedford, Marjorie E. Oakes, Ronald L. Geer, Marvin R. Jones, and Albert E. Woefel

Herbert Allen, National Academy of Engineering member, died June 12, 1990, in Houston, Texas. During his eighty-three years, he demonstrated that opportunity awaits Americans with vision, with imagination, with a talent for motivating associates, and with energy for using these talents.

Born in an east Texas sawmill camp to parents of limited means, Allen planned from early youth to educate himself, both formally and informally. Friends, teachers, and business and community peers provided him opportunities for exchange of thought and information all throughout life. Such supplements to his formal education, he was a mechanical engineering graduate of The William Marsh Rice Institute, gave him an unusually broad and rounded education.

During his fifty-five plus years with Cameron Iron Works, Inc. of Houston, Allen held positions ranging from design engineer to president and chairman of the board of directors. At the same time, he served as a director of Big Three Industries, Inc., Texas Commerce Bank, Fenneco, and Spring Branch Bank. On retirement from Cameron, he formed and managed the Hallen Company.

In other nonengineering activities, he also served as chairman of the board of governors of The William Marsh Rice University, trustee of Texas Tech University, trustee of Southwest Research

Institute, director of The Houston Symphony Society, and director of The Houston Chamber of Commerce.

At least 389 U.S. and foreign patents listing Allen as sole or joint inventor have been issued. At the time of his death, he had some fifty-six applications pending. A number of these patents were issued from applications against which patent examiners applied few or no prior art references, requiring in consequence little or no reduction in the scope or subject matter originally claimed. Such patents evidence substantial originality.

In 1964 the American Society of Mechanical Engineers elected Allen a fellow of the Society, in 1972 a life fellow, and in 1973 elevated him to the grade of honorary member.

The Texas Society of Professional Engineers in 1961 elected Allen "Engineer of the Year." Rice University named him "R" Man of the Year in 1969, gave him its "Outstanding Engineer" award in 1975, and in 1978 presented him its "Distinguished Alumnus" award. The Houston Patent Law Association and the Houston Intellectual Property Law Association awarded Allen their "Inventor of the Year" honors in 1977 and 1989, respectively.

Through his ability to recognize and evaluate the scope of long-standing and imperfectly recognized problems, reinforced with much imagination and persistence, Allen created some highly original problem solutions. One such solution, affecting the economy of the entire world, dealt with a packing for use on closing members of high pressure valves. By providing a metal support for totally enclosing resilient material, he enabled valves to hold pressures substantially higher than the strength of the resilient material itself, while sealing against rough surfaces such as those of pipes suspended in oil and gas wells.

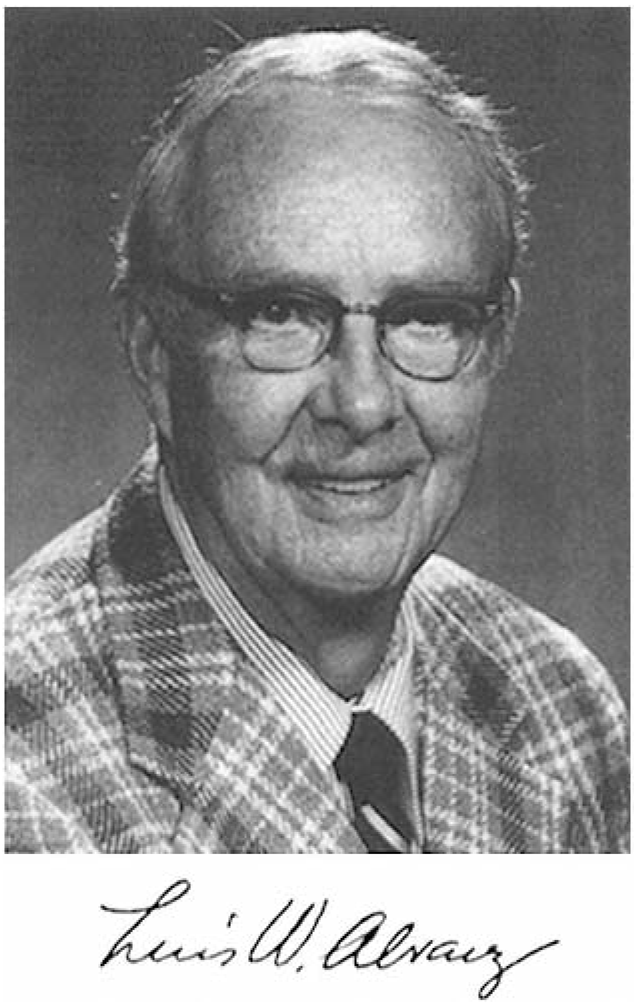
National defense also benefited from Allen's energy and imagination. In 1940 he selected a team of engineering talent that, working under his direction, substantially modified the construction of depth charge projectors so as to eliminate firing mechanism malfunctions. Under the team's supervision, Cameron designed and set up an automated plant to produce the stems and trays used in firing depth charges. With other groups, this team developed improved ways of manufacturing 3-inch, 50 caliber naval gun barrels, and designed hydraulically operated mounts for 40-mm Olerikon rapid-fire guns.

In the period between 1949 and 1986, Allen convinced the Naval Bureau of Ordnance of the feasibility of forging breech blocks, which had previously been made less economically and satisfactorily from steel castings. After receiving approval from the Bureau, he assembled and directed a team that successfully developed the equipment, alloys, and procedures for making superior breech blocks.

Allen freely acknowledged his debts to those who helped him in his struggles with poverty and illness—his teachers, friends, and early associates. But he reserved primary gratitude for his parents, Leona Matthews Allen and Jasper Allen, for supplying help and encouragement to the full measure of their abilities.

As one way of repaying his mentors, Allen during his life offered his help in various ways to younger people seeking to educate themselves. As an example, he and Mrs. Allen gave Rice University an administration office building now known as the Allen Center. Over the years the Allens endowed a very substantial scholarship fund at Rice, with scholarships to be awarded to students on the basis of academic achievement and leadership qualities. Allen willed the Hallen Company, along with the Thomas Instrument Company, to Rice for addition to this scholarship fund, the recipients of which are designated Herbert Allen Scholars.

In recognition of this trait of character, the South Texas Section of the American Society of Mechanical Engineers in 1972 established its Herbert Allen award. Each year, the section presents this award to a section member under thirty years of age for outstanding technical contributions to the profession of mechanical engineering. Herbert Allen is survived by his wife, Helen Daniels Allen, and children, Anne Allen Symonds and Michael Herbert Allen.



Courtesy of Lawrence Berkeley Laboratory, University of California

Luis W. Alvarez

1911–1988

By Richard L. Garwin

Luis W. Alvarez was outstanding as scientist and engineer. It is a challenge to his friends and biographers to do justice to the breadth and depth of Luis's accomplishments. His bare-bones biography does provide a hint:

Physicist, born in San Francisco June 13, 1911, son of Walter C. and Harriet Smyth Alvarez, married (1936) Geraldine Smith-wick, with whom he had two children, Walter and Jean. In 1958 married Janet L. Landis—two children, Donald and Helen. Luis[1] Alvarez earned a B.S., M.S., and Ph.D. in physics from the University of Chicago in 1932, 1934, and 1936, respectively. Beginning in 1936, his entire career was spent at the University of California, Berkeley, as professor of physics from 1945 to 1978, and professor emeritus from 1978. He was associate director of the Lawrence Radiation Laboratory from 1949 to 1959 and from 1975 to 1978. He did radar research and development at the Massachusetts Institute of Technology (MIT) from 1940 to 1943, and then worked at Los Alamos in 1944 and 1945.

Luis Alvarez was a consultant over the years to numerous agencies of the United States government and was a member of the President's Science Advisory Committee in 1973. He was a

[1] Pronounced in the Spanish fashion as "Loueese," but almost everyone called him "Louee," for his nickname, Luie.

long-time member of the IBM Science Advisory Committee and a director of the Hewlett-Packard Company.

His talents did not go unrecognized. He was a fellow of the American Physical Society (and president of the APS in 1969), a member of the National Academy of Sciences and the National Academy of Engineering, of the American Philosophical Society and the American Academy of Arts and Sciences, of Phi Beta Kappa and Sigma Xi. He was also an associate member of the Institut D'Egypt.

He received the Collier Trophy (aviation) in 1946, the Medal for Merit in 1948, the John Scott Medal in 1953, the Einstein Medal in 1961, the National Medal of Science in 1964, the Michelson Award in 1965, the Nobel Prize in Physics in 1968, the Dudley Wright Prize (Interdisciplinary Science) in 1981. He was named California Scientist of the Year in 1960 and named to the National Inventors Hall of Fame in 1978.

Luis Alvarez presented a fascinating view of his life and involvements in his autobiography,[2] and the flavor of his scientific activities is available in a recent book subtitled *Selected Works of Luis W. Alvarez, with Commentary by his Students and Colleagues*.[3] Luis's father was a physician in San Francisco, where he worked each morning on research in physiology, and as a private practitioner in the afternoons to support his family. Although Luis showed no interest in the biological aspects of his father's work, by the time he was ten he could use all of the small tools in his father's shop and wire up electrical circuits.

In 1925 Walter Alvarez left his very successful practice as an internist in San Francisco to join the staff of the Mayo Clinic in Rochester, Minnesota, as a research physiologist, resuming his

[2] *Alvarez, Adventures of a Physicist*, by Luis W. Alvarez, Basic Books, Inc., New York (1987). All unattributed quotations in this tribute are from this book.

[3] *Discovering Alvarez*, edited by W. Peter Trower, the University of Chicago Press, Chicago and London (1987). This volume contains a complete list of Alvarez publications and patents through 1986, to which should be added U.S. Patent 4,911,541, *Inertial Pendulum Stabilizer* with Stephen F. Sporer issued on March 27, 1990.

career there as a clinician a few years later during the Depression. On his retirement, he had a third career as a syndicated newspaper medical columnist, gaining fame as "America's Family Doctor."

During two high school summers, Luis added to his experimental skills as an apprentice in the instrument shop of the Mayo Clinic. Enrolling in the University of Chicago in chemistry, he discovered instead a real talent and passion in physics, beginning with a fascination for optics in which his native talent was nourished by Albert Michelson's optical technicians. Studying optics, working with Michelson's own instruments, taking twelve physics courses in five quarters, Alvarez soon read in the physics library every word Michelson had published. Thus he began his long and tremendously facile acquaintanceship with the literature, exercising an excellent memory for the substance, presentation, and even the location of articles he had read many years before.

In 1934 Luis began his long involvement with aviation, soloing "with just three hours of dual instruction. "He flew for fifty years, logging more than a thousand hours as a pilot before deciding at the age of seventy-three that it was time to put away that demanding and delightful avocation.

In 1936 Ernest O. Lawrence invited Alvarez to join the Berkeley Radiation Laboratory. Luis's older sister, Gladys, worked for Lawrence in Berkeley as a secretary, and on a visit to Chicago, Lawrence (then thirty-two) invited Luis to tour the Chicago Exposition with him, the beginning of a close and productive friendship.

At Berkeley Luis spent almost a year "reading *everything* that had been written on the subject" of nuclear physics. He also soon knew the contents "of every drawer and cabinet in the Radiation Laboratory," resurrecting the first small cyclotrons from oblivion. Key to his evolution as a scientist was Ernest Lawrence's journal club, meeting every Monday night at 7:30—a tradition that continued for decades in Luis's home. Also influential was the "Bethe Bible," three articles published by Hans Bethe in *Reviews of Modern Physics* in 1936 and 1937. Luis's highly developed competitive spirit was stimulated by these 468 pages—"If he (Bethe) said a phenomenon would never be observable, I wanted to prove him wrong, which would make both of us happy. In several significant instances over the next four years, I did."

Luis's discoveries in physics are treated at length in his autobiography and in *Discovering Alvarez*, cited earlier. The discovery of the K-capture process, of He^3, the extraordinary development of the liquid hydrogen bubble chamber, and the work on the comet-impact origin of the extinction of species are evidence of a person of extraordinary experimental talent. But Luis was much more, in driving himself to find the most important application of his capabilities.

Luis recounts his father's injunction "to sit every few months in my reading chair for an entire evening, close my eyes, and try to think of new problems to solve. I took his advice very seriously and have been glad ever since that I did."[4]

Those who lack perfection in educational opportunity might take heart in his further words, "By almost any standard, my training at Chicago had been atrocious.... From another point of view, though, my training had been extraordinarily good. I could build anything out of metal or glass, and I had the enormous self-confidence to be expected of a Robinson Crusoe who had spent three years on a desert island. I had browsed the library so thoroughly that I knew where to find the books I needed to learn almost anything I wanted to know." And Alvarez characteristically would disappear for days into the library at Berkeley, emerging with ideas, plans for experiments, explanations for puzzling results.

Time after time, Luis showed that dogged but imaginative persistence that forced him not to stop with the first idea because there might be a better one. Repeatedly he would leap to a conclusion and then strive to find evidence that would refute it. Alvarez was perpetually surprised to find individuals who do not challenge their own results, and who do not immediately accept even the strongest contrary evidence.

[4] This tribute draws upon my review of "Alvarez: Adventures of a Physicist," published in *Physics Today*, pp. 83–84 (December 1987).

During World War II, Alvarez played a key role at the MIT Radiation Laboratory, working on radar and other systems. There he invented Vixen, which permitted radar-equipped aircraft once again to destroy surfaced German submarines. After an early success, radar had become ineffective in this role because the submarine's radar warning receiver indicated the increasing signal as the aircraft approached on its attack run. Alvarez thought of reducing the radar power output inversely as the *cube* of the range to the submarine. As the aircraft approached, the submarine would detect *decreasing* radar signal and have no fear of impending attack, while the aircraft would receive a continuously *increasing* radar reflection (returned signal energy goes as the inverse *fourth* power of range).

From the MIT Rad Lab, Luis and his group invented, perfected, and fielded Ground-Controlled Approach (GCA) to allow aircraft and pilots to land at night and in poor visibility. Also at MIT, Luis contributed greatly to the MEW (Microwave Early Warning System) and the Eagle blind bombing system, although he left MIT before MEW or Eagle were complete. Like GCA, these important systems used the Alvarez invention of the first microwave linear arrays that were "electrically scannable," the phased array.

After his six weeks in England to transplant GCA, Luis left MIT where he was head of Special Systems (also known as Luie's Gadgets) to work with Enrico Fermi at the Metallurgical Laboratory at the University of Chicago.

Luie soon moved to Los Alamos. Among his major contributions was the invention and development of capacitor-discharge bridgewire detonators for simultaneous initiation of the multiple high-explosive "lenses" in the implosion system of the plutonium bomb. With a detonation wave speed in high explosive of some 8 km/s, 10 nanoseconds (one "shake" as it was called at Los Alamos) timing uncertainty would cause about 0.1 mm asymmetry in the shock wave; normal blasting caps demonstrated 10,000-times greater timing variation. Typical of Alvarez, the first trial of his invention involved firing a normal "bridgewire" with a 15-kV capacitor rather than the typical 6-volt battery. The necessary improvement in timing accuracy was accompanied by improve ment in safety because of the elimination of the more sensitive primer explosive.

Returning to Berkeley after World War II, Luis designed the first proton linear accelerator and headed the team that brought it into operation. He also provided the first published proposal for charge-exchange accelerators, doubling the energy available in electrostatic acceleration and (no small matter) allowing the ion source and the target region *both* to be at laboratory potential.

After World War II, Alvarez was swept up in an E. O. Lawrence passion to build a large deuteron accelerator for the production of plutonium for nuclear weapons; for once Alvarez did not himself look at the data, which would have convinced him that there was plenty of uranium for the reactor production route. Recognizing that he had drifted far from experimental physics, he recast himself as research assistant to two of his own research assistants. This discipline and redirection obviously bore fruit—in the Alvarez work on particle physics with hydrogen bubble chambers for which he won the 1968 Nobel Prize, and in his commitment to technical work and avoidance of formal management roles. His intellectual curiosity and talent for experiment led him to conceive and to execute the "x-raying" of the pyramid of Khephren by the use of cosmic-ray muons, establishing that this pyramid had no hidden chamber.

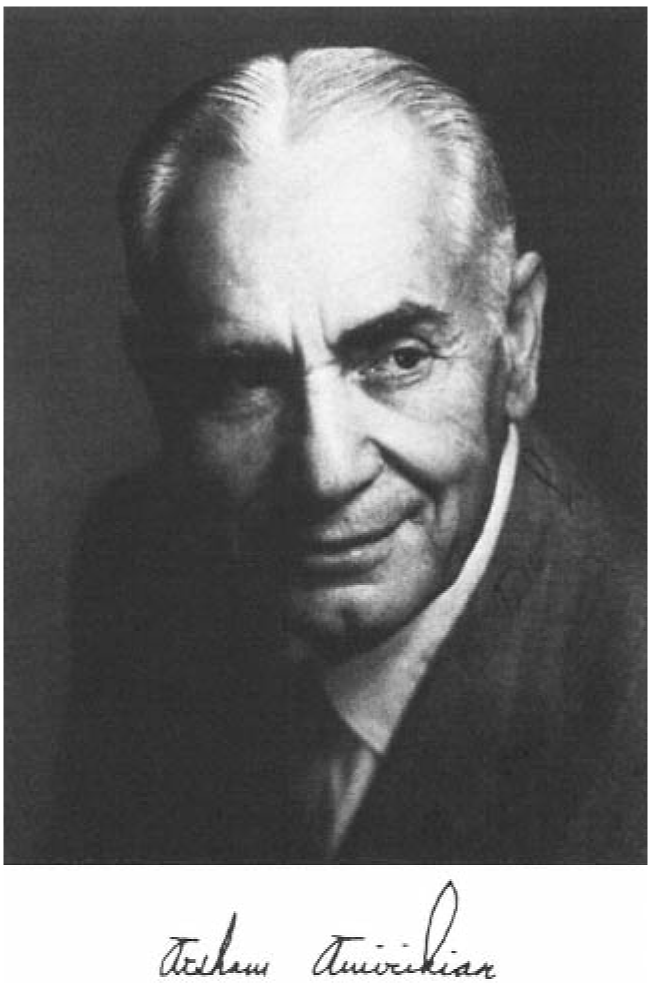
In Alvarez's long and broad history, it is striking to observe how some of his best and most practical ideas were only very much later brought to fruition by his own efforts, despite his early patents that would have been available to profit-minded industry at relatively low cost. The stabilized optical system for binoculars or cameras that Luie invented in 1963 while his wife, Jan, lay ill with malaria in Kenya has only in the late 1980s been sold (by a company of which Jan is president) as a stabilizing zoom lens for shoulder-held video cameras, despite working systems twenty years earlier. The same lag is found with the variable-power lens he invented and demonstrated to Polaroid in the 1960s. It first appeared on the consumer goods market (in the Polaroid Spectrum camera) in 1986.

The life of an inventor (even one in the Inventor's Hall of Fame and winner of the Collier Trophy in Aviation) may be a lot of fun, but it is not always profitable; Alvarez realized the first profit from *any* of his forty-some inventions just a few years before his death.

Luis Alvarez was very much aware of himself and carried into his physics the constructive competitive spirit he had learned early in athletics. He was quick to judge, but also very much open to reason and to his own challenge of the validity of his judgment. "The most," "the best," "the first" were important to Luis, in others as well as in himself, and throughout his life he rejoiced in being associated with the very best in physics, in industry, and in government. He wrote "Heroes have been important to my development as a scientist.... In aviation my two principal heroes are Jimmy Doolittle and Chuck Yeager." Luis wrote, frankly and perceptively, "Valuing honors myself, I've worked hard to see to it that my favorite candidates win them as well," and he could point to successes in that field.

Luis enjoyed the broad spectrum of intelligent laymen at the summer encampment of the Bohemian Club and gave illuminating, enjoyable, and well-prepared talks there. Luis's love of the unique shows itself in his description of his work in 1957 with a panel involved with the "Supersecret National Security Agency.... We were the first outside panel with access to NSA secrets.... I especially enjoyed learning in great detail from William Friedman how the United States broke the Japanese diplomatic codes before World War II."

Luis W. Alvarez was a consummate engineer and technologist who contributed greatly to the evolution of productive and effective civil and military aviation. His knowledge of technology was essential to his outstanding achievements in physics, and his clever and deep inventions in the field of optics may yet have the major impact that they deserve.



Arsham Amirikian

1899–1990

By Eugene J.Peltier

Arsham Amirikian, a former chief engineering adviser of the U.S. Naval Facilities Engineering Command (formerly Bureau of Yards and Docks), died on July 2, 1990, at the age of ninety-one.

Dr. Amirikian was born in Kighie, Armenia, in 1899. He graduated from Bézazian College, Constantinople, in 1917; Ecole Supérieure ties Ponts et Chaussées with a B.S. in civil engineering in 1919; Cornell University with the degree in civil engineering in 1923; and the Institute of Technology (Technische Hochschule) of Vienna, Austria, in 1960 with a D.Sc. based on a thesis of his theory of protective construction.

He was elected to the National Academy of Engineering in 1980. He was a brilliant engineer and was known for his many innovative projects that served the Navy and the Seabees, as well as the entire technical community and engineering profession.

Dr. Amirikian, who lived in Chevy Chase, Maryland, started his career in 1923 as a structural draftsman working for five steel fabrication shops. In 1928 he entered government service as an assistant structural engineer with the U.S. Navy Bureau of Yards and Docks in Washington, D.C. He remained with the command until May 31,1971, advancing through the grades of chief design engineer and special structural consultant to that of his position as chief engineering consultant.

Dr. Amirikian's area of specialization was very broad, including but not limited to the analysis and design of special structures, waterfront installations and auxiliary floating craft, and the development of application techniques for welded steel and precast concrete construction. He received the U.S. Navy Civilian Career Achievement Award for the development of the Ammi Lift Dock and Transfer System. He received the Department of Defense Distinguished Civilian Service Award for his concept and design of Ammi Tactical Support Structures a the invention of the biserrated orthotropic framing system.

He was granted awards for progress in engineering design for arc welded structures. The award he received in 1968 from the American Welding Society was for welded pontoon bridges used in the war effort in Vietnam. He received several awards in design competitions sponsored by the J. F. Lincoln Arc Welding Foundation. He also received the Alfred E. Lindau Award from the American Concrete Institute in 1958, the George W. Goethals Medal of the Society of American Military Engineers in 1971, and the Ernest E. Howard Award from the American Society of Civil Engineers in 1978.

Dr. Amirikian had a long association with technical and professional societies and took an active part in their work through committees. He was chairman of the American Welding Society Committee 17. This committee developed, over a period of time, a new code for welding reinforcing bars. Nothing of this sort was available heretofore, and previous work was done without formulating standards or guidelines.

His publications, which well exceeded one hundred, included *Analysis of Rigid Frames* published in 1942, *Basic Structural Engineering* in 1954, and *The Influence of the Art of Welding on the Creative Concepts of Structural Design* in 1966.

His creative designs included timber and reinforced concrete structures. One of his designs in timber, the U.S. Navy's famed wooden hangar for dirigibles, of which fourteen were built during World War II, was appraised by *Engineering News Record* as the most outstanding structural development of the period. He developed two types of thin-section concrete framing systems, one for floating craft and one for shore structures, for which he received an award from the Concrete Reinforcing Steel Institute in 1952.

Dr. Amirikian was a honorary member of the American Society of Civil Engineers and the American Welding Society and was a registered professional engineer in several states. He retired as a colonel in the Air Force Reserve in the mid-1960s. Besides English and his native Armenian, he spoke and wrote French and Turkish and read and wrote German, Spanish, and Italian.

In a field of wide scope covering a variety of shore facilities and floating craft, his entire career was devoted to developing and improving methods of structural analysis, framing arrangements of increased efficiency, and construction techniques and procedures of greater economy. If he had been allowed another ambition, it might have been to have capped his distinguished career by extending his contact and influence in the ever-widening theater of world science and applied techniques, perhaps through a new assignment such as a technical or scientific attaché in a U.S. embassy abroad or in a special educational endeavor in his prime field of structural engineering.

Dr. Amirikian was a most honored engineer; he received numerous awards from government, industry, and technical societies.

His dedication and expertise in several fields were an inspiration to many who worked with him and had the privilege of knowing him. He truly left his mark in furthering the knowledge base of the engineering profession.

James Bliss Austin

1904–1988

By Harold W. Paxton

James Bliss Austin retired from the United States Steel Corporation as administrative vice-president, research and technology, in 1968 and then continued an active professional career. He died on May 25, 1988, at the age of eighty-four.

Dr. Austin was born in Washington, D.C., on July 16, 1904. He attended the Washington public schools and graduated from Central High School. He attended Lehigh University, graduating with a degree in chemical engineering in 1925, and subsequently received a Ph.D. in physical chemistry from Yale in 1928, studying with Professor John Johnston.

In 1926 the U.S. Steel Corporation (USS) of New Jersey decided to establish one of the first modern central research facilities in the United States at Kearney, New Jersey, and selected John Johnston to be the first director. He persuaded Jim Austin to join him in what was to be a lifelong career with USS. After several years as a physical chemist, he moved though positions of increasing responsibility and became the chief technical officer of USS before his retirement.

During the years at Kearney, which spanned the depression during the 1930s, he was part of a relatively small but influential group that changed the face of production and heat treatment of steel. Some of his distinguished colleagues, whose names are still part of the lexicon of modern metallurgy, were Edgar C. Bain, Lawrence S. Darken (both later elected to the National

Academy of Sciences), and Marcus Grossman. He himself was elected in 1967 to the National Academy of Engineering.

In 1956 the successes and financial impact of the Kearney laboratory and a desire to consolidate research work of many of the operating divisions of the company led to a decision to create a new central laboratory in Monroeville, Pennsylvania, just outside Pittsburgh. Jim was appointed vice-president of fundamental research in 1956, vice-president of research and technology in 1957, and to his final position in 1958.

From its early years in Monroeville, the laboratory was ranked among the finest in the world and was on the "visit list" for all overseas (and many domestic!) metallurgists, or, as they were beginning to think of themselves, materials scientists. Jim Austin could feel rightfully proud of the climate he was able to create. In addition to the outstanding staff, the facilities were superb, with the high point being perhaps the first million-volt electron microscope.

Throughout his career, he was very active in a wide range of professional societies including the American Chemical Society; the American Ceramic Society (ACS); the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME); and the American Society for Metals (now ASM International). He was elected a fellow of ACS, ASM, AIME, and the American Association for the Advancement of Science and to several honorary fraternities, such as Phi Beta Kappa and Tau Beta Pi, and was an honorary member of AIME, ASM, the Iron and Steel Institute of Japan, and the Metals Society of London. He was the 1954 president of ASM and the 1973 president of AIME. He was invited to deliver several important memorial lectures to various societies and was awarded the Edward DeMille Campbell Memorial Lecture of the American Society for Metals. He also served on a number of civic committees at the local and state level.

He and his wife, Janet, were fond of traveling. They particularly enjoyed Japan, and over the years Jim accumulated a superb collection of Japanese wood block prints, which was eventually exhibited at the Carnegie Museum in Pittsburgh. He also had a major collection concerning Sir Arthur Conan Doyle and his works, particularly Sherlock Holmes. Jim was a great lover of music and a regular contributor to WQED, the listener-supported local classical radio station (both financially and as an occasional "disc jockey!").

To the end of his life, he was an active member of the Pittsburgh "Metallurgical Luncheon Club," and his recitation of limericks at the annual Christmas party was always a highlight of this event.

His wife died shortly before him; they had a son, Peter, a daughter, Winifred (Mrs. Donald C. Morton), and several grandchildren.


Roy Bainer

Roy Bainer

1902–1990

Written by Robert A. Kepner and Henry E. Studer

Submitted by the NAE Home Secretary

Roy Bainer was born on a farm near Ottawa, Kansas, in 1902. For several years after graduation from high school he operated a wheat farm in partnership with his father and served as a summertime field service representative for a tractor company. He entered Kansas State University in the fall of 1921, obtaining his B.S. in agricultural engineering in 1926 and an M.S. in 1929. He was instructor and junior agricultural engineer during his last two years at Kansas State. He and Lena Cook were married in 1926.

Roy joined the Agricultural Engineering Department at the University of California (UC), Davis, as assistant professor and assistant agricultural engineer in the experiment station in 1929, and advanced to full professor and agricultural engineer in 1943. He was chairman of the department from 1947 to 1961. His primary interest in teaching and in his research was agricultural mechanization. Among his research accomplishments was the development of a process for segmentation and decortication of sugar beet seed that substantially reduced the need for hand thinning, thereby saving an estimated ten man-hours of labor per acre.

During the years Roy was chairman of the Agricultural Engineering Department, it grew substantially in size and stature and became one of the foremost departments of agricultural engineering in the nation. He, himself, became internationally recognized as a leader in agricultural mechanization. He was a coauthor of two widely used engineering textbooks on farm machinery and tractors, and was author or coauthor of more than one hundred technical papers and reports.

For many years the agricultural engineering undergraduate program at Davis was an option under mechanical engineering in the College of Engineering at UC Berkeley, with only a six-week summer field course and the senior year being taken at Davis. In 1962 when the Regents approved the establishment of a College of Engineering on the Davis campus, separate from the college at Berkeley, Roy Bainer became the founding dean of the new college. He served in that capacity until his retirement in 1969. His responsibilities as dean included recruiting of new faculty and seeing that curricula for the programs in the new areas of engineering were developed—duties that required a great deal of time, travel, judgment, patience, and the ability to evaluate and attract potential faculty personnel. During his seven years as dean, sixty-five new engineering faculty were hired and the College of Engineering total enrollment increased from 265 to 1,030. When he retired, the new engineering building, completed in 1966, was named Roy Bainer Hall in his honor.

Roy was a member of the American Society of Agricultural Engineers for sixty-three years. He was advanced to the honorary grade of fellow in 1946. In addition to numerous committee and division responsibilities, he served as president of the national organization in 1956–1957. He was also a fellow of the American Association for the Advancement of Science. He was elected to the National Academy of Engineering in 1965, served as a member of the National Research Council representing the Division of Engineering from 1961 to 1969, and was a life member of the American Society for Engineering Education. He received numerous honorary awards, including honorary doctorates from the University of California in 1969 and from Kansas State University in 1983. He was one of four engineers inducted into Kansas State University's first Hall of Fame in 1989.

Roy's international stature led to his service as a consultant in at least ten countries, beginning in 1945 with a three-month visit to England to help in the mechanization of sugar beet produc tion, followed by visits to Japan in 1948 and Chile in 1958 regarding various aspects of agricultural mechanization. Included among subsequent consulting assignments were involvement in developing a five-year professional program for agricultural engineering at the Agrarian University of Peru, planning a complete College of Engineering for the Kasetsart University in Thailand, and planning six commodity-oriented research centers in Spain.

Roy died in Davis on January 18, 1990. He is survived by his wife, Lena, and his daughter, LaNelle Bainer. He will be remembered as a man who, characteristically, was enthusiastic about whatever he and his colleagues were doing. He enjoyed people and he encouraged individuals to perform to the best of their capabilities.

William B. Bergen

1915–1987

By Rene H. Miller

William B. Bergen, aerospace engineer and executive, died on October 9, 1987, of cancer at the age of seventy-two in his home at St. Michaels, Maryland. His entire career was spent in the aerospace industry, first at Martin Marietta where he was president of the Martin Company Division at the time of his leaving to join the Rockwell Company in 1967. There he served as president of the Space Division and was the principal executive responsible for the command and service module for Apollo during the crucial period of its development. After his retirement in 1975, he served as a consultant, including a year with Rolls-Royce in England.

Bill Bergen was born at Floral Park, Long Island, New York, a descendant in a direct male line from the Dutch colonists who settled in America prior to 1675. He graduated from the Massachusetts Institute of Technology (MIT) in 1937 with a B.S. in aeronautical engineering and in the same year joined the Glenn L. Martin (GLM) Company (now Martin Marietta Corporation) as a structures engineer. He became interested in the emerging problem of aeroelasticity, a problem that soon proved to be of critical importance to the company. At the time, GLM was developing the PBM-1 flying boat, using the then new concept of large extrusions in an innovative wing design in which all bending loads were taken by the spar caps with a thin skin acting mainly as a torsion box. The intent was to avoid the weight penalties of shear lag. However, the result was a wing highly flexible in torsion. Literature on the subject of wing flutter had just become available (National Advisory Committee on Aeronautics, NACA TR 496) and calculations of torsion-flexure flutter indicated a critical speed well below design dive speed. The company was understandably skeptical of these complex analyses but authorized the construction of a dynamically similar flutter model after Bergen had demonstrated the phenomenon of flutter with a simple tabletop wind tunnel driven by a cooling fan. A dynamically similar model of the PBM-1 was quickly constructed, probably the first scaled flutter model ever built, and tested at NACA, Langley. The model exhibited a perfect example of the equally new and poorly understood problem of wing torsional divergence, well below the computed flutter speed.

By this time the PBM-1 was nearing rollout and there was no possibility of design changes. It was decided to conduct a cautious flight-test program with primary emphasis on flutter prediction. Accordingly, Bergen designed a wing vibrator in order to excite the wing in flight, hopefully well away from flutter, with the intent of measuring the reduction of damping with speed and extrapolating to the critical flutter speed. Since this involved extensive real-time computations during flight, the flutter analysts joined the flight test crew. Similar tests had just been conducted in Germany, resulting in the crash of a JU90 for reasons that at the time were not well understood. A similar fate was probably spared the PBM-1 because other problems associated with the highly flexible wing quickly surfaced.

The aircraft was equipped with retractable wing floats and the first attempt to retract and then extend these in flight resulted in the starboard float jamming in the retracted position due to wing flexibility. Bergen was asked if he would climb out on the port wing during the approach to landing and crawl out to the tip in order to keep the wings reasonably level during landing, a successfully executed maneuver. His reputation was further enhanced when a redesigned, now fixed, float exhibited a steady vibration that grew alarmingly with speed. Bergen designed a damper that cured the problem. By this time it was concluded that the battle with wing vibration had been lost and the aircraft was returned to the shop for a complete wing redesign using the corrugated skin and cover previously standard at GLM.

The abilities he had exhibited during this very difficult development program helped to establish Bergen's reputation as a highly capable and dynamic young engineer. He advanced rapidly in the company thereafter. Always ready to tackle new technology, he became interested in pilotless aircraft at a time when the guided missile was a new and promising weapon system, and developed early automated flight-test equipment for these systems. In 1945 he became chief of the Guided Missile Section and paved the way for Martin's entry into the missile and electronics fields. He had the prime engineering role in the development of the first U.S. tactical missile, the Air Force Matador, and the U.S. Navy's Viking high-altitude research rocket. From 1948 to 1961 he was successively director, Special Weapons; chief engineer; and vice-president engineering. In 1953 he was appointed vice-president operations, then executive vice-president, followed by his appointment as president of the company in 1959. Under his guiding hand, a management concept evolved giving Martin the capabilities to handle many major programs at one time, efficiently. Bergen was the father of this. It was called "systems management" and has been employed by many companies the world over. In 1961 the Martin Marietta Corporation was formed, and Bergen became corporate vice-president, remaining as president of the Aerospace Division. He was responsible for the development of Titan I, II, and III, and Pershing, Sprint, and Gemini. Aircraft developed during this period included the Martin 404, the XB-51, and the XP6M-1.

Bill Bergen left Martin Marietta early in 1967 and joined North American/ Rockwell shortly afterward. Very difficult work on the Apollo was in progress then, following the disastrous Apollo fire. He was appointed president of the Space Division and was instrumental in bringing Apollo and the Saturn V Stage II programs to a successful conclusion. In 1970 he became president of the North American Aerospace Group. During his eight years at Rockwell, he directed, in addition to the Apollo program, the Space Shuttle development and the B-1 Bomber program. He also had responsibility over the Rocketdyne Engines and Atomics International divisions. One of his major contributions at Rockwell was to emphasize equal opportunity programs for minorities.

In 1975 he retired to his home in St. Michaels, Maryland, where he continued to act as a consultant, including an enjoyable period in England as director of the Commercial Engine Division of Rolls-Royce.

Bergen received several honors during his eventful career. In 1943 he received the Lawrence Sperry Award of the Institute of Aeronautical Sciences for his pioneering work on aircraft structures. In 1963 he was awarded an honorary doctorate of engineering degree from Drexel University. He received three Public Service awards from NASA, in 1966 for his contributions to the success of the Gemini program; in 1969 for his contributions to the Apollo 8 program, the first manned lunar orbit mission; and again in 1969 for his contributions to the exceptionally successful flight of Apollo 11. The National Academy of Engineering elected him a member in 1974.

One of Bergen's major personal and professional motivations was to advance the cause of engineering in the public sector by means of his frequent speeches and public appearances, and to bring his enthusiasm and knowledge, and that of his company associates, to bear on pressing technological issues. His dedication to public service is evidenced by his willingness to serve actively on innumerable boards and associations. He was a member of the board of governors and a fellow of the American Institute of Aeronautics and Astronautics and a fellow of the American Astronautical Society. He was also a member of the Association of the U.S. Army (Industrial Advisory Group); Armed Forces Association; Air Force Association; Society of Automotive Engineers; Delta Tau Delta, of which he was a member at MIT; the National Space Club; and the Conquistadore del Cielo. He served on the board of directors of the California Chamber of Commerce and was a member of MIT's Aeronautics and Astronautics Visiting Committee and its Corporation and Executive Committee.

An active sportsman throughout his career, Bergen was an enthusiastic oarsman at MIT and continued this hobby through his early days at GLM. He enjoyed horseback riding, golf, tennis, hunting, particularly duck hunting on the Chesapeake, and fishing. He held both single and multiengine pilot certificates.

Bill Bergen was an inspired engineer and a skillful and driving manager, fair but demanding. He drove himself as hard as he drove his colleagues, but his sense of humor always served to lighten the work load and establish a spirit of camaraderie that helped to carry his endeavors to their usual successful conclusion. He was warm and kind, and a delightful friend, companion, and colleague.

James Boyd

1904–1987

By Harvey A. Wagner and Walker L. Cisler

James Boyd, past president and honorary member of the American Institute of Mining Engineers, died on November 24, 1987.

Dr. Boyd was born in Kanowna, Western Australia, on December 20, 1904, and became an American citizen in October 1925 through the naturalization of his father. He had a long and distinguished career in education, science, technology, engineering, and industry. He received a B.S. in engineering and economics from the California Institute of Technology in 1927, with emphasis on mechanical engineering. He earned his M.Sc. in geophysics and D.Sc. in geology at the Colorado School of Mines, where he taught until 1941.

During World War II, he first served as army representative on the Army and Navy Munitions Board and then on the War Production Board's Program Adjustment Committee; as executive officer to the director of material, Army Service Forces; and as director of the Industry Division of the Office of Military Government for Germany (OMGUS). In these duties, he was a close associate of General Lucius Clay and became known to Walker Cisler. Dr. Boyd received the Legion of Merit with an Oak Leaf Cluster for this service.

Upon his return to the United States in 1946, Dr. Boyd became dean of the faculty at the Colorado School of Mines. In 1947 he was appointed director of the U.S. Bureau of Mines. During the Korean War, he served, concurrently, as defense minerals administrator. He became chairman of the White Pines Copper Company in Michigan, a director of the Detroit Edison Company, and closely associated with Walker Cisler and Harvey Wagner in the development of nuclear power for the generation of electricity. He was strongly in support of the Atoms for Peace program.

Dr. Boyd left government service in 1951 to assume the position of exploration manager with the Kennecott Copper Corporation, where he was named vice-president in 1955. In 1960 he became president of Copper Range Company and chairman of the board of directors in 1970. In 1971 he was appointed executive director of the National Commission on Materials Policy in Washington, D.C. The commission published an extensive study and report in the 1973, *Material Needs and the Environment Today and Tomorrow*. He then became chairman of the Materials Advisory Panel of the Office of Technology Assessment, and a consultant to government and industry.

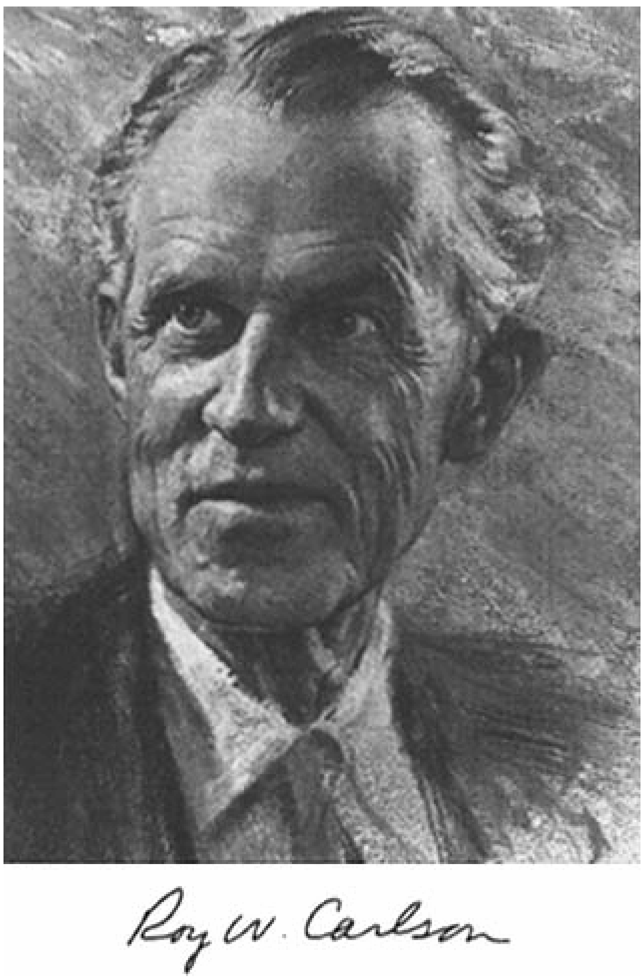
Dr. Boyd was awarded the Hoover Medal from the American Society of Mechanical Engineers in 1975. He received the Charles F. Rand Award of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) in 1963 and distinguished alumnus awards of the California Institute of Technology in 1967 and the Colorado School of Mines in 1949. He delivered the Jackling Lecture before the Society of Mining Engineers of AIME (SME-AIME) in 1967, the ASM and TMS-AIME Distinguished Lectureship in Materials and Society to the American Society for Metals (ASM) and The Metallurgical Society (TMS) in 1973, and the Edward Orton, Jr., Memorial Lecture to the American Ceramic Society in 1974. In 1973 he was awarded the Ben H. Parker Memorial Medal of the American Institute of Professional Geologists, of which he was vice-president in 1966. The University of California, Berkeley, has published a history of James Boyd's life, entitled *Minerals and Critical Materials Management: Military and Government Administrator and Mining Executive, 1941–1987*.

Dr. Boyd was a director of the Detroit Edison Company, New Jersey Zinc, Felmont Petroleum, Copper Development Association, and the International Copper Research Company.

Dr. Boyd was elected to membership in the National Academy of Engineering in 1967. He was active in the affairs of the Academy for many years, and was also very active in professional societies relating to the metals and mining industries. He published many articles on matters relating to mining and the metals industry.

He was first reader at the First Church of Christ Scientist in Carmel, California. Jim Boyd was a devoted family man and is survived by his second wife, Clemence, and four sons by his first wife, Ruth.

The citation that accompanied Dr. Boyd's D. C. Jackling Award from SME-AIME summarized very well his contributions to engineering in particular and to society in general: "For his eminent academic and administrative leadership; significant contributions as a public servant; imaginative guidance in the field of mineral exploration; and steadfast perseverance in applying science and logic to mining geology, mineral research, and technology."



Roy W. Carlson

1900–1990

By Wallace L. Chadwick

Roy W. Carlson, consulting civil engineer, teacher, inventor, and specialist in materials technology, particularly Portland cement concrete, died November 21, 1990, in Oakland, California, at age ninety. At the time of his death, he was retired research associate at the University of California, Berkeley.

Dr. Carlson was born in Big Stone, Minnesota, on September 23, 1900. He graduated from the University of Redlands (California) in 1922 with an A.B. in mathematics. In 1923–1924 he studied at the California Institute of Technology, majoring in physics. The following year he received an M.S. in civil engineering from the University of California, Berkeley, and in 1939 a Sc.D. in materials from the Massachusetts Institute of Technology (MIT).

Dr. Carlson began his engineering career in 1925 as a concrete inspector on construction of the Florence Lake multiple-arch dam of the Southern California Edison Company in the Sierra Nevada Mountains of California. This experience whetted a keen interest in concrete dam design that was furthered while serving as an inspector of construction and testing of the Stevenson Creek Test Dam, also in the Sierra Nevada, during 1925 and 1926. This dam was built as a research tool to supplement the technology then used in designing arch dams.

Elected to membership in the National Academy of Engineering in 1974, Carlson received a Berkeley Citation from the

University of California in 1980, and in 1984 he was awarded the Order of the Southern Cross by the government of Brazil in recognition of his contributions to the engineering of large hydroelectric power developments in that country, including the great Itaipu project where he solved puzzling problems with Portland cement concrete construction. Such an award is seldom made to a foreign individual.

Carlson received an honorary doctor of science degree from the University of Redlands in 1951, the Dudley Medal of the American Society for Testing Materials, and the Wason and Turner Medals from the American Concrete Institute. In 1972 he received an Outstanding Civilian Service Award from the U.S. Army Corps of Engineers. He was elected an honorary member of the American Concrete Institute in 1967, and a fellow of the American Society of Civil Engineers.

During 1944 Carlson worked at Los Alamos and at the Radiation Laboratory at Berkeley on development and testing of the atomic bomb, his particular role being development of the required high-strength materials.

Carlson wrote fifty-six technical papers that were published by various professional societies. The subjects were principally design and testing of remote sensing instruments for measuring stress, strain, temperature, pore pressure, similitude requirements for model construction and testing, structural action in dams and bridges, safety of dams, concrete technology, chemistry of cement and concrete, and methods of structural analysis.

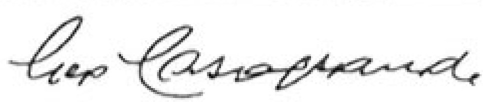
The Stevenson Creek Experimental Dam, built of high-quality concrete, was 60 feet high, and varied from 7.5 feet thick at its base to 2 feet thick through its upper 30 feet. It was tested to failure. When ready for loading, it was packed with instruments and built to the leading edge of the current technology. However, acceptable instruments to measure internal stress did not yet exist, and authoritative opinion doubted the possibility of developing such devices. This notion challenged Carlson, who invested in, built, and for many years manufactured instruments for measurement of stress, strain, temperature, and pressure. He proved that compressive stress could be measured in a semielastic material without needing to know the deformation. Thou sands of Carlson's instruments were built into major dams of the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation, as well as those of Brazil and other countries.

In addition to his development and manufacture of instruments for internal measurements of concrete dams, Carlson developed a worldwide consulting practice and for eight years was active as lecturer and research assistant at MIT, and later at the University of California, Berkeley. Carlson was an active member of the Committee on the Long Term Performance of Portland Cement in Concrete that developed the five kinds of Portland cement now in general use.

Carlson was testing engineer on ten dams for the Los Angeles County Flood Control District from 1927 to 1931. He then served until 1934 as assistant director of Research on Materials for the construction of Hoover Dam. Following that he divided his time between teaching; the manufacture of instruments of his own design; and consultation on concrete dams, structural analysis, and concrete technology.

Carlson was the donor of several auxiliary facilities of the Engineering Department of the University of California, Berkeley. He owned patents on the Carlson Strain Meter #2,036,458, Electric Pressure Meters #2,059,549, Stress Meters #2,148,013, and stress meter for soils and granular materials #3,529,468. Carlson resumed manufacture of his instruments in 1972 in a limited partnership with Walter D. Dieden. The writer gratefully acknowledges the assistance of Mr. Dieden in assembling biographical data for this memorial tribute.

Carlson is survived by two daughters, Susan C. Ichinaga of Morgan Hill, California, and Sally C. Brasseur of Penn Grove, California.



Leo Casagrande

1903–1990

By Anton Tedesko and Ralph B. Peck

Leo Casagrande, a person of great warmth and personal charm, was an experienced civil engineer with a solid theoretical foundation; he excelled in what is now known as geotechnical engineering. He combined high technical ability with good judgment and, in proper balance, scientific rigor with an awareness of the needs of practical engineering and construction.

Leo was born September 17, 1903, in Haidenschaft, near Trieste, a cultural center in the German-speaking part of the old Austrian empire, which was torn apart by World War I. He died at Winchester, Massachusetts, on October 25, 1990, after many years as a consultant and a professor at Harvard University.

His father, Angelus Casagrande, served as a cavalry officer in the Austrian army during the war and was taken prisoner in Russia, which repatriated prisoners only years after hostilities had ended. He returned from Russia in 1922 but died shortly thereafter. In his father's absence, Leo; his mother, Anna; elder brother, Arthur; and younger sister, Alix, moved from their home to remain in Austria because the province in which they lived had become a part of Italy.

Leo attended high school in Austria, and in 1918 the Casagrandes moved to Vienna and lived for a while with the family of Leo's uncle. Later, they rented a modest apartment there, a couple of miles from the center of town.

Leo, as well as his brother, Arthur, twelve months his senior, were students at the Institute of Technology in Vienna, where they had outstanding teachers, Friedrich Hartmann (bridges) and Rudolf Saliger (reinforced concrete) among them. They attended five and a half years of engineering courses, their educations being nearly identical.

Vienna during these postwar years attracted outstanding, stimulating people in the fields of sciences, arts, music, literature, and drama. It had become a center of great cultural and intellectual activity. The young Casagrandes were exposed to, and influenced by, the cultural climate that contributed to their well-rounded education. Old-world manners and courtesy came naturally to Leo (and he knew how to dance a Viennese waltz). Men like Leo who lived in Vienna during that period felt a continuing nostalgia for those Vienna days; he grew up as an Austrian, not as a German.

While Arthur went to the United States soon after his graduation and became an assistant to Professor Karl Terzaghi (the founder of soil mechanics) at the Massachusetts Institute of Technology (MIT), Leo started his career as a structural engineer in Augsburg, Bavaria. After two and a half years, in 1930, he too decided to go to the United States, where he became a research assistant at MIT.

In 1931 Terzaghi accepted the offer of the Institute of Technology in Vienna to become its first professor in the new field of soil mechanics, and Leo returned to Vienna in 1932 to become his assistant at the Institute. Part of a small seminal group surrounding Terzaghi in those early years, Leo acquired a great deal of new knowledge and received an engineering doctorate.

In 1933 he accepted a teaching assignment at the Technological University of Berlin, where he took charge of organizing a soil mechanics institute.

In 1934 he was asked to head the Soil Mechanics Division of the Office of the Inspector General for the German Highways, which had the principal assignment of building the German Autobahn, the first true superhighway system. For more than ten years he had most challenging assignments, solving many problems in foundation and earthworks engineering and in soil stabilization. He developed the principles and practice of electro-osmotic dewatering and stabilization of soils and used it extensively. He rapidly became recognized as one of the most knowledgeable soil mechanics engineers in Europe, experienced in research and in common sense practical applications.

While acting as a guide and interpreter for a British delegation of Members of Parliament on an excursion-inspection of Autobahn bridges, Leo met the attractive Carla Maria Busch, a free-lance photographer assigned to document the visit. He and Carla Maria were married in 1937.

In 1940 and for several years thereafter he was a lecturer in soil mechanics at the Institute of Technology in Braunschweig, which gave him the title of professor. He lived and worked in Berlin during the devastating war. Carla Maria, their three sons, and one daughter stayed with him for most of that time, but during the last year Carla and the children lived with her mother in the north.

Immediately after the end of World War II, Allied teams of engineers and scientists went to Europe to seek out and examine recent innovations used in Germany and to search for outstanding men who could be induced to work in the United States or Great Britain, which offered them attractive opportunities in their field. Among outstanding men thus recruited were Wernher von Braun and Wilhelm Flügge. The Russians were engaged in a similar quest. Leo and his family fortunately left Berlin just before the Russians arrived; the British reached him first. He was invited by the British government to join the Building Research Station at Watford. He worked there from 1946 to 1950 and was joined there by his family in 1947. His fourth son was born in England.

In his employment as head of the Soil Mechanics Division of the German highway system, Leo pioneered in several aspects of soil mechanics in addition to electro-osmosis. He also wrote technical papers on such diverse subjects as soil sampling, removal of peat by blasting as a means of stabilization, the significance of drainage, and settlement of bridges and other structures. His application of electro-osmosis to stabilize excavation slopes in extra-sensitive clays in Norway was a remarkable success. This achievement came to the attention of the British and most likely led to his assignment to the Building Research Station, then the leading organization developing the still relatively new field of soil mechanics in the United Kingdom. The station's initial interest was in Leo's expertise in electro-osmosis, about which very little was known outside Germany. Consequently, his first assignments were to summarize the relevant principles and practical applications. His report, *The Application of Electro-Osmosis to Practical Problems in Foundations and Earthworks* published by the station in 1947, was widely circulated and quickly brought recognition to both Leo and the subject among geotechnical engineers throughout the English-speaking world.

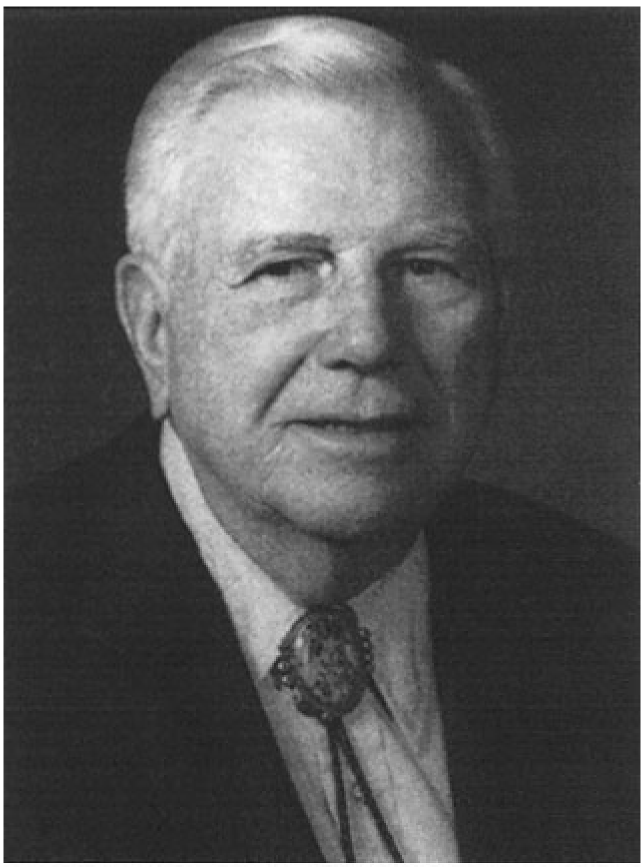
Leo's brother Arthur, in the meantime, had built the soil mechanics program in the graduate school at Harvard into a preeminent position in the United States. He succeeded in bringing Leo and his family to the United States in 1950 and added him to Harvard's illustrious group. In 1956 Leo became professor of the practice of soil mechanics and foundation engineering. In addition to performing his academic duties, he became increasingly active as a consultant, in later years practicing with Arthur and his son, Dirk, as Casagrande Consultants in Arlington, Massachusetts. He was elected to membership in the National Academy of Engineering in 1974.

His consulting activities included a wide variety of major projects: foundations for conventional and nuclear power plants and for commercial and industrial buildings, dams for hydroelectric developments, tailings dams, and numerous slope-stabilization assignments. Electro-osmosis continued to be significant in his practice, including investigations regarding its suitability for such diverse applications as stabilization of the collapsed weathered volcanic soil in the Wilson Tunnel in Honolulu, stabilization of the sensitive soils of the Turnagain slide area after the 1964 Good Friday Earthquake in Anchorage, and an eminently practical scheme for arresting the tilt of the Leaning Tower of Pisa.

His students found him to be a superb teacher, at once scientific and practical, who required thoughtful solutions encompassing the broad as well as the specialized picture.

He devoted most of his time to his work, but he also took great pleasure in his family. Having lost the guidance of his father at an early age and all his material possessions in World War II, he highly valued personal relationships and was unusually close to his wife and children. To the extent possible, he shared with them the development of a farm in New Hampshire, which he and the family enhanced by planting thousands of pine seedlings and painstakingly pruning them as they grew. He also characteristically used his expertise to create successfully a pond on the property, even though local agricultural advisers were of the opinion it would not hold water.

He was a gentle, kind man with a deep, somewhat wry sense of humor, a gentleman of the old school, whose contributions to engineering were notable but were unsung except by others.



Carl Covalt Chambers

1907–1987

Written by S. Reid Warren, Jr.

Submitted by the Nae Home Secretary

Carl Covalt Chambers died suddenly on November 25, 1987, in Palm Harbor, Florida, where he had lived with his wife, Margaret Morrison Chambers, since his retirement from the University of Pennsylvania in 1975.

Dr. Chambers' wide-ranging career included contributions to the fields of teaching, research, consulting, and administration—in his university and in several national and international professional societies.

Dr. Chambers received his B.S. from Dickinson College in 1929; he majored in mathematics. He worked in research and development for RCA in Camden, New Jersey, (three years) and in research at the Bartol Research Foundation of The Franklin Institute (one year), before his appointment as an instructor of electrical engineering in the Moore School of Electrical Engineering, University of Pennsylvania, in 1933. At that time he had already completed most of the course work for the D.Sc. (electrical engineering) at the university; the degree was awarded in 1934.

Dr. Chambers designed and presented both undergraduate and graduate courses and courses organized for special purposes during World War II. He was known and respected for his unconventional but effective methods of stimulating his students to learn for themselves rather than to be instructed by lecture and examination. He was one of the first to present courses in physical electronics.

In research he was particularly versatile. His work at RCA and Bartol was essentially scientific research in the field of cold emission from metal surfaces at high field gradients. In contrast, during World War II he participated in and directed classified projects in short-range communication and radio interference under grants from the Office of Scientific Research and Development and the Office of Naval Research. At the same time, he supervised a program of courses offered at the university under the Engineering, Science, and Management War Training Program.

Dr. Chambers was supervisor of research in the Moore School from 1947 to 1949. He had been promoted through the several ranks to become professor of electrical engineering in 1947. He became dean of the Moore School in 1949. He served as vice-president for engineering affairs from 1953 to 1972, when he fostered a reorganization of the engineering departments into a more unified structure.

Carl Chambers served as consultant to many companies, including Brooke Engineering Company (1934–1954), automatic industrial controls; Edward Stern: & Company (1936–1954), research into improved methods of photoengraving and lithography; International Resistance Company (1944–1954), design of an automatic bridge to sort resistors to preselected tolerances; and Hazeltine Corporation (1939–1940), extensive consultations during an extended research planning conference on FM and TV system designs. As a result of this work, he was awarded eight patents.

In spite of the demands of his academic position, Dr. Chambers welcomed opportunities to contribute to the activities of professional societies including the American Institute of Electrical Engineers (fellow 1932); Institute of Radio Engineers (fellow 1929); Institute of Electrical and Electronic Engineers (life fellow 1963); National Society of Professional Engineers; Engineers Joint Council; American Society for Engineering Education (fellow 1946, president 1968–69). He was particularly interested in the International Electrotechnical Commission

(IEC) (1946–70). He served as member and chairman of two technical committees of IEC, helped to organize the 1954 and 1970 IEC meetings in the United States, and was a delegate to many IEC meetings throughout the world.

Carl Chambers was honored by election to membership in several engineering honor societies; by his selection as Engineer of the Year in the Delaware Valley in 1966; and in particular, by his election into membership in the National Academy of Engineering in 1970.

Carl Chambers was a careful, even-handed, unbiased administrator. He would discuss problems with his colleagues, state what he thought should be done, and listen to responses. After a decision had been reached, he expected the responsible colleagues to implement it. Thus, as indicated above, his innate ability to manage led to his selection for positions of high responsibility.

Arthur A. Collins

1909–1987

By J. S. Kilbey

Arthur A. Collins, founder of Collins Radio and A. A. Collins, Inc. died in Dallas, Texas, on February 25, 1987, after suffering a stroke. He was seventy-seven.

Collins was born in Kingfisher, Oklahoma, on September 9, 1909. His father, a large-scale farm operator, soon moved the family to Cedar Rapids, Iowa. His interest in radio began at an early age, and by the time he was nine he had built his first crystal receiver, using the traditional Quaker Oats box as a coil form.

At the age of fourteen, Collins had passed the test as an amateur radio operator and was licensed as 9CXX. The hobby was encouraged by his father, and Collins built a complete transmitter and receiver. Working the amateur 20-meter band, he contacted other "hams" around the world.

In 1925 the McMillan expedition sailed on a scientific mission to Greenland. One of the explorers was U.S. Navy Commander Richard E. Byrd. The expedition had planned to make daily contact with a U.S. naval station in Washington, but because of atmospheric conditions the station was unable to receive the messages consistently. Collins was able to establish regular contact with the expedition. Each night after the broadcast, young Collins took the messages downtown and relayed by telegraph the expedition report for the day. Collins attracted national attention for this feat.

By the end of 1931 he had set up a shop to manufacture radio transmitters. Collins designed the circuits; fabricated chassis; mounted and wired the components; and tested, packed, and shipped each unit. The equipment was well engineered and well built, and gave years of trouble-free service. The Collins Radio Company was incorporated in 1933.

In 1930 Richard E. Byrd, now a rear admiral, sailed for the Antarctic on his first expedition to the South Pole. Byrd remembered Collins from the 1925 expedition and insisted on Collins radio telegraph equipment. Communications were successfully established, so for the 1933 expedition Byrd decided to use Collins equipment for voice radio communications. This effort was supported by CBS, which sold the time to General Electric. A successful commercial broadcast was made in 1934, and later regular weekly broadcasts were established. This equipment used ideas that were later widely adopted in the radio field. These included multiple pretuned frequency bays, which allowed the operator to make quick frequency changes, and Class B modulation, which permitted large audio power from relatively small tubes.

These innovations were the first of many for Collins. The need for quick frequency changes, particularly for aircraft radio, led to the development of the autotune, an electromechanical system that permitted selection of ten pretuned frequencies at the touch of a dial.

By 1940 Collins Radio had grown steadily and employed 150 people, building fixed-base communications equipment, mobile radios for the police, and aircraft radios. Collins was selected by the navy as a supplier of airborne equipment for the war effort, and designed the AN\ART-13. Because it used the auto-tune feature, it could be remotely located in the aircraft and eliminated the need for a radio operator. More than ninety thousand of these sets were supplied by Collins during the war to all of the U.S. armed forces and to the British. Other types of communication and direction-finding equipment were also supplied. Because Collins equipment was unique, Collins also assisted others in its manufacture. By the end of the war, Collins employment reached 3,332.

Although the end of the war caused a rapid cutback and several years of losses for Collins, the company continued as a major supplier of military communications equipment. It also rapidly reentered commercial markets. A licensed pilot, Collins returned to Cedar Rapids after a visit to Beech Aircraft with an idea for a new product. A quick survey of the possibilities indicated that a commercial airborne radio could be built with components that the company had on hand. Ten minutes later the project was assigned, carrying "A.A.C." (Arthur A. Collins) priority in the shop. Rough sketches were used in lieu of drawings, and chassis construction used paper templates with the layout drawn on the paper. Parts were arranged on the chassis and holes drilled as required.

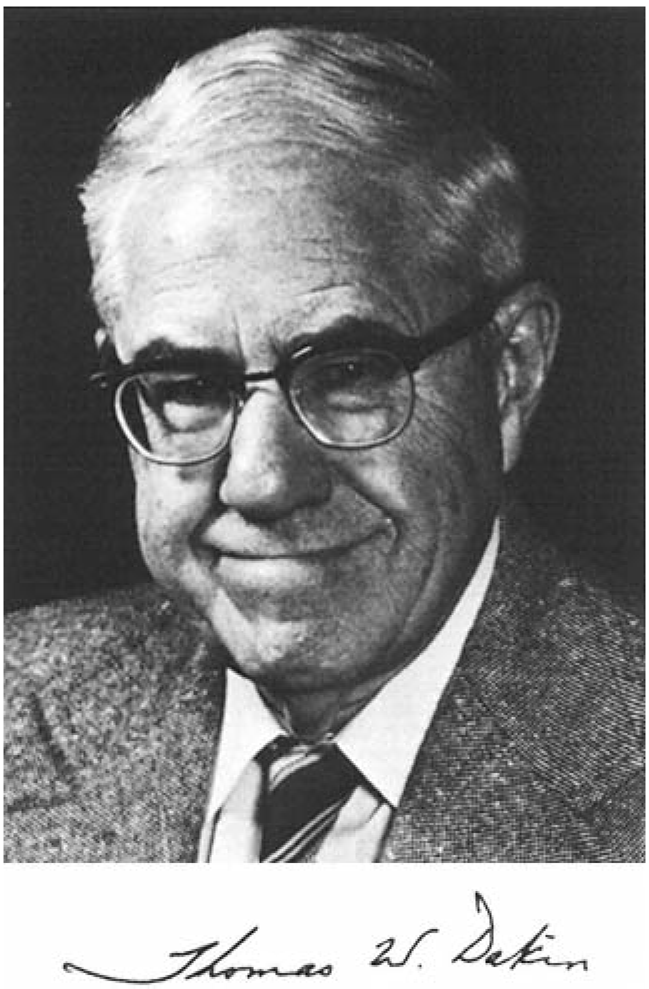
Ten days after its inception, the model and remote control box were completed and tested. The 17E-2 was ready for installation in a twin-engine or large single-engine airplane. During the next week, inquiries about the transmitter by those who saw the model indicated the need for the 17E-2. The first production run was for two hundred units. This early effort led Collins Radio to a dominant position in the commercial avionics marketplace.

This hands-on effort was a typical Art Collins engineering approach. Later, for larger projects, he would have a large room cleared of all telephones. Desks for the marketing staff, design engineers, manufacturing engineers, purchasing people, and Collins would be installed. All would work together until the project was complete. Today this technique would be called concurrent engineering. It was a standard practice at Collins Radio more than twenty years ago.

The rapid demobilization after the Vietnam War caused severe economic pressures for Collins Radio, and in 1973 Collins decided to merge his company with Rockwell International. Collins stayed with the new company for several months, then left to start a small new venture, A. A. Collins, Inc.

This company permitted Collins to explore some of his ideas on digital switching of communications networks. Collins felt that the space division approach used by the Bell System could be improved by changing to a time division approach, which could be implemented readily with modern electronic technol ogy. He built a small group of skilled engineers to rethink the problem. Collins's death precluded exploitation of his ideas, although eight patents resulted from the work. The last of these was issued after his death.

Collins was one of the early high-tech entrepreneurs. He possessed a broad vision and keen technical insight combined with the stubborn persistence needed to develop major new markets. He was a true engineer, directly involved in the research and development activities of his companies throughout his life. He led Collins Radio to a preeminent position in modern communications technology. Arthur Collins was elected a member of the National Academy of Engineering in 1968. Although reticent, he was warm, friendly, and always interested in new ideas. He will be missed.



Thomas W. Dakin

1915–1990

By Lee A. Kilgore

Tom Dakin, world-renowned specialist on insulation for electric machinery, died April 1, 1990. He was born in Minneapolis on May 5, 1915. After graduating from the University of Minnesota, he received a Ph.D. in physical chemistry in 1941 from Harvard.

He made his career with the Research Department of Westing-house Electric. From 1946 he directed the company's electrical insulation development, making many individual contributions. In 1948 he proposed a method whereby insulation deterioration with aging at elevated temperatures could be treated as a chemical rate phenomenon in accordance with the Arrhenius equation. This method is widely used because it has more validity than other methods that have been proposed and because of its relative simplicity.

He pioneered investigations into the effects of electric discharges on the breakdown of solid insulation, a method of estimating the magnitude of internal electric discharges and discharging void volume in high-voltage apparatus by measuring capacitance increase with increasingly high voltages. He confirmed and applied the concept that alternating-current voltage endurance (useful life of insulation under voltage stress) is proportional to the number of cycles applied. Bushings for high-voltage applications are made with cycloaliphatic epoxy resins. Under his guidance, cycloaliphatic epoxy bushings have been field tested in contaminated atmospheres under high-voltage stress for more than eight years with excellent results. In addition to field testing, weathering stations were established in areas that were typical of the types of environment bushings might encounter in service. He devised a laboratory-accelerated test that appears to duplicate, in less than a week, a year of exposure in the weathering stations. He investigated the voltage endurance of cast epoxy resins with microcavity type defects. The study indicated that care must be exercised so as not to apply too high an average voltage stress to cast epoxy insulators, even when no internal corona can be detected.

He was a major contributor over a period of many years in the field of power capacitor development. A key to the dramatic progress made in size and cost reduction per kilovolt-ampere was, again, the development of an accelerated life test based on power factor increases with time at several temperatures. These studies, which permitted the selection of the best low-loss materials, were carried out with the paper-askarel and polypropylene-paper-askarel systems, and also the latter where the askarel was replaced by liquids free of polychlorinated biphenyls (e.g., isopropylbiphenyl).

A fellow of the Institute of Electrical and Electronics Engineers (IEEE), he received IEEE's Electrical Insulation Society Award for Technical Achievement in 1978 and its Westinghouse Order of Merit and Lamme Medal. He served on the National Research Council's Conference on Electrical Insulation and Dielectric Phenomena and was the U.S. representative to the International Conference on High Voltage Electric Systems (chairman of the Committee on Solid Insulation). He was elected a member of the National Academy of Engineering in 1981.

Dr. Dakin was active in civic affairs, serving for many years as secretary of the local School Building Authority, and he was an active member of the local Rotary Club. His wife Theodora was a medical doctor, and they were known among friends as Dr. Tom and Dr. Ted.

Richard W. Damon

1923–1991

Eds. Paul Damon, Robert Halstead, Timothy Huemiller, and Robert Price [1]

Richard W. Damon distinguished himself in the research of microwave magnetic and acoustic phenomena; in management at Microwave Associates and Sperry Corporation; in professional activities as president of the Institute of Electrical and Electronics Engineers (IEEE); and in civic, church, and family activities in Schenectady, New York, and Concord, Massachusetts, where he was born May 14, 1923.

"When I was about ten, I decided that I was going to be a scientist" Dick Damon wrote. He formed a "Society of Science" at age eleven as a vehicle for him and his friends "to discuss astronomy and other subjects that might appeal to us." Starting with a deep interest in astronomy, he took up photography and then chemistry and electronics, building a radio transmitter as a hobby. Winning a full scholarship to Harvard, he felt the strongly competitive academic pressures there—indeed, Frederic de Hoffman, who along with Edward Teller conceived the hydrogen bomb in 1959, was his roommate. Following the shock of Pearl Harbor, they switched from chemistry to physics, and persuaded J. H. van Vleck, who in 1971 became a Nobelist, to teach them both halves of a course in electricity and magnetism at the same time.

[1] With contributions from additional family members and friends and material drawn from the personal memoirs of Dr. Richard W. Damon.

As a U.S. Navy ensign (later lieutenant junior grade), Dick was a senior officer in charge of installing shipboard sonar for the invasion of Japan. After the war, he returned to Harvard for graduate school. From attending "enthralling" lectures in electromagnetic theory given by Julian Schwinger, a 1965 Nobelist, Dick decided that he "really loved this stuff' and would go for "my Ph.D. so that I could do research."

Initially Dick's dissertation was to be in making a new measurement of the velocity of sound. This was interrupted, however, when he left school to gain hands-on competence in magnetrons at Raytheon. His thesis then switched to measuring for the first time the spin-lattice relaxation time of the ferromagnetic resonance. This work was made possible through his knowledge of magnetrons. Here Dick worked closely with Nicolaas Bloembergen, a 1981 Nobelist, who stimulated him with a series of vital insights leading to their joint discovery of spin-wave instability and of the band structure caused by spin-wave demagnetizing fields. The work involved many months of concentrated effort and several setbacks. The thesis "in addition to the improved theory developed at Bell Labs," Dick noted, "established the fundamental high power limitation of ferrite devices, such as isolators and circulators, and also pointed the way to new nonlinear devices such as frequency doublers, power limiters and, a few years later, a form of parametric amplifier."

Major portions of his landmark thesis have been presented in *Reviews of Modern Physics*, vol. 25, pp. 239–245, January 1953; and in his chapter in *Magnetism*, G. Rado and H. Suhl, eds., Academic Press, 1963. Another kind of parametric amplifier, based on spin waves in yttrium-iron-garnet (YIG) rather than in ferrite, was developed jointly with Herman van de Vaart, published in the *Proceedings of the IEEE* in 1965, and reported in the press. This was a sequel to investigations on microwave magnetostatic (MS) spin waves, and to the original exposition of surface MS waves, done with John Eshbach at General Electric and published in the *Journal of Physics and Chemimy of Solids*, vol. 19, p. 308, 1961. Dick was the first to observe bulk MS waves and make applications of them. He held a number of patents in these areas.

Dick Damon's initial leadership position in industry was with Microwave Associates (now M/A-COM) where in 1960 he was appointed manager of the Microwave Control Devices Department. But he had received numerous university teaching offers from the time of his first postdoctoral job at the General Electric Research Laboratory, where he had been since 1951. For Dick it was "hard to decide between industry and academia."

Dick's new company cooperated in enabling him to teach an intensive graduate course in solid-state electronics at Harvard in 1962. This was "the opportunity to see how much I enjoyed teaching," Dick observed. He found it to be "a challenging, exciting experience."

Dick next joined the newly formed Sperry Rand Research Center in Sudbury, Massachusetts, at the invitation of Karl Willenbrock, a Harvard faculty member and consultant and the 1969 IEEE president, and Roger Newman, the center's first manager, solid-state sciences. Dick progressed rapidly to become the director of the Applied Physics Laboratory. There he was in charge of research into semiconductor devices, tribology, gas discharge displays, magnetic disks, fiber optics, fingerprint identification, surface acoustic waves, and other advanced programs. For those who worked in Dick's laboratory, his warm personality and profound understanding of the scientific creative process, with all its highs and its lows, were a permanent source of support. In spite of his busy schedule, he was always ready to listen, encourage, and advise.

Dick's final position before he retired from Sperry was his most influential one, as corporate director of technology. There he had oversight of $500 million in research and development programs annually. He became an adjunct professor at the Gordon Institute after his retirement, and he also served as director of the Matec Corporation.

Dick was deeply committed to public service and served the Institute of Electrical and Electronics Engineers in many ways. He was on the editorial board of the *Proceedings of the IEEE* for eight years, was the IEEE National Microwave Lecturer in 1969, and became known for many other contributions to technical and local chapter activities of the IEEE. As a result, in 1971 he joined about a dozen other IEEE Boston Section members who met as the "Rivers committee." This committee, put together by Bob Rivers, considered how to make the IEEE a more effective advocate for engineers and for public understanding of the engineering profession. The Rivers committee had a substantial influence on the 1972 IEEE constitutional amendment to initiate such activities. The committee also adopted a set of seven goals including "a lifetime engineering career with adequate compensation" and "public support for engineering in solving society's problems" that became the basis for the program of the IEEE U.S. Activities Board with which Dick held numerous positions from 1977 through 1984.

Through these activities Dick earned increasing recognition, serving on the IEEE's board of directors in 1977–1978 and later on the IEEE fellow selections committee. He earned respect too: a 1979 letter from Bruno Weinschel, who became the IEEE president in 1986, states, "I believe you are one of the most capable and knowledgeable directors I have ever seen.... In 1979 you are not engaged in any IEEE activity. Considering your abilities, past performance, talent, and wealth of knowledge, this appears to me almost sinful." Still, Dick little realized where the path that began with the Rivers committee would soon lead.

In 1980 Dick, nominated from the floor at an IEEE board of directors meeting, became the directors' official nominee for the IEEE presidency. "I can't say no," was his modest explanation for running for president of the IEEE, the largest engineering society in the world. Dick ran unopposed but campaigned anyhow, to encourage the spirit of volunteerism that he saw as the IEEE's lifeblood.

Dick's objectives for the IEEE included, of course, excellence in its technical and educational activities. "But," he stated, "competent technical performance is not enough!" He worked for the objectives first enunciated by the Rivers committee, and was particularly passionate in supporting improved pension rights for working engineers. He also argued for more applications-oriented papers in IEEE conferences and publications and advocated strengthening the IEEE's visiting lecturer programs.

He urged the IEEE to develop publications and other means to enhance public understanding of engineering and technology. In speeches to engineering students, he challenged them to consider policy positions in business, industry, and government as well as the traditional engineering roles. Clearly, Dick lived up to his own advice.

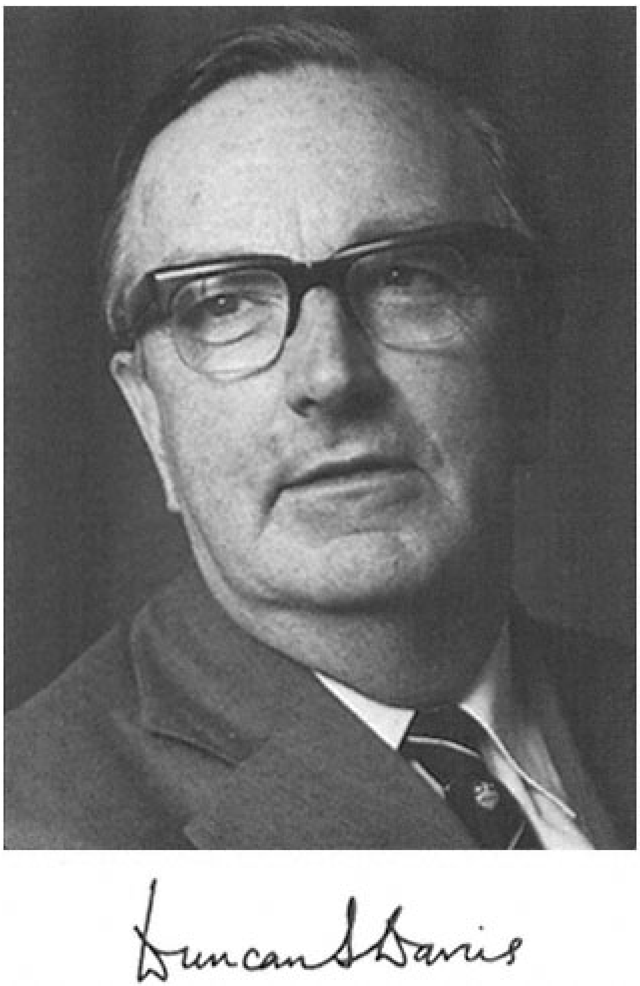
In addition to travels throughout the world for the IEEE, Dick long rendered public service on important U.S. government committees. He also was a fellow of the American Physical Society and of the American Association for the Advancement of Science. In 1989 Dick was elected to the National Academy of Engineering.

Dick had a broad range of interests in his personal life as well. From an early age he was an avid outdoorsman and was committed to his local community, church, and family. Throughout his life he displayed his talents for helping and leading others.

Concord, Massachusetts, still a rural community in the first half of the century and where Dick grew up, was a perfect place for developing an interest in the outdoors. Boy Scouts was an important part of his life with the weekly hikes and community service activities. His talent for helping others was also evident here. In 1938 at age fifteen, he saved the lives of two friends who had fallen through the ice on a local pond. He represented his local community at the National Jamboree in Washington, D.C., in 1937, and went on to become an Eagle Scout. Throughout his life Dick enjoyed hiking, fishing, and skiing.

Dick contributed his leadership talents throughout his life in his local community, his church, and his family. He served as senior class president in high school and served the community on various working committees of the town of Concord. While living in Schenectady, New York, he served the First Methodist Church as chairman of the Education Commission and the board of stewards, and subsequently he was the lay leader, the top lay position in the church. In his later years he served as a trustee of the West Concord Union Church. His family and their heritage were always important to him. He and his wife, Anna, had three children and five grandchildren. In 1963 he bought the Damon home in Concord, which was built as a wedding present for his grandparents in 1884. In 1977 he and a partner bought the Damon Mill in Concord, renovated it, and converted it into office space. The Damon Mill had been built by Dick's great grandfather in the 1860s.

These, then, were his accomplishments, his life. Giving of himself to his research; to his management responsibilities; to his professional societies; and to his community, church, and family, Dick Damon accomplished much in his life, contributing right up to the end. He died on February 15, 1991.



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Duncan S. Davies

1921–1987

Written By Anthony Challis

Submitted by The NAE Home Secretary

Duncan S. Davies, a polymath who was interested and knowledgeable in all aspects of human affairs, died March 25, 1987, at age sixty-five. He was a scientist of excellence in both the pure and applied fields, an engineer, and one of the founders of the science of technological economics. Above all he was a man of vision, of ideas, of concepts, but also of warmth and humanity. He truly loved his fellow men and women, and he always did us the honor of behaving as though we were as intelligent, as hardworking, as conscientious, and as well motivated as he was himself.

Born in Liverpool on April 20, 1921, Davies valued his origins in that city, but Oxford and his contact there with Cyril Hinschel-wood formed him. He received his B.Sc. in chemistry (Minor Scholar), 1st Class-Honours, in 1943 from Oxford University; his Ph.D. from that university in 1945; and his M.A. in chemistry from Trinity College, Cambridge, in 1947. At Oxford he gained an understanding of physical chemistry as a description of dynamic systems that served him well in his lifetime attempts to understand, explain, and influence human systems. Although his ability to organize and convince was much recognized, his major role was his ability to influence and persuade "men of action" in both industry and government into fresh channels.

In 1945 he began work in the Research Department of the Dyestuffs Division of Imperial Chemical Industries (ICI), the

United Kingdom's largest chemical firm; he remained with that firm for thirty-five years. In 1955 he was appointed head of the Colours Experimental Department, Grangemouty Works; in 1959 to research manager and then research director of ICI General Chemicals Division; in 1962 to director of ICI Central Petrochemical and Polymer Laboratory; in 1967 to deputy chairman of Mond Division, a heavy chemicals division of ICI; and in 1969 to general manager of research and development at ICI, responsible for formulation of research and development policy and its connection with long-term business policy internationally.

At ICI Davies was originally concerned with the application of chemistry to the improvement of products and processes, and the design of innovation in the chemical and polymer industries, including first manufacture of polymer (fiber)-reactive dyes. He was subsequently responsible for research and development direction covering all parts of the chemical industry. Perhaps his most important innovation at ICI was his major role in the creation of the Petrochemicals and Polymers Laboratory, of which he was the first director. Davies had an international reputation in providing new concepts and means for making industrial research useful, particularly as it becomes more multidisciplinary and must be economically viable.

Because he had become especially active in the integration of technology, economics, and social studies relevant to the success and acceptability of innovations in the United Kingdom, Davies was appointed in 1977 chief engineer and scientist at the U.K.'s Department of Trade and Industry. There he was responsible for recommending technology policy to the U.K. Secretary of State for Industry, determining government needs for industrial research and development, and placing appropriate contracts with state or private sector agencies.

While becoming in 1982 a director and then in 1983 chairman of the British Ceramics Research Ltd., Davies also took on consulting responsibilities for Unilever, Tate & Lyle, Monsanto, and in Washington, D.C., the National Bureau of Standards.

Davies's accomplishments span the science, development, engineering, and manufacture of synthetic polymeric materials, which constitute one of the most important groups of modern industrial engineering materials and revolutionized the plastics, synthetic fibers, textiles, and protective coating industries. His technical and engineering contributions have had significant effects upon industries other than those in which he was directly concerned. The dyestuff, mining, ceramic, and metallurgical industries owe much to him. Above all he was an outstanding innovator. In ICI he pioneered the effective direct use of laboratory-type science on the plant.

He served as president of the Council of the Society of Chemical Industry and of the R&D Society. He served on the Science Research Council (SRC) and its successor, the Science and Engineering Research Council, and also the Social Science Research Council Joint Committee. These bodies are a major source of research funds for British universities. He also served on the Organization for Economic Cooperation and Development ad hoc Working Group on Technology Transfer. He was a member of the U.K. Chemical Society, Faraday Division; the Council of Liverpool University; the Confederation of British Industry, Research and Technology Committee; U.K. Advisory Board for Research Councils; Advisory Council on Applied R&D, Natural Environment Research Council; Swann Manpower Working Group; Council, Liverpool University; and Council, The Organization of the European Community, London. He was a visiting professor at Imperial College (1968–1970) and University of York (1983–1987); a visiting fellow, St. Cross College, Oxford (1970); visiting fellow, Australian National University; and visiting professorial fellow, University College, Swansea (1974–1979).

In 1967 Davies received the Society of Chemical Industry Castner Medal. He was awarded an honorary doctorate from the University of Stirling, 1975, and the University of Surrey, 1980. He received an honorary doctor of science from Bath University, 1981, and Haifa University, 1982. Davies was elected a foreign associate of the National Academy of Engineering in 1978.

Davies was a writer of great clarity. "If you want to understand something," he said, "then write a book about it." He wrote several, including *An Introduction to Technological Economics*, with Callum McCarthy, where he takes the reader by the hand and walks with him into the development of the subject.

He was a superb communicator, both as a speaker and a writer—witty, erudite, compelling, with apposite quotations from sources as widely apart as *Winnie the Pooh* and Wagner's *Ring*. He delighted in travel. A key memory is of him ensconced in corners of obscure airports writing yet another chapter or another article under his many noms de plume in a neat rapid hand with scarcely a correction, or dashing off dozens of strange and funny postcards to his worldwide circle of friends.

He loved his family; they provided that firm and secure base from which he forayed to do battle on many fronts. He loved the young, and they loved him for he shared with them his bubbling enthusiasms, his vulnerability, and a sharp detestation of injustice of any form.

The Research Society has instituted a Duncan Davies Memorial Lecture and Medal. The first of these was given at the Royal Society on April 3, 1990, by one of his many friends and disciples from ICI, Robert Malpas, then chairman of PowerGen, a privatized half of the old Central Electricity Generating Board. His lecture title was the "Marketing of Technology." Duncan would have loved it, but proposed yet another new approach, if not three! The medal was presented by Mrs. Ann Davies. All of us present had the sense of affection, loss, and respect.

Duncan Davies never retired, and he was always seeking change. He wrote, he consulted, he lectured, he traveled, he served his profession. The luster of Duncan shines brighter with time. I would commend to you his book *The Humane Technologist*. He was, above all, the humane technologist himself. His major ideas, seemingly outrageous at the time, are now an integral part of the background from which we work. We could do with his yeast now to leaven our dull bread.

Richard D. Delauer

1918–1990

By Ruber F. Mettler

Richard D. Delauer—engineer, naval officer, corporate executive, government official, and entrepreneur—died in Los Angeles on April 22, 1990, at the age of seventy-one. The scope and diversity of his experience and his contributions to society were extraordinary.

Dick was born in Oakland, California, on September 23, 1918. Upon graduation from Oakland High School, he was admitted to Stanford University across the bay. His boyhood interest in science and mathematics led him to choose an engineering major, and in 1940 he received a B.S. in mechanical engineering.

He began his career at the Glenn L. Martin Company in Baltimore as a structural aircraft designer, where he worked on the Mars flying boat project. Returning to California in 1941, Dick joined the Northrop Black Widow night fighter project as a structural engineer. In 1942 he returned to the bay area to take a job as a test engineer at the Moffett Field Naval Air Station. The next year he received a commission in the U.S. Navy and joined the staff of the Commander, Fleet Airships Pacific, as an aeronautical engineering officer. For the remainder of the war years, he was involved in engineering development, modification, and installation of innovative applications of weapons and fire control systems for the Navy's blimp fleet, both at Moffett Field and the Naval Airship Station in Lakehurst, New Jersey.

In 1947 Dick was posted to the Naval Postgraduate School, then at Annapolis, where he not only earned a degree in aeronautical engineering but also coached the Naval Academy baseball team. His outstanding record at Annapolis earned him an assignment to the California Institute of Technology in 1949. In his first year he earned an A.E. in aeronautical engineering, followed in 1953 by a Ph.D. in aeronautics and mathematics.

For the next five years he was assigned to various engineering projects, including the Sparrow and Bullpup guided missiles, and as Navy project officer for the interagency Kiwi-A nuclear rocket reactor experimental test program at Los Alamos Scientific Laboratory. His final navy assignment was as a project officer at the Naval Air Special Weapons Facility in Albuquerque. Dick's pioneering work in nuclear rocket propulsion is documented in two books that he coauthored with Robert W. Bussard: *Nuclear Rocket Propulsion* (McGraw Hill, 1958) and *Fundamentals of Nuclear Flight* (McGraw Hill, 1965).

In 1958 Lieutenant Commander "Dog" DeLauer retired from the navy and Dr. Dick DeLauer joined the fledgling TRW Space Technology Laboratories as an assistant laboratory director. He participated in the design and development of several of the first U.S. satellites and space probes, including the early Explorer and Pioneer space vehicles. In 1960 he was appointed director of the Titan Program Office, where he managed a multidisciplinary technical team that provided systems engineering and technical direction to the Air Force Titan ICBM associate contractor team. He later assumed program management oversight responsibility for the Atlas and Minuteman programs as well as Titan.

Dick was named vice-president and general manager of TRW's Systems Engineering and Integration Division in 1965. He led this division into new fields based on ballistic missile technology, including transportation systems engineering, advanced energy research, and sophisticated computer-based information systems applications. He was promoted in 1968 to vice-president and group general manager with executive responsibility for all of TRW's defense, space, electronics, and information systems activities.

In 1970 Dick was elected an executive vice-president and sector executive of TRW Inc., and in 1972 was elected to the TRW board of directors. For the next decade, he led the defense and space systems, energy, and information systems activities of the corporation. He spearheaded significant technical advances in alternative energy research and production; pollution monitoring and control systems; petroleum exploration and production technology; defense command and control systems; data fusion technology; military, commercial, and reconnaissance spacecraft design, development, and orbital operations; and innovative international engineering ventures in defense, space, and commercial technology.

Dick accepted the post of under secretary of defense for research and engineering in 1981, in which position he was the principal technical adviser to the secretary of defense. As under secretary, he was the senior Department of Defense executive for research and development policy, acquisition management, and defense atomic energy programs. He continued this assignment through 1984, and during his tenure was able to make significant improvement in the timeliness and efficiency of the defense acquisition process.

Always an outspoken advocate of defense policies he felt to be in the national interest, Dick never hesitated to take issue with those who espoused contrary views. It is a fitting tribute to Dick's integrity, dedication, and persuasiveness that he nearly always emerged from these confrontations with his reputation enhanced in the eyes of his opponents. It could be said that, although Dick may have stepped on a few toes when he felt it was necessary, he very rarely made an enemy as a result.

When Dick left the Department of Defense at the end of President Reagan's first term, he founded the Orion Group, Ltd., an international consulting and technical services firm. He also rejoined the Defense Science Board, of which he had been a member during the 1970s, and therein continued to provide technical advice and consultation to the Office of the Secretary of Defense. Late in 1989 he was invited to become the chief executive officer of Fairchild Space and Defense, which he managed until his untimely death.

Dick DeLauer was elected to membership in the National Academy of Engineering in 1969. His membership in the NAE always gave Dick great satisfaction. He enthusiastically supported the Academy's programs and projects, serving as organizer and chairman of the 1970 Symposium on the Food-People Balance and as chairman of the Nominating Committee in 1978. When Dick was asked why he felt qualified to undertake a searching examination of world food production, population trends, and related socioeconomic factors—a subject far removed from ballistic missile and space technology—Dick's answer was simple and direct: He said that world hunger was a quantifiable and definable problem, and engineers are trained as problem solvers.

Besides the National Academy of Engineering, Dick's favorite professional organization was probably the American Institute of Aeronautics and Astronautics. A member since his student days at Caltech, Dick took part in virtually every aspect of the AIAA program, from technical committee chairman to vice-president and director of the Institute. In 1968 Dick's many contributions were recognized by his election as a fellow of the AIAA.

He also found time to participate in an impressive number of other professional and community activities. He was a member of the board of governors and chairman of the Aerospace Technical Council of the Aerospace Industries Association. He was founding chairman of the American League for International Security Assistance. He served as vice-chairman of Governor Reagan's 1968 Task Force on California Transportation and was a regional chairman of the National Alliance of Businessmen. He was a vice-president and director of the Los Angeles Area Chamber of Commerce and a member of the California Council on Science and Technology.

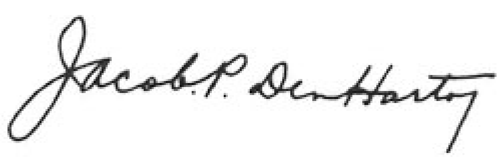
Dick was a trustee of the University of Redlands and chairman of the board of overseers of its Johnston College. He was member of the Advisory Committee to the Stanford School of Engineering and of the Engineering Advisory Council of the University of Southern California. He served as a regional chairman for the United Way of Los Angeles and was a member of the Advisory

Committee of the Institute for the Advancement of Engineering. He served on the Board of Visitors of the Defense Systems Management College. An ardent and supportive alumnus of both Stanford and Caltech, Dick participated as an active fundraiser for both schools in addition to his membership in the Caltech Associates and the Stanford Cabinet.

He also served on the National Aeronautics and Space Administration's Advisory Committee, the Air Force Scientific Advisory Board, the National Research Council's Air Force Studies Board, the Naval Research Advisory Committee, the Energy Research Advisory Board of the Department of Energy, and the Army Materiel Acquisition Review Committee.

He was the recipient of an honorary doctor of letters degree from the University of the Redlands. He was recognized by the National Conference of Christians and Jews for distinguished service in the field of human relations. He received the Herbert V. Roback Memorial Award of the National Contract Management Association for outstanding contributions to the defense acquisition process. He was decorated by the government of France for his contributions to the cause of world peace and security.

Dick DeLauer's boundless energy, contagious enthusiasm, zest for life, positive approach to problems and their solutions, steadfast loyalty to friends and associates, lifelong dedication to the profession of engineering, and never-wavering devotion to the cause of human freedom and national security are inspirational in their extent and extraordinary in their diversity. He lived his life in a manner that brought both honor and credit to the profession of engineering, to his associates, to himself and his family, and to the aerospace industry.



Jacob Pieter Den Hartog

1901–1989

By Robert Cannon and Stephen Crandall

Jacob Pieter Den Hartog, internationally famous vibration consultant, author, and teacher, died March 17, 1989, after a long illness. He authored the best-known textbook on mechanical vibrations and was widely acclaimed for his skill in perceiving the mechanisms underlying unexpected vibration problems in machines and structures.

Yet above all, Professor Den Hartog was a consummate teacher. He would get you raptly engrossed in some inscrutable mechanical system, and envelop you in the sheer fun of imagining the ways in which it will move, and why—physically. It's called dynamics; and he taught each of its secrets with words that always created a vivid image of yet another particular mechanism whose intriguing behavior dramatized a generic concept. And you never forgot that image; and that's why that concept was now yours in whatever new guise you encountered it. Generations of students were enriched by this man of verve, of wit, of captivating physical insight, who was affectionately known as Jaappy (pronounced Yahppy, the Dutch diminutive of Jacob).

Den Hartog was born on July 23, 1901, in the Netherlands East Indies (now Indonesia), where he lived until the family returned to Holland in 1916. He did his undergraduate study at Delft Polytechnical Institute in Holland, graduating with a degree in electrical engineering in 1924. Because of poor economic conditions in Holland at that time, he emigrated immediately to the

United States. Through a series of fortunate accidents, he soon found himself in Pittsburgh working for Westinghouse as the assistant to a Russian émigré, Stephen P. Timoshenko, twenty years his senior and venerated world guru in applied mechanics. Timoshenko's selection process was to compose a written examination for the group of Westinghouse candidates to try their hand at. When he saw Den Hartog's solution set he pronounced, "Bring me this man!"

Timoshenko assigned the young Dutchman to a gamut of vibration problems in electric motors and generators, hydraulic power machinery, railroad electrification, steam turbines, and the like. And his repertoire of physical images began to take shape. The sequence, Dr. Den Hartog explained, was that "one day in freshman physics at Delft the professor slowly charged up two great spheres, one at each end of the lecture table, until suddenly a great bolt of electricity leaped between them. *At that instant* I became an electrical engineer; and it took Stephen Timoshenko three years in Pittsburgh to convert me back to mechanical." Later a son was named Stephen Den Hartog.

While at Westinghouse, Jacob Pieter studied mathematics at the University of Pittsburgh in the evenings, completing his Ph.D. in 1929 with a thesis on nonlinear vibrations.

In 1931 he spent a sabbatical year in Göttingen in the laboratory of Professor Prandtl. On his return in 1932 he joined the faculty of Harvard University and began his teaching career, lecturing on vibrations and assembling an extensive collection of vibration demonstration models. His lectures had such a reputation that professors from the nearby Massachusetts Institute of Technology (MIT) would take the trolley across town to sit in with the Harvard students. Here he published the first edition of his famous text *Mechanical Vibrations* in 1934. He had also published another dozen papers before the signs of impending war persuaded him that he could be more useful (and have more fun) by serving in the military than by remaining a civilian. He accepted a reserve commission in the U.S. Navy in 1939. From 1941 to 1944 he was on active full-time duty on ship vibration problems in the Bureau of Ships, working in the nation's navy yards and ships as well as in naval machinery manufacturing plants all over the country. In 1945 he served in Europe on the Naval Technical Mission, Europe.

When the war was over, Captain Den Hartog returned with great energy and enthusiasm to a civilian life of consulting, and to a new—and rest-of-his-life—post as professor of mechanical engineering at MIT. He served also as department head from 1954 to 1958, but his first love was lecturing and tackling challenging consulting problems.

His consulting life was one of helping solve mysterious dynamic problems. Usually something was inexplicably vibrating in a system just built—a submarine's drive shaft, or an electric power transmission line, or a very tall chimney. The proprietor would put the project on "hold" and call Professor Den Hartog. He would come on the next overnight train and watch the phenomenon intently and ask questions. In his remarkable mind an image would develop of the simple essence of the phenomenon, of cause and effect. He would of course share his surgical insight in real time, in simple terms, and with a unique and endearing wit.

And then he would share it with his students; it would become part of the delightful set of case studies with which he wove the fabric of fundamental concepts. And finally, of course, they took their place in the body of his written contributions. There came a series of landmark papers in nonlinear vibrations of electrical machinery, of turbine blades, of tall stacks with von Kármán vortices, of piping systems, of the foundations for elevated structures, of great furnace walls and tubes, and on torsional vibration dampers and dynamic vibration absorbers. There came three new textbooks. And there came successively three new American editions of the venerable *Mechanical Vibrations* , which had also fifteen foreign editions in eleven languages. The style is so simple and direct as the reader is led skillfully (and impishly) to the essential heart of each problem.

Thus Den Hartog's precious legacy came in three parts: his wealth of new physical insights into mechanical vibrations, the highly readable way he committed them to prose, and the solid, endearing (and entertaining!) way in which he shared them with the generations of lucky students who got to study with him.

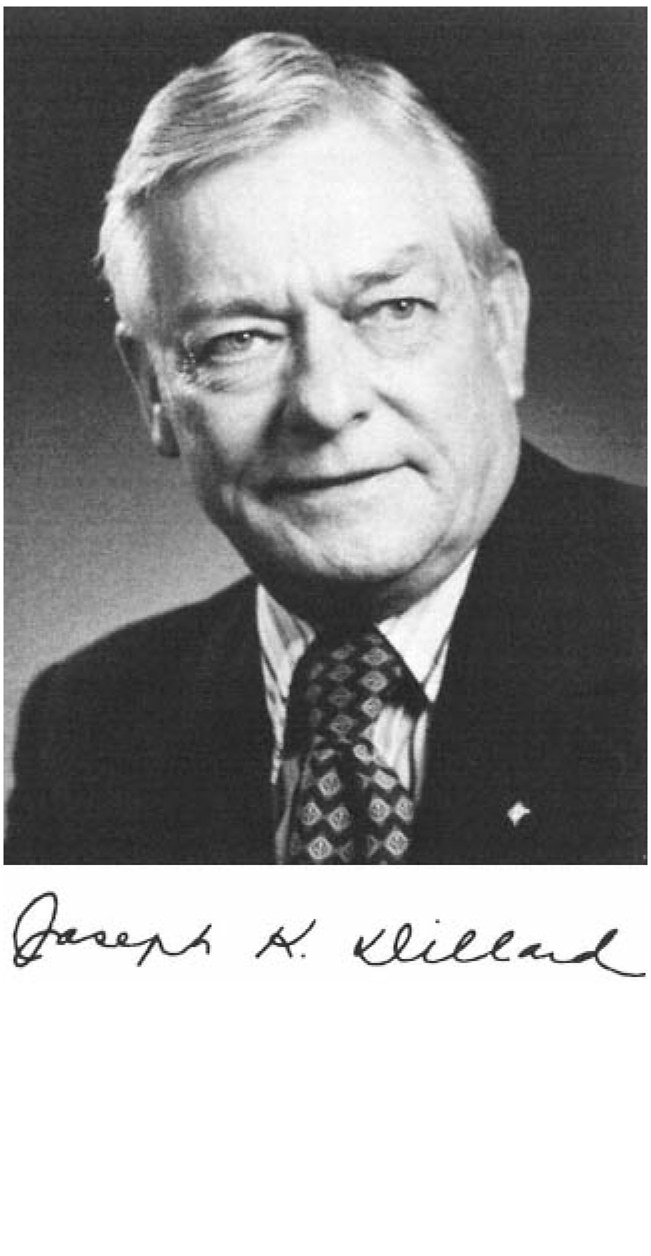
In the 1940s Professor Den Hartog's fame as lecturer spread rapidly; he was invited to lecture in most leading American universities and in approximately sixty foreign universities.

He spent four months in 1955 as a Fulbright visiting lecturer in Japan and was invited to give the Thomas Hawksley Lecture in London in 1957, the first American to be so honored.

Jaappy loved music, was a good amateur violinist, and a marvelous raconteur. He and his wife, Beppie, and sons, Maarten and Stephen, also loved to act as unofficial ambassadors to foreign students and scientists. They owned an island in the middle of Lake Winnipesaukee, which they used to entertain visitors. For many foreign scientists their most vivid memory of the United States is of being bundled into a car, driven up to New Hampshire, seated in a canoe, and paddled across the lake to spend an idyllic weekend on the island.

Jacob Den Hartog's talents were widely recognized, and he received many honors from his fellow engineers, from universities, and from prestigious academies. From the American Society of Mechanical Engineers (ASME), in addition to the Timoshenko Medal in 1972, he received the Charles Russ Richards Memorial Award, the Worcester Reed Warner Medal, and the American Society of Mechanical Engineers Medal. The American Society for Engineering Education awarded him the Lamme Award, and the Acoustical Society of America awarded him the Trent-Crede Award. He was an honorary member of ASME and the Japan Society of Mechanical Engineers, and a fellow of the British Institution of Mechanical Engineers. He was awarded honorary doctorates from Carnegie Institute of Technology, the University of Ghent, the Technical University of Delft, Salford University, and the University of Newcastle-Upon-Tyne. He was elected to both the U.S. National Academy of Sciences and the U.S. National Academy of Engineering, to the American Academy of Arts and Sciences, and to the Royal Dutch Academy of Arts and Sciences. At the end of his career, he received three major awards during his eightieth year: the James Watt International Medal from the British Institution of Mechanical Engineers, the Founders Award from the U.S. National Academy of Engineering, and the Order of the Rising Sun from the Emperor of Japan. He is remembered also by MIT's J. P. Den Hartog Distinguished Educator award to recognize "excellence ... in the tradition of Den Hartog," and the ASME Design Engineering Division's Jacob P. Den Hartog Award for "sustained meritorious contributions to vibration engineering," of which he was first recipient.

Some of us remember best that he told us, "Spend your life teaching, and you'll have a lot of fun." For we did. And he was right.



Joseph K. Dillard

1917–1988

By Edwin L. Harder

For Twenty-Five Years, from 1955 to 1980, Joseph K. Dillard and his talented group of associates were the virtual leaders in the tremendous advances in power system technology. His seventy-five papers published between 1952 and 1974 are an excellent chronology of these developments. They cover the solutions to all the problems encountered as the system transmission voltages were increased to 345 kilovolts (kV), then to 500 kV and 765 kV, and as the systems were interconnected, pooled, and operated as vast networks.

Notable are the Tidd 345-kV Project, joint with American Electric Power Company, Inc. (A.E.P.), and the Leadville 345-kV High-Altitude Project. These provided the fundamental basis for 345-kV transmission. Then came the Apple Grove Project, joint with A.E.P., which provided the fundamental basis for 500-kV and 765-kV transmission line design, and the 1100-kV Waltz Mill Project, which provided for testing cables up to these voltages.

All phases of lightning protection were studied: the phenomenon itself, the protection of lines and stations, switching transients, and the design of equipment to minimize and control these transients.

The most comprehensive economic study of power system operation and planning ever undertaken led to the Powercasting Program for long-range system design by computer, which, for the first time, made possible the comparison of all reasonable alternatives of system design to provide for expected load growth over many years.

Along with these larger, interconnected systems came huge turbo-generators, high-voltage transformers, nuclear power, and the special problems of system stability and economic dispatching. As his papers attest, Joe provided the much-needed leadership in this period of rapid system growth.

Under Joe's leadership, Westinghouse took the lead in technical development of the first U.S. 500-kV commercial system at Virginia Electric & Power Company. This was followed by the Allegheny Power 500-kV system. These projects were the first in which switching surge design was determined to be a major consideration. This led to the development of circuit breakers with closing resistors to permit economies of equipment and transmission line design.

A very important part of electric utility engineering was the Westinghouse annual Electric Utilities School, which brought together promising young engineers from all over America and the world to learn the advanced technology involved in the design and operation of electric power systems. Joe and his group were personally acquainted with most of the key engineers in electric utilities throughout the world. Joe was always at the heart of these schools, never sparing himself (or his people) in making them a model of excellence. This contributed greatly to the respect and confidence with which electric utilities all over the world looked to Joe's Advanced System Technology Department for leadership and help in solving the highly complex problems of their growing systems.

All great engineering advances are the work of many engineering groups, all working in concert through the professional technical interchange afforded by the professional societies. Joe was a firm believer in professionalism, and the efficacy of this interchange. He was an outstanding leader in the Institute of Electrical and Electronics Engineers (IEEE), chairman of many of its committees, active on the board of directors for many years, and vice-president of technical activities and in 1976 became president of the IEEE, the largest professional technical organization in the world.

He led also in other international organizations. In CIGRE, the International Conference on Large High Voltage Electric Systems, he was a member of the Executive Committee, and from 1972 to 1979, vice-president of the U.S. National Committee of CIGRE. For the World Energy Conference, he served on the board of directors of the U.S. National Committee (1972–1980) and as chairman of the Technical Program Committee in 1974.

Born on May 10, 1917, in Westminster, South Carolina, son of a plumber-general contractor, Joe became accustomed very early to hard work, a characteristic, along with his exceptionally clear analytical mind, that was to pay rich dividends throughout his strenuous career. After Westminster High School, Joe went on to the Georgia Institute of Technology, where he studied electrical engineering, in the Cooperative Program. After three years, however, he left for the U.S. Navy Yard in Charleston, South Carolina, to become a planner and estimator for the repair and conversion of naval vessels throughout World War II.

He married Elizabeth (Betty) Wash of Greenwood, South Carolina, on December 8, 1939. In 1946 he returned to Georgia Tech to complete his B.S. in electrical engineering, while teaching mathematics for support. Betty worked as secretary in the Electrical Engineering Department. In 1947 he went on to the Massachusetts Institute of Technology (MIT) for his MSEE, while teaching electrical engineering at the same time. Again at MIT, Betty became secretary in the Electrical Engineering Department. Betty's intimate knowledge of Joe's engineering education, and his subsequent superb use of it, was a boon not bestowed on many engineer's wives.

In 1950 Joe joined the Westinghouse Electric Company, and after assignments in the Electric Utility Engineering Department, the Switchgear Division, and the Analytical Department, he became manager of Electric Utility Engineering in 1956. With a reorganization, he became manager of Electric Utility Advanced Systems Technology in 1967, and then general manager of Advanced Systems Technology from 1975 until 1980. He retired as a senior consultant in 1982 and died on February 13, 1988, survived by his wife, Betty, and his two sons, William King (Bill) and John Holcombe (Jack), and their families.

Joe gave generously of his time and talents in support of the engineering programs at Georgia Tech, MIT, and Carnegie Mellon University and received the highest commendations from these institutions. He served as chairman of the National Advisory Board for Georgia Tech and was a very strong supporter of many of the university's programs. He was a member of the Board of Visitors at MIT, representing industry. He served as chairman of the Steering Committee for the graduate program in power systems engineering at Carnegie Mellon University.

He was a professional engineer registered in Pennsylvania and a member of the Engineering Society of Western Pennsylvania and the National Society of Professional Engineers, and he encouraged all members of the team to follow suit.

Many honors came his way. He was elected a member of Sigma Xi and in 1963 a fellow of the IEEE "for contribution to electric power systems engineering in conversion and transmission research." He was awarded the Westinghouse Order of Merit, the company's highest recognition, in 1973 "for his work in the development of extra-high-voltage transmission systems technology." He was elected to the National Academy of Engineering in 1975, among the highest distinctions given to any American engineer. In this election he was honored "for his pioneering work in applying digital computers to the technical and economic analysis of power generation and transmission systems."

With all this, letters from many of his friends and associates, as well as the author's personal experience, it is revealed that Joe was a very warm and caring human being, demanding of himself and those who worked with him, but extremely supportive and proud of them all, with a charismatic style that endeared him to all his many friends and associates. He was recognized for his technical ability and his friendly and cooperative spirit. He enjoyed his work and the people he worked with. His associates and friends remember him as a "real guy." This had much to do with the success of the vast enterprise that he led and his election as president of the IEEE.

The superb electric power systems of today stand as a lasting memorial to the group of dedicated engineers who created them. Joe's name stands very high on the list of those who shepherded this fantastic development during its period of most dynamic growth.


Chas. W. Elston

Charles W. Elston

1914–1989

By Charles H. Holley

Charles W. Elston, engineer, business and community leader, and, above all, unselfish humanitarian, died on June 5, 1989, at the age of seventy-four.

A Philadelphia native, Charlie Elston graduated from high school in Downingtown, Pennsylvania, and in 1937 received a degree in mechanical engineering from Drexel University. He then joined the General Electric Company in Schenectady and soon became widely known in the power generation field for his technical competence and integrity, his leadership, and his ability to inspire a climate of soundly based technical confidence in his associates. He possessed the ability to look beyond immediate details and see the overall problem. Throughout his career, he continuously made significant technical contributions to the technology of bulk power generation.

Mr. Elston was elected to the National Academy of Engineering in April 1967.

Early in his career he was instrumental in the development of three-dimensional flow concepts of the 3-D design system for turbine buckets, which resulted in increased turbine efficiency. He was a prime contributor to the design and development of the original opposed-flow reheat steam-turbine design, a design simplification that led to widespread acceptance of the reheat cycle. This is a concept that became universal in U.S. design practice, except for the very largest ratings.

He led the establishment of substantially higher steam temperatures and pressures, with corresponding advances in the metallurgy, the forge and foundry practices, and the quality control and inspection practices necessary to support these advances. This work led to the design of the world's first supercritical steam turbine, the 125-megawatt Philo #6 unit, for American Electric Power, which established the supercritical steam cycle as a preferred option for high-efficiency base load steam power plants.

The combination of the reheat cycle and advances in steam conditions described above provided efficiency gains of 8 to 10 percent over levels existing in the late 1940s. In 1980, for example, these improvements equated to an annual saving by the electrical utilities of 2 to 3 percent of the total U.S. energy consumption, including sixty million barrels of fuel for oil-fired power plants.

Under his leadership there was a rapid growth in steam-turbine generator ratings with 3,600-rpm tandem compound units going from 60 to 800 megawatts, while maintaining high efficiency and reliability. He also led the development of nuclear steam-turbine generators, successfully putting into service units at 1,100 megawatts.

He was one of the first in the industry to evaluate the importance of operating practices in controlling thermal stresses and turbine casing cracking. His paper, "Factors Involved in the Starting and Subsequent Loading of Modern Steam Turbines," at the American Society of Mechanical Engineers (ASME) Annual Meeting in 1952 was a significant contribution to power plant operation.

He was responsible for the introduction of the Package Power Plant, an integrated preassembled gas-turbine generator plant that fostered the rapid growth of gas-turbine peaking generation by substantially reducing the installed cost of such plants. He also had a leading role in the gas-turbine design and in the overall cycle development for one of the first combined-cycle gas-turbine/steam-turbine generating plants at Oklahoma Gas and Electric's Horseshoe Lake Plant.

His continual striving for improved performance and reliability was instrumental in enabling his company to provide large turbine generators with reliability substantially better than the nation's average. Mr. Elston has achieved international recognition for the quality of his work in this area.

During his long career in the power generation business, he was a major factor in the design and production of reliable and efficient steam-and gas-turbine generators. His positive influence is evident in approximately half of the capacity of power generation equipment installed in the United States today.

His broad experience and technical insights were recognized widely within the General Electric Company as well as by others. For example, he played a key role in assessing the reliability of boiling water reactor systems components. Mr. Elston was most penetrating in his evaluation of mechanical equipment in nuclear plants, and was instrumental in specifying test programs to define operating problems and to determine practical solutions to these problems.

Mr. Elston was interested in education throughout his career and made significant contributions to technical education. He was a member of the Visiting Committee on Mechanical Engineering for Lehigh University, and a member of the Board of Trustees of Green Mountain College in Poultney, Vermont.

He was a founding member of the Board of Trustees of Schenectady County Community College and its chairman for ten years, and was instrumental in the establishment of the college. In recognition of his work, in 1978 the main college building was named Elston Hall. Further, in 1985 he received the Distinguished Citizen of the Year Award from the State University of New York, the state education system's highest award.

He served numerous other volunteer civic organizations throughout his career. For example, his work as a board member of the Schenectady Boys Club earned him recognition as a national associate of the Boys Clubs of America by then Vice-President Richard M. Nixon.

From 1983 to 1987 he was chairman of the board of managers at Ellis Hospital, having been a member since 1964. As chairman, he spearheaded the revitalization of the hospital, and the planning and construction phases of a new surgical suite that included facilities for cardiac surgery—a first for Schenectady County.

With all of his many areas of activity, Charlie Elston, a gentle man of good humor, always had time and patience to meet with his peers and others to discuss their problems and career progress. He was recognized as a mentor and role model by all who knew him. He lived a life of love and integrity.

Mr. Elston's contributions have had a positive effect on the economy and the standard of living that we have in the United States. His untiring contributions have had a significant impact on providing reliable and inexpensive electrical energy for the nation. His peers recognized his contributions by electing him to the grade of fellow in the American Society of Mechanical Engineers. In further recognition of his achievements, in September 1974 he was awarded the ASME George Westinghouse Gold Medal for his significant contributions to power generation technology. In 1980 he received an honorary doctorate from Union College in recognition of his business, technical, and community contributions.

The author of this tribute has never known of anyone who made as many significant contributions and gave so freely of his time and talents throughout his lifetime as Charlie Elston.

Mars G. Fontana

1910–1988

By Robert A. Rapp

Mars G. Fontana, a world-renowned educator and corrosion engineer, died February 29, 1988, at age seventy-seven. He was one of the world's pioneers in research establishing basic scientific knowledge of the phenomenon of corrosion and its applications in engineering. In addition to his noteworthy technical achievements, Fontana was an outstanding administrator and stimulating teacher.

Born in Iron Mountain, Michigan, on April 6, 1910, Fontana received a B.S. in chemical engineering (1931) and an M.S. (1932) and Ph.D. (1935) in metallurgical engineering from the University of Michigan. From 1929 to 1934 he served as a research assistant in the university's Department of Engineering, where his work included investigations of scaling of steel at forging temperatures, development and use of apparatus for vacuum fusion analysis for gases in steels, high-temperature creep of metals and alloys, and also basic work on the thermodynamics of steelmaking. He published four articles based on this work.

From 1934 to 1945 Fontana worked for E. I. du Pont de Nemours and Company, Inc. in Wilmington, Delaware, as a metallurgical engineer and group supervisor in the Technical Division of the Engineering Department. There he devoted limited time to research while concentrating largely on plant and design engineering. This included organizing work on materials of construction in various Du Pont production departments and developing materials and designs for acid service. He also pioneered industrial uses of nylon and Teflon. Four patents were assigned to Du Pont in connection with his corrosion work.

This early practical experience set the stage for his research, writing, and teaching that followed during the succeeding thirty years of professional activity as professor and chairman in the Department of Metallurgical Engineering at The Ohio State University (OSU). In 1945 he was named a professor of metallurgical engineering at OSU, and in 1948 department chairman and director of the Corrosion Center, the largest university effort in corrosion research in the United States. He was named a regents professor in 1967 and chairman emeritus in 1975.

He was known as an excellent teacher, lecturer, and researcher, but also a considerate and efficient leader. At OSU he was particularly effective in bringing about the building of new laboratories, recruiting and developing outstanding young faculty members, and participating in the administration of the college and university. During his tenure, $3 million worth of new facilities for metallurgical engineering were constructed, and research under contract grew to $1 million a year. At OSU he was called upon to serve on various faculty committees, including the Faculty Advisory Committee to the president and Board of Trustees, Faculty Council, Advisory Council of the Engineering Experiment Station, and Executive Committee of the College of Engineering.

Throughout his career, Fontana merged science and engineering to clarify the mechanisms of corrosive attack of engineering materials by aggressive environments, and to develop and recommend inhibitors, coatings, and electrolytic and other means to protect engineering structures. These efforts led to his famous textbook *Corrosion Engineering* , published by McGraw-Hill in 1967. The author of two hundred technical papers in recognized journals, he also authored *Corrosion: A Compilation* , published by Hollenback Press in 1957. He was exceptionally well qualified and recognized as a consultant to industry on corrosion problems and materials selection, and he did consulting work for Duriron Company, Mallinckrodt Chemical, Com bustion Engineering, Dow Chemical, General Electric, U.S. Steel, Republic Steel, Humble Oil, Standard Oil of New Jersey and of Ohio, Kaiser Aluminum, American Potash and Chemical Co., the U.S. Air Force, Argonne National Laboratory, Oak Ridge National Laboratory, and other firms and agencies of the federal government.

Fontana was elected a member of the National Academy of Engineering in 1967 and later served on the National Research Council's Committee on Ocean Engineering. He served as an honorary member of the American Society for Metals (ASM) in 1969 and was a fellow of the ASM in 1970, of the Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineering (AIME) in 1971, and of the American Institute of Chemical Engineers in 1972. He served as president of the National Association of Corrosion Engineers in 1952, chairman of the Corrosion Division of the Electrochemical Society in 1948–1949, and chairman of the Columbus Chapter of the ASM in 1948. He was a member of Sigma Xi, Phi Lambda Upsilon, Phi Eta Sigma, Iota Alpha, Alpha Sigma Mu, and faculty adviser to Texnikoi.

The University of Michigan named him Distinguished Engineering Alumnus in 1953, gave him its Sesquicentennial Award in 1967, and awarded him an honorary doctor of engineering degree in 1975. He received the Frank Newman Speller Award in 1956 from the National Association of Corrosion Engineers (NACE). In 1973 the Ohio Society of Professional Engineers gave him its Neil Armstrong Award; in 1969 the American Society for Engineering Education presented him its award for excellence in instruction of engineering students; in 1973 the students in the College of Engineering at OSU awarded him the C. E. MacQuigg Award in teaching; The Metallurgical Society of AIME awarded him its first Outstanding Educator Award; and in 1979 ASM presented him its Gold Medal. He was editor of the NACE journal *Corrosion* from 1962 to 1974.

In 1962–1963 Fontana was named to a six-man corrosion exchange between the United States and the U.S.S.R., and from 1972 to 1975 served as a public member of the Technical Pipeline Safety Standards Committee of the U.S. Department of

Transportation. He presented the Plenary Lecture at the Second International Congress on Corrosion in 1963 and was the Edward DeMille Campbell Lecturer of ASM in 1970.

He held eight patents including that for Alloy FA-20, a standard alloy for many corrosive services. His Alloy DC4MCu was patented by OSU, and he invented Duriron anodes for cathodic protection that are used to protect buildings at the Kennedy Space Center.

Fontana and his wife Elizabeth had four children, Martha, Mary Beth, David, and Tommy. He enjoyed a good game of golf and bowled in the Faculty League (highest score, 279). Active in his community, Fontana participated in Cub Scouts, Cub Scout baseball (he had played semiprofessional baseball), Boy Scout fund raising, the United Appeal, and the First Congregational Church, where he was an usher and member of the building committee.

To his many students, colleagues, and friends, Mars G. Fontana was known to be particularly kind, friendly, generous, and tolerant. He provided a very positive contribution to the lives of hundreds of people and to the engineering world in general. He will be missed, but remembered, by those who loved, respected, and admired Mars G. Fontana.

Photograph by Fabian Bachrach.

Michael L. Haider

1904–1986

By Walker L. Cisler

Michael L. Haider, chairman of Exxon Corporation from 1965 to 1969, died on August 14, 1986, at his home in Atherton, California.

Born on a farm in Mandan, North Dakota, on October 1, 1904, Michael Haider was one of eight children of a wheat rancher and his wife. He was a 1927 graduate of Stanford University with a B.A. in chemistry. He joined the Exxon organization in Tulsa, Oklahoma, in 1929 as a chemical and petroleum engineer with Carter Oil, one of the company's affiliates. He became chief petroleum engineer and then headed all phases of engineering work for Carter before being transferred in 1938 to Exxon's research organization in New York as manager of production engineering and research.

In 1945 he joined the corporation as executive assistant in the Producing Department and a year later moved to Toronto as manager of the Producing and Exploration Department of Imperial Oil, Limited, a Canadian company in which Exxon held a 70 percent interest. He was elected a director of Imperial in 1948 and vice-president in 1950.

Mr. Haider returned to Exxon's corporate headquarters in New York in 1952 and served for two years as deputy coordinator of the company's worldwide producing activities. He then become president and a director of International Petroleum Com pany, Limited, which was responsible for Exxon's operations in parts of South America.

In 1959 he was elected a director of Exxon Corporation, a year later became vice-president and director with responsibility for Latin America, and in 1961 was elected executive vice-president and a member of the Executive Committee. In 1963 he was elected president and vice-chairman of the Executive Committee, and in 1965 he became chairman of the board, chief executive officer, and chairman of the Executive Committee, a position he held until his retirement in 1969.

Mr. Haider was a founding member of the National Academy of Engineering. He was a past chairman of the American Petroleum Institute and a past president of the American Institute of Mining, Metallurgical, and Petroleum Engineers. He was director of the Economic Development Council of New York City; a trustee of the Committee for Economic Development; and a member of the Council on Foreign Relations, the National Petroleum Council, and The Business Council.

He was a former chairman of the Radio Free Europe Fund; and a former member of the board, cochairman of the Development Committee, and a member of the Finance Committee of The Metropolitan Opera. He was also a director of the First National City Bank.

He held honorary degrees from the University of Miami, Rensselaer Polytechnic Institute, and C.W. Post College of Long Island University. Mr. Haider was elected to the Instituto de Cultura Hispanica of Spain in 1962 and was awarded the Gran Cruz de la Orden del Merito Civil (Great Cross of the Civil Order of Merit) by the Spanish government in 1969. In April 1968 he received an honorary doctor of engineering and the Engineering Centennial Medal from PMC College in Chester, Pennsylvania. In 1969 he received The John Fritz Medal, granted jointly by the five professional societies representing mining, civil, mechanical, electrical, and chemical engineers, and was a member of Tau Beta Pi Engineering Honor Society.

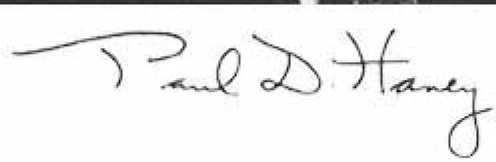
In 1969 he received the Cavaliere de Gran Crose, the highest recognition of the Italian government. In 1970 he received the

Charles F. Rand Award from the American Institute of Mining, Metallurgical, and Petroleum Engineers.

Mr. Haider was survived by his wife of fifty-eight years, Alice, one daughter, and three grandchildren.

As chief executive officer of one of the world's largest corporations, Mr. Haider was one of the pioneers in the globalization by U.S. corporations in overseas markets. He earned a reputation as an innovator who got things done. He undertook many jobs where changing times and situations called for changing business methods. He was a longtime sailboat enthusiast, mainly at Cape Cod, summer home of the Haiders, their daughter, and their daughter's family. He also had an interest in archaeology and Peruvian and Columbian artifacts.

Mr. Haider will best be remembered as a distinguished petroleum engineer and outstanding executive, whose skill and experience in research, exploration, and production greatly contributed to progress of the petroleum industry throughout the world, and whose imaginative leadership as chairman and chief executive officer of one of the world's great corporations earned him the respect and admiration of the entire business community.



Paul D. Haney

1911–1990

By Dwight F. Metzler

Paul D. Haney, an internationally recognized authority in environmental engineering, died on May 5, 1990, at the age of seventy-nine. He was a retired partner of Black & Veatch.

Born in Kansas City, Missouri, on February 5, 1911, he was educated in the local schools. Paul received his B.S. in chemical engineering from the University of Kansas (K.U.) in 1933 and his S.M. in sanitary engineering in 1937 from Harvard University, where he studied under Gordon Fair. He was elected to Delta Omega, the honorary public health society.

In a career spanning nearly sixty years, Paul taught at two universities, guided surface water quality studies for the nation, and made major contributions to the theory and practice of water purification and wastewater treatment. He was a teacher, researcher, and practicing engineer, whose dedication to the profession was recognized by his peers. They elected him to high office in the Water Pollution Control Federation (president, 1968–1969), the American Society of Civil Engineers (ASCE; chair, Sanitary Engineering Division, 1966–1967), and the American Water Works Association (chair, Purification Division, 1958; director, 1964–1967).

He was elected to the National Academy of Engineering in 1974. Before and after his election, he served on numerous committees of the National Research Council. He was a member of the Assembly of Engineering, the Potomac Estuary Study Committees, and the Subcommittee on Water Supply of the Division of Medical Sciences' Committee on Sanitary Engineering and Environment.

Paul began his career as an instructor in sanitary engineering at the University of Kansas and an engineer for the Kansas State Board of Health. In the latter capacity he supervised the Kansas Water and Sewage Laboratory. This experience caused him to insist on factual accuracy as a basis for problem solving. Throughout his career, he encouraged and guided many young engineers as they advanced in their profession. Subsequently, they moved into leadership positions in teaching, private practice, and the public sector.

Paul left Kansas in 1947 to teach at the School of Public Health, University of North Carolina. A year later he was commissioned in the Regular Corps of the U.S. Public Health Service. He was assigned to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. For six years he directed nation wide stream quality studies as authorized by Congress in 1948. The findings from these studies provided the basis for the first federal law representing a comprehensive national effort to clean up surface waters (1956) and provided limited construction grants to municipalities.

He joined the consulting firm of Black & Veatch in 1954 and was elevated to partner in 1956. He directed investigations and guided designs in sewage and industrial waste treatment and in advanced wastewater treatment for some of the nation's largest cities in the Midwest and the East. He also directed water supply and treatment investigations, including a landmark study for Washington, D.C., that led to a one-million-gallon-a-day pilot plant designed to remove a wide variety of toxins from the lower Potomac River.

After he retired in 1978 as a Black & Veatch partner, he continued as a technical adviser to the firm's designers and researched inquiries from associates and friends. He read widely medical students at the University of Kansas School of Medicine through 1988, and found great satisfaction in taking them to observe water supply and wastewater projects. He served in the K.U. Chancellor's Club and on various committees of the School of Engineering.

Paul wrote manuals for the U.S. Army Corps of Engineers, the Environmental Protection Agency, and the Department of Interior. He served as a consultant to four federal departments and was a member of more than a dozen committees for establishing criteria and setting standards for water quality.

Paul was always a teacher who enjoyed sharing his scholarship with others. His forty-five published papers ranged from the analysis of broad environmental policy issues to highly technical discussion of water treatment. One of his earliest papers dealt with dual water systems. He was a major contributor or senior author for four books: The *ASCE Manual of Practice for Sewage Treatment Plant Design* (1959); the American Society of Civil Engineers, American Water Works Association, Conference of State Sanitary Engineers book, *Water Treatment Plant Design* (1969); *The Process Design Manual for Phosphorus Removal* (1971); and the 654-page book, *Water Quality and Treatment*, published by McGraw-Hill in 1971. These books and articles are used by engineers around the world.

Paul was concerned with the improvement of civil engineering practice. His influence on the profession was apparent as he served on the program committees for annual meetings of national organizations. He is credited with the creation and development of the technical programs plan used by the Water Pollution Control Federation for its annual meetings.

Paul was honored repeatedly for his contributions. The American Water Works Association awarded him its prize for the outstanding water supply paper of the year three times (1955, 1966, and 1970). He received its Goodell Prize in 1955, George Warren Fuller Award in 1958, honorary membership in 1970, and Divens Medal in 1971.

In addition to the presidency, his Water Pollution Control Federation honors included the Arthur Sidney Bedell Award (1970), the Charles Alvin Emerson Award (1975), the William J. Orchard Distinguished Service Medal (1979), and honorary membership in 1977.

The American Academy of Environmental Engineers presented him with the Edward J. Cleary Award in 1977, and the University of Kansas its Distinguished Engineering Service Award in 1983.

In addition to memberships in nine professional organizations, he was a member of Sigma Xi, Tau Beta Pi, the Cosmos Club of Washington, D.C., and the Carriage Club of Kansas City.

Paul's legacy to the engineering profession will long be remembered. His originality and creativity led to better understanding of water-related problems and to important achievements in water purification and treatment. Through engineering education, research, consulting, and management, he did much for the improvement, preservation, and proper use of America's water resources.

Raymond J. Hodge

1922–1990

By Wilson V. Binger

Raymond J. Hodge, retired partner in the engineering, architectural, and planning firm of Tippetts-Abbett-McCarthy-Stratton (TAMS) headquartered in New York, died on October 27, 1990, at the age of sixty-eight.

Hodge was born in New York City on May 15, 1922, and received a B.C.E. from Manhattan College in 1944. He entered the U.S. Navy in 1943 and served as an engineering officer with the 105th U.S. Naval Construction Battalion, working on military airfields, roads, and waterfront facilities in New Guinea, the Philippines, and North China. From 1946 to 1951 he was at Cornell University in Ithaca, New York, first as a graduate student earning an M.C.E. in 1948, then as an assistant professor of engineering. More recently he became a member of the Board of Advisors of Cornell's College of Engineering.

During the Korean War, Ray Hodge served from 1951 to 1953 as a lieutenant commander in the U.S. Navy, with responsibility for developing a U.S. Navy Master Jet Base in Brunswick, Maine.

In 1953 Hodge joined TAMS, where he remained until his retirement in 1988. During his thirty-five years with the firm, twenty of them as a partner, he traveled widely, was in residence in several overseas locations, and became an internationally recognized expert in airport planning and design. He managed the planning, design, and construction supervision of the Dal las/Fort Worth Airport in Texas. He also directed the planning and design of airports in Amman, Jordan; Lisbon, Portugal; Seoul, Korea; Bangkok, Thailand; and Tehran, Iran.

Ray's experience was not limited to airports, however. He was in charge of the Mount Newman iron ore project in northwestern Australia, which included planning and design for a 285-mile railroad, two towns, and port and harbor facilities. He also oversaw highway and port projects in Southeast Asia and in Central America. Most recently, in charge of TAMS's South Atlantic office in Washington, D.C., he oversaw the firm's services for the Pennsylvania Avenue Development Corporation and the rehabilitation of Union Station.

Hodge held professional licenses in eleven states, the District of Columbia, and Australia. He was a member of Chi Epsilon and Tau Beta Pi. His professional society affiliations included the American Society of Civil Engineers; the Society of American Military Engineers; the American Consulting Engineers Council; the American Institute of Mining Engineers; the National Society of Professional Engineers; the American Academy of Environmental Engineers; and the Institution of Engineers, Australia. He was elected to the National Academy of Engineering in 1983. He chaired and spoke at many meetings in the United States and overseas and was active in committee work of several organizations.

Many professional honors came to Ray Hodge during his career. He received the Past Presidents Award from the American Consulting Engineers Council, the Guy Kelcey Award from the American Road and Transportation Builders Association, and the James Laurie Prize from the American Society of Civil Engineers. In addition, he received awards from *Engineering News Record* and *Civil Engineering* magazines for his work on the Dallas/Fort Worth Airport. He authored a number of articles on airports for technical and professional publications.

Ray is remembered by his associates as a warm, caring individual with an outstanding personality. He liked people generally and did not forget his friends, of whom he had a great many throughout the world. He was almost always cheerful, despite suffering for more than twenty years from rheumatoid arthritis, complications from which led to his death.

Ray is survived by his wife, Lorraine; two daughters, Susan and Patricia; two sons, Christopher and Raymond; and two grandchildren.

George Edward Holbrook

1909–1987

By Edward G. Jefferson

George E. Holbrook, a retired vice president and member of the Executive Committee of the Du Pont Company, died February 26, 1987, at the age of seventy-seven.

Elected one of twenty-five charter members of the National Academy of Engineering in 1964, George was an exceptionally talented chemical engineer and an executive of broad vision and foresight, who made important contributions both to Du Pont and to the many professional and educational institutions with which he was affiliated.

He joined Du Pont in 1933 at age twenty-four and before his thirtieth birthday was head of new products research at the company's Jackson Laboratory in Deepwater Point, New Jersey. He became assistant director of that laboratory in 1943, and in 1949 served as general superintendent of product development at Du Pont's Chambers Works, which was then the largest chemical plant in the world. Later he was transferred to Du Pont's home office, first as manager of process development for the company's organic chemicals business, and later as assistant director of Du Pont's Development Department.

George was given leave from Du Pont in 1952 to serve as deputy director of the Chemical, Rubber, and Forest Products Bureau of the National Production Authority, and subsequently became director of the Bureau. Upon returning to Du Pont he resumed his duties at the Development Department and under took an additional assignment as chairman of Du Pont's Corporate Committee for Educational Fellowships and Grants, which became a lifelong interest. In 1955 he was appointed assistant general manager of Du Pont's Organic Chemicals Department, and in 1957 he became general manager of the newly created Elastomer Chemicals Department. He was named a vice-president, a director, and a member of the Executive Committee of the Du Pont Company in 1958.

Born in St. Louis, Missouri, in 1909, George attended the University of Michigan where he received a B.S. in 1931, M.S. in 1932, and Ph.D. in 1933, all in chemical engineering. In 1959 he was honored by his alma mater for outstanding career achievement, and in 1967 the university granted him the honorary doctor of science degree. Deeply concerned with the quality of higher education, George served on the Visiting Committee for the Department of Chemical Engineering at Carnegie Institution of Technology, the Board of Directors of the Development Council of the University of Michigan, the Chemical Engineering Advisory Board of the University of Rochester, the Board of Engineering Education of the University of Pennsylvania, and the Board of Overseers of Newark College.

George wrote many articles for technical publications and scientific organizations, and was issued several patents covering inventions in the organic chemicals field.

He was a member of the Tau Beta Pi, Sigma Xi, Phi Kappa Phi, and Phi Eta Sigma honor societies and the Phi Lambda Upsilon chemistry society. He was also a member of the American Chemical Society, American Physical Society, Society of Chemical Industry, New York Academy of Science, Franklin Institute, American Association for the Advancement of Science, the Chemical Society (London), an honorary member of the Institution of Chemical Engineers (London), a member of the Board of Trustees of the University of Delaware Research Foundation, and an adviser on engineering matters to the Ford Foundation.

George was a member and treasurer of the American Institute of Chemical Engineers, a director in 1950–1952 and 1954–1956, and president in 1958. In 1953 he received the Institute's Profes sional Progress Award, and in 1961 its Founders' Award for outstanding contributions to the field of chemical engineering.

In addition, he served as vice-president of the Engineers Joint Council and was for several years a member of its board of directors, its Executive Committee, and Planning Committee. He also served as a director and member of the Executive Committee of the Manufacturing Chemists' Association.

George Holbrook was a talented and dedicated professional. His contributions to human welfare were numerous and important, and he is greatly missed.

J. Herbert Hollomon

1919–1985

By Donald N. Frey

J. Herbert Hollomon died on May 8, 1985, in Albany, New York, after a varied and distinguished career in industry, government, and academia. Born in Norfolk, Virginia, he was educated in physics and in metallurgy at the Massachusetts Institute of Technology (MIT), from which he received his D.Sc. in metallurgy in 1946.

Following wartime service as a major in the United States Army at the Watertown Arsenal, Hollomon joined the research laboratories of the General Electric Company (GE) in Schenectady, New York, where he rose over a sixteen-year career to be the general manager of the General Engineering Laboratory.

Hollomon made a speech in early 1960 that called for a national academy of engineers. His speech, reprinted in *Science*, came to the attention of Harold Work, director of the Engineering Foundation. Working with other distinguished engineers, their labors paid off with the establishment in 1964 of the National Academy of Engineering of which Hollomon was a founding member.

Responding to the call of President John F. Kennedy, he was appointed in 1962 the first assistant secretary for science and technology at the Department of Commerce (DOC), from which position he oversaw all of the department's scientific and technical undertakings, including the National Bureau of Standards, the Patent and Trademark Office, and the Weather

Bureau. He established the Environmental Sciences Services Administration (later, the National Oceanic and Atmospheric Administration), the Commerce Technical Advisory Board, and the State Technical Services program. While in this position, he was among the first to recognize the importance of national policies directed at improving the technological performance of civilian industries, and became famous, if not infamous, for his efforts at establishing the ill-fated Civilian Industrial Technology Program. He was also instrumental in legislative proposals that led to the passage of the National Highway Transportation Safety Act, one of the earliest modern laws addressing consumer safety. He served for part of 1967 as acting under secretary of commerce, but left DOC for the University of Oklahoma in the fall of 1967, in part over differences with President Lyndon B. Johnson on the U.S. role in the Vietnam War.

Hollomon served the University of Oklahoma for three exciting years: one as president-designate and two as president. While there he received national attention for implementing an innovative, change-oriented planning process for the university that involved hundreds of students, alumni, faculty, administrators, and citizens of the state in charting the future of the university. The turbulence surrounding this process, combined with sharp disagreements with the then-governor of the state over many issues, including his responsiveness to student demands in that period of national campus unrest, led to his resignation in 1970.

Hollomon then returned to his alma mater, MIT, serving as consultant to the president and the provost and then as Japan Steel Industry Professor of Engineering and founding director of the Center for Policy Alternatives. From this base he and his colleagues among the students, faculty, and staff contributed to the formation of national technology strategies in countries as diverse as Brazil, Korea, Israel, Sweden, and the United States, as well as to influential reexaminations of the premises of governmental efforts to encourage research and development and to manage the environmental and safety consequences of new technology. In addition to his contributions to research and policy analysis, he played a central role in establishment of graduate programs at MIT in technology and policy and in the management of technology, both areas in which he was an acknowledged innovator.

In 1983 he and several other center staff and their activities moved to the campus of Boston University, where he remained until his death.

Hollomon tore through life, leaving in his wake myriad expanded minds, changed lives, and reformed institutions. Combative, controversial, often ahead of his time, and always pushing those around him to do more and do better, he was a colorful and complex man. He touched all those around him in an intense and personal way.

I knew and treasured knowing J. Herbert Hollomon for nearly forty years after he received his D.Sc. in metallurgy and I received mine in 1949 from Michigan. In those days not many doctorates were granted in metallurgy in the United States, and we all knew each other.

I first called on Herb when he was at GE. We had an exhilarating conversation on dislocations and everything else. I then actively followed, and in some instances participated in, his career until his death. From the first meeting to the last, our association was one of great content, humor, and plain fun. I greatly admired Herb, could get mad at him at times, but was always turned on by him. He could be provocative in the extreme, could take outrageous positions to see what would happen, but always made you think—and he was very often right in his views.

My most intense association with Herb was during the periods from 1979 to 1982 and in 1984 and 1985 when he served as a director of Bell & Howell (for which I was chief executive). (The gap in service occurred when he was recovering from his stroke.) Herb performed exactly as I hoped he would. As is common with any large public company, the directors were a diverse lot with backgrounds in such fields as finance, operations, or law. Herb was, as always, the provocative technologist. He constantly stirred up the directors and on more than one occasion was strongly and noisily supportive of my efforts to introduce more innovations into the company and take the risks thereby. We had no choice, but some directors are never comfortable with ambiguity. Herb was. He also knew the greater risks of doing nothing. At one time he was even instrumental in saving my job during the dark days of Bell & Howell.

Bell & Howell eventually converted itself from a sleepy, obsolescent company to one based on cutting-edge, newer technologies, and became very successful. Herb can take a lot of credit for this. He was there when needed. It is worth noting further that Herb always took his director fees in Bell & Howell stock. He put his money where his beliefs were. When the company was acquired in a leveraged buy out in 1988, at a fancy price (and coincidentally as I retired), and Herb had tragically departed us, the stock left his wife Nancy well off. It was a typical Herb payoff!

As a special note, Herb and I had a lot of fun redesigning everyday objects that partially paralyzed stroke victims, as he then was, could use. He and I, in his dark days, would work out the designs, and I would get them made for him. It was a small special form of thanks for knowing him. I wanted to be there when he needed me.

I miss Herb, ever the provocateur over the right issues in all his various walks of life. I wish his spirit well, for he lives on in my life.

Raymond W. Ketchledge

1919–1987

By Amos E. Joel, Jr.

Raymond W. Ketchledge, who was best known for his inventions and leadership in telecommunications and in the military, died of cancer on October 23, 1987, in Engelwood, Florida. He was born in Harrisburg, Pennsylvania, December 8, 1919. His father was a Presbyterian minister, and in his preteen years Ray moved with his family to Johnstown, New York. Upon graduation from high school, he attended the Massachusetts Institute of Technology from which he received a B.S. and M.S. in electrical engineering in 1942.

Following graduation he entered the employ of Bell Telephone Laboratories, where he spent his entire career in engineering and executive capacities. At the time of his retirement in 1982, he was executive director of military development.

Ray initially was a member of the technical staff of Bell Telephone Laboratories. During World War II he was engaged in the development of radar and other systems for the detection of enemy aircraft and submarines. He was particularly attracted to underwater sound detection and made several important contributions in this area. These included development of the Mark 24 mine, an acoustically guided torpedo, and several infrared detectors for locating enemy targets through their heat radiation.

After the war, he was assigned to the development of transmission systems. He made substantial contributions to the equaliza tion of the broadband signals transmitted over long (4,000-mile) coaxial cable systems. He also developed the method for the remote testing of repeaters used in the first transatlantic submarine cable system.

In 1954 he became head of a department engaged in the development of memories, switching networks, and logic equipment for the initial development and application of electronic techniques and new technology in switching systems. In 1956 Ray was promoted to assistant director of electronic switching development and in 1959 to director responsible for the design and manufacturability of all device, circuit, and physical elements required in this important new field of electronic switching.

During the initial phases of this work, he was not only the organizational leader but also a great innovator in providing the basic technology needed to make these systems successful. Among his most famous contributions was the use of cathode ray tubes and photographic plates for a digital read-only-memory to store large amounts of digital information for rapid random access retrieval. Known as the "flying spot store," it not only stored large amounts of information for its day but also was controlled by a unique digital servo control. The availability of this subsystem made possible the demonstration of the first stored program control of switching systems. He was also the coinventor of the basic switching network used in this system.

The development of the first electronic switching system was a high-risk project involving the expenditure of far more than any previous telecommunications development project. Ray blended technical innovation, management, and salesmanship to enable the commercial success of this technology, which was unequaled in the telecommunications business at the time. It was an undertaking that was the envy of experts in this field throughout the world.

In 1966 Ray was promoted to executive director of electronic switching and established a new development laboratory, called Indian Hill, in Naperville, Illinois, where most of this work was organized. Initially 1,500 engineers and technicians were assigned there. Ray was the first leader of this laboratory, which hosted many visitors from around the world who came to marvel over the wonders of this new technology—electronic switching.

He was also an outstanding citizen in Naperville and of the state as a member of the board of directors of the Naperville National Bank and Trust Company and the Illinois State Chamber of Commerce, and a member of the Illinois Science Advisory Council.

In 1975 Ray returned to Bell Laboratories in New Jersey as executive director of military systems. There he continued to make important contributions to the nation's military posture. During his career he received more than sixty U.S. patents. His last patent, filed in 1981, was granted just before his retirement in 1983.

He carried his enthusiasm and technical expertise over to his hobbies. The most prominent of these was his radio-controlled airplanes, for which he received several patents. He placed so much emphasis on keeping abreast of the technology that when he retired in 1984 to Englewood, Florida, he built a special room as a laboratory where he could continue to build experimental models.

Mr. Ketchledge received several honors for his work. He was elected to the National Academy of Engineering in 1970, was corecipient of the Institute of Electrical and Electronics Engineers (IEEE) Alexander Graham Bell Medal in 1972, and was posthumously elected to the New Jersey Congress and Inventors Hall of Fame in 1989. He was also a fellow of the IEEE and a member of Sigma Xi.

He is survived by his wife, Janet, seven sons (Bruce Ketchledge, Raymond A. Ketchledge, David Ketchledge, Richard Ketchledge, Kevin Bell, William Bell, and Randy Bell), two daughters (Carol Jossem. and Robin Heffner), two brothers (Arthur and Edwin), and eleven grandchildren.

Garbis Hvannes Keulegan

1890–1989

By John F. Kennedy

Garbis H. Keulegan, physicist, hydraulic engineer, and specialist in theoretical and experimental fluid mechanics, died on July 28, 1989, at the age of ninety-nine years. In September of the preceding year he had retired after sixty-seven years of continuous employment with the federal government, first as a physicist with the National Bureau of Standards (from 1921 to 1962), and then as consultant and special assistant to the chief, Army Corps of Engineers' Waterways Experiment Station (WES) Hydraulic Laboratory (from 1962 to 1988). He served as a federal government employee longer, and to an older age, than any other person in the annals of federal service.

Keulegan was born on July 12, 1890, in Sebastia-Sivas in Turkish-occupied Armenia Minor, the first of six children born to his Armenian engineer father and his immigrant (daughter of an itinerant kiln designer and builder) German mother née Emma Marguerite Klein. Keulegan received his first degree, in engineering, from Anatolin College in Marsovan, Armenia Minor, in 1912. Later that year he came to the United States to continue his engineering education under a scholarship he had been awarded by Ohio State University, where he changed fields and received an A.B. in mathematics and physics in 1914 and an M.A. in physics in 1915. He then was employed by Westinghouse until he joined the army in 1918, where he served in France as a translator on the staff of General John J. Pershing until 1919.

His original plan to return to his native Armenia after the war and go into engineering practice in his father's business was ended by the 1915 Armenian massacre. Therefore, upon his discharge from the army he returned to Westinghouse where he remained until 1920, when he joined the staff of the Terrestrial Magnetism Department at Carnegie Institution.

Keulegan commenced his employment as a physicist with the National Bureau of Standards (NBS) in 1921. His early work there was concerned principally with solid mechanics, in particular hysteresis in structural members subjected to cyclic loading; development of various instruments and meters for use in aircraft; and, building on his M.S. thesis, temperature coefficients and elastic moduli of metals. Shortly after joining the NBS staff, he started work toward his doctorate in physics by taking night courses at Johns Hopkins University. In 1928 he received his Ph.D. after submitting a thesis entitled "On the Vibration of U Bars"; and in September of that year he married Nellie Virginia Moore.

In 1932 Keulegan was transferred to the then newly established NBS National Hydraulic Laboratory (NHL), which was envisioned to be "The Nation's Hydraulic Laboratory." It was there during the prewar years that he conducted his classic work on turbulent flow in open channels; roll-wave formation; water-wave theory; flow in curved pipes; and salinity intrusion.

From 1942 until 1946 Keulegan was seconded from NHL to the Army Corps of Engineers Beach Erosion Board (BEB), where he applied the extensive knowledge of waves, tides, and currents he had acquired at NHL to a variety of military problems. Particularly noteworthy at BEB was his work with the beach-intelligence group, whose mission was to provide the planners of military amphibious landings with information on beach slopes, sand characteristics, reef positions and sizes, tide and surf conditions, etc. This information was essential to the successful execution of amphibious-Ianding operations, and much of it had to be inferred from aerial photos and study of wave-diffraction patterns. The first study for an actual landing was of the North Africa coast for "Operation Torch." Subsequent studies were concerned with landing sites on Sicily and southern Italy, and then the Pacific islands. Other BEB activities on which Keulegan worked during the war years included the beaching and retraction characteristics of landing craft; development of towed breakwaters; and feasibility of a mid-Atlantic floating landing field for aircraft refueling.

Following his return to NHL in 1946, Keulegan resumed his work on development of model laws for density currents, and theory of water waves and tides. His work on density currents was of great interest to the Corps of Engineers because of salt-water intrusion problems that were being encountered in large reservoirs and at the mouths of several large rivers, as well as at navigation locks between fresh-space and salt-water bodies. These problems were complicated by water waves, sand, and especially, tides. This work was to occupy much of his technical attention for the next sixteen years until he retired from NHL in 1962 and joined the staff of the Army Corps of Engineers' Waterways Experiment Station (WES).

Because of his age, special authorization had to be obtained to employ Keulegan at WES. These administrative hurdles finally were overcome, and in 1963 the Keulegan family moved to Vicksburg, Mississippi, where he was employed on a nominally half-time basis as a consultant and special assistant to the chief, WES Hydraulic Laboratory. There his work continued to be concerned principally with waves, tides, and density currents and salinity intrusion. During his first few years at WES, these interests were broadened to include flow through tidal inlets and resulted in his seminal work on this important problem. He was invaluable in designing strategies for, and guiding conduct of, particularly difficult model studies. He also worked closely with the WES group involved in the then rapidly growing field of numerical hydraulics, and he assisted them in developing the physical bases and mathematical strategies for their family of software. However, pencil and paper continued to be his principal tools. He never even adopted the electronic desktop calculators; instead, he utilized progressively longer slide rules as his eyesight became weaker. However, with the passage of time his workday became shorter, and eventually he spent just the mornings in his office. Three bouts of surgery, including cataract removal in 1980 and its repair (following a fall outside his office at WES) in 1984, failed to stop his relentless research productivity. During the latter years of his career, his daily routine consisted of going to his office at 7:00 a.m. There he would work on the problems of interest to him, taking special delight in helping others find new ways to approach technical problems that were troubling them. At about 11:00 a.m. he would leave his office for lunch at home or a restaurant.

Among the most noteworthy of his numerous outstanding publications were his series of twelve progress reports on density-current model laws and related problems prepared at NBS under contract to WES between 1946 and 1960. The bibliography of his publications contains nearly one hundred entries, including Chapter 11, "Wave Motion," in Rouse's *Engineering Hydraulics*; Chapters 11, "The Mechanism of an Arrested Saline Wedge," and 17, "Model laws for Coastal and Estuarine Models," of Ippen's *Estuary and Coastline Hydrodynamics*; and the proceedings he edited (with NBS colleague K. H. Beij) of the 1951 *NBS Semicentennial Symposium on Gravity Waves*.

In the course of his long and very distinguished career, Keulegan was accorded a full complement of professional recognition. These included the Commerce Department's Gold Medal (1960), the National Medal of Science (1968), the Army Research and Development Award and honorary membership in the American Society of Civil Engineers (1969), U.S. Army's Meritorious Civilian Service Award (1973), the Commander's Service Award for Civilian Service and election to the National Academy of Engineering (1979), and selection for inclusion in the WES Gallery of Distinguished Civilian Employees (1986). He had numerous hobbies. He loved to read American history, especially that of the early West. He also liked western movies, particularly those starring Gene Autry or the Lone Ranger, and the family dinner hour was arranged so he could watch televised programs featuring these heroes. He was an avid gardener and prized his roses and tomatoes. His lifelong morning delight was to arise early (usually around 4:00 a.m.) and drink coffee and smoke cigarettes while "doing his thinking." Later, after the birds arose, thinking was joined by watching them come to the bird houses and bird baths he built and tended.

In 1981 when asked to what he attributed his longevity and ability to work for so many years, Keulegan explained, "I never had big ideas. I did not want to be a section chief, I did not want to be rich—I'm just interested in my work. I love people; I love working in the hydraulics laboratory; I enjoy my work immensely—it helps keep me alert."

Keulegan had a professional career that spanned nearly eight decades. This is nearly double the time apportioned most professional people for their productive careers. He was a citizen of two countries. He was educated in science and engineering and did extensive research in both solid and fluid mechanics. He was a longtime employee of two agencies, NBS and WES. In short, he was granted the equivalent of roughly two lifetimes, and he used them, and enjoyed them, wonderfully well.

James R. Killian, Jr.

1904–1988

By Paul E. Gray

With the Assistance of Walter L. Milne

When I entered the Massachusetts Institute of Technology (MIT) as a freshman in 1951, James Killian was just two years into his term as president. A decade later it became my privilege to know him well, and to respect and admire him, during much of the four decades he served MIT as president, chairman, honorary chairman, and senior adviser.

One of the great presidents of MIT, Dr. Killian was also a key figure in developing U.S. education and scientific policy during the middle years of the twentieth century. For nearly sixty years, until his death on January 29, 1988, his life was intimately bound up with the physical and intellectual development of MIT. In addition, for more than half those years he was a notably influential participant in national affairs concerned with engineering and science. His extraordinary impact was felt across a broad range of issues directly related to the central interests of the National Academy of Engineering (NAE).

Born in Blacksburg, South Carolina, on July 24, 1904, Killian received his B.S. in business and engineering administration from MIT in 1926 and then served in various capacities with MIT's *Technology Review* until 1939, when Karl Compton, then president of MIT, asked Killian to become his executive assistant. When Compton later became fully engaged in the national management of wartime research, operating responsibility for MIT was in Killian's hands. That task was made especially challenging by MIT's assumption of large responsibility, beginning in 1940, for wartime projects that included the development of radar at the Radiation Laboratory, a technical undertaking second in size only to the Manhattan Project.

Following the war, Dr. Killian was elected president of MIT, serving from July 1, 1949, until January 1, 1959, when he became chairman of the MIT Corporation. In 1971 he became MIT's honorary chairman, a post he held until 1983. It was while he was MIT chairman that he was elected in 1967 to the National Academy of Engineering in a group of ninety-three new members that nearly doubled the size of the fledgling organization, then only two years old. His field was listed as "administration of education and public policy in engineering," and his first NAE service was on the Committee on Public Engineering Policy, which he returned to as a member from 1971 to 1973.

The end of World War II brought to the nation's universities the complexities of reorganization and of providing an education for returning veterans. More important at MIT, it brought a consciousness that MIT had made a quantum jump in its reach and in its capabilities, and the consequent need to prepare for a changing role for MIT absorbed Dr. Killian in the planning for this new era. However, while Killian was setting about to expand MIT's role as, in his words, "a university polarized around science," the world scene—including the reality of the cold war—was unstable. And the United States, which soon found itself engaged in a new technological race, again turned to MIT, among others, for help.

Under Killian's leadership, MIT established the Lincoln Laboratory that would develop an electronic continental defense system, a semiautomatic interconnected system so vast and sophisticated that it could not have been imagined even a few years earlier. During the same period, the MIT Instrumentation Laboratory was developing inertial guidance systems for intercontinental ballistic missiles—and the space vehicles and nuclear-powered submarines that were yet to come. There were other projects, too, of course, but these two large developments were especially notable among those for which Killian had a major initiating role and ultimate oversight.

During those early postwar years, Killian was also being drawn into national councils. He served on President Truman's Communications Policy Board, 1950–1951; on the President's Advisory Committee on Management, 1950–1952; as chairman of the Army Scientific Advisory Panel, 1951–1956; and as a member of the Science Advisory Committee of Truman's Office of Defense Mobilization in 1951. Later, in the mid-1950s he served President Eisenhower in evaluating national technological capabilities as chairman of the Technical Capabilities Panel of the President's Science Advisory Committee (PSAC) and in assessing national intelligence capabilities as chairman of the President's Board of Consultants on Foreign Intelligence. In the latter role, he served as chairman for two years, remained on the Board for a third, and was called back to such a Board by President Kennedy in 1961, when he again served for two years as its chairman.

During that time, it became apparent then, as again today, that there was a growing shortage of scientific and engineering manpower in the United States; this shortage was viewed with special concern in the context of the 1950s because of the reports that the Soviet Union was educating increasing numbers of technical professionals. Dr. Killian was one of the first to warn of the situation and to lead the public discussion of what could and should be done about it. Again, then, as now, reasons for the shortage could be traced in part to the secondary schools.

Acting on his concern, Killian served from 1954 to 1956 as a member of the Committee for the White House Conference on Education, which stimulated positive changes and responses in the form of curriculum developments in the schools and in growing and effective federal fellowship programs. At MIT, Killian gave support to the Physical Sciences Study Committee (PSSC), which was formed in 1956 to develop a markedly different physics course for secondary schools. When PSSC was organized on a broader and more permanent basis as Educational Services, Inc., he became the Chairman of the Board.

Later, motivated by the same sense of service and concern, he became a leader in advancing the cause of educational television when he accepted the chairmanship of the Carnegie Commis sion on Educational Television. In this project, Dr. Killian saw an opportunity to broaden the horizons of this new technology and acted upon it. Considered "the father of public broadcasting," he was a leader in support of the congressional act that established the Corporation for Public Broadcasting (PBS). He later served as chairman of PBS and received two George Foster Peabody Awards for his "outstanding contributions to public broadcasting" in the United States.

During the early 1950s, Dr. Killian's participation in studies concerned with the U.S.S.R.'s growing military power earned him great respect for his knowledge and leadership not only from the scientific and academic communities but also from industry and government. This became especially important at the time of national trauma in October 1957 when the Soviets launched the first Sputnik. The American public was sharply aroused, and the effectiveness of government, science, and education was brought into question.

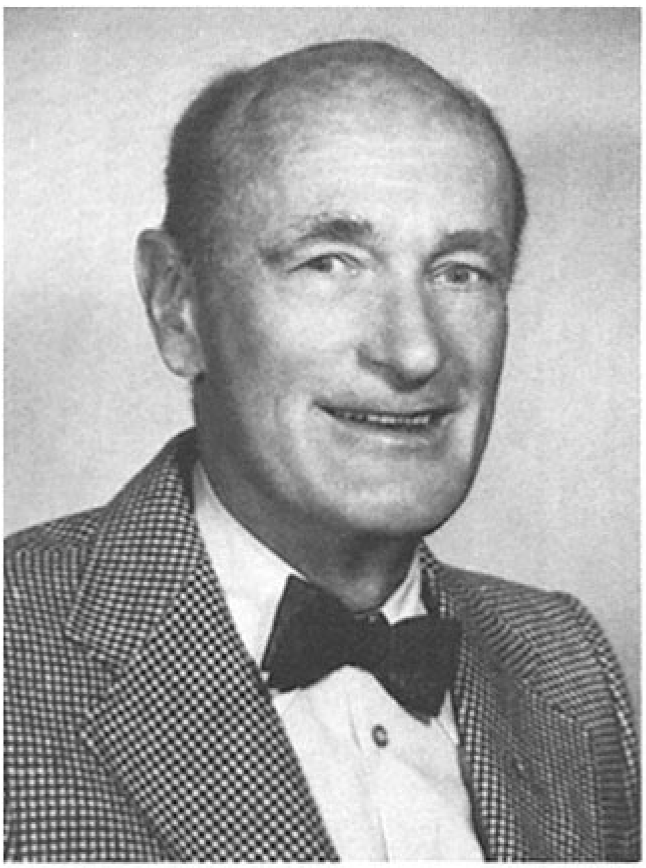
President Eisenhower then turned to Dr. Killian for help. Giving a nationwide address on the situation, the President announced the appointment of Killian as his special assistant for science and technology. With direct access to the President, and a congenial relationship, Killian put into place a strong mechanism for providing U.S. presidents with the best scientific advice the nation had to offer. As the columnist Arthur Krock wrote in Killian's obituary in the *New York Times*, he "repaired a dangerous national deficiency by bringing science and technology into the inner circles of the government."

Of the many other contributions Killian made as presidential science adviser from 1957 to 1959, one of the most significant was the establishment on his recommendation in 1958 of the National Aeronautics and Space Administration (NASA) around the nucleus of the existing National Advisory Committee for Aeronautics. NASA was given the responsibility for peaceful exploration of space.

Perhaps of even more lasting importance, Killian also brought into being official concern for arms control and disarmament. It began when a panel of the President's Science Advisory Committee that he established, and whose work he represented in the top councils of government, reported that a nuclear test ban, soundly grounded on scientific principles and knowledge, was possible. That report started the concerned governments down the long road to an atmospheric test ban agreement and had a seminal effect in altering the climate within the government and the nation for consideration of arms control issues.

After Killian returned to MIT as chairman in 1959 and throughout his subsequent intensive involvement in institution building, Dr. Killian continued to play an important national role. He was on the panel of the Rockefeller Brothers Fund that published from 1958 to 1961 a series of six special studies under the general title "Prospect for America," and he served in 1960–1961 on President Eisenhower's Commission on National Goals, which issued an additional comprehensive report "Goals for Americans." Later, from 1962 to 1965 he was chairman of a committee formed by the National Research Council to study the utilization of scientific and engineering manpower.

For these and many other accomplishments and services, Killian received numerous awards and honors including, of special interest for this record, the President's Certificate of Merit (1948), the Public Welfare Medal of the National Academy of Sciences (1957), and the Marconi International Fellowship from the NAE (1975). In addition, he was awarded thirty-nine honorary degrees, including a doctor of laws from Harvard University in 1950 and a doctor of engineering from the University of Illinois in 1960. But he placed little store on such trappings, reminding colleagues of a line from George Meredith's novel *Vittoria* expressing a philosophy he shared: "Life is but a little holding lent to do a mighty labor." This memorial note sets down but a small part of the "mighty labor" James Killian performed on behalf of education, science, engineering, and the country.



Photograph by Geoff Cook Studio, San Mateo, California.

August Uno Lamm

1904–1989

By William R. Gould

August Uno Lamm, a distinguished engineer of international reputation and renown, a prolific inventor, and the man who is most properly called the father of modern direct-current electrical transmission, died on June 1, 1989, at the age of eighty-five.

Uno, as he was known to his many friends and associates, was born in Göteborg, Sweden, on May 22, 1904. All references to his childhood indicate that it was a happy one. He grew up as the second of three children in a home where the mother and father were both dedicated to the cultural arts of music, poetry, literature, and painting. His father, an engineer by profession, wrote poetry, played the violin, served on the local theater board, and designed clean-lined furniture as several of his many nonprofessional interests. He required all of his children to pursue the arts and study music. Under his guidance Uno learned to play the violin and developed a lifelong interest in music, the theater, opera, and the finer arts. It was also from his father that an early interest in engineering developed. This led to his pursuit of a technical education and his subsequent successful career as a distinguished engineer of world renown.

His early education was obtained at the Royal Institute of Technology in Stockholm, from which he received an M.S. in electrical engineering in 1927. Subsequently, while employed full time at the large Swedish industrial conglomerate ASEA, and involved in demanding technical program development, he pursued a Ph.D. in his spare time. This was awarded to him at the age of thirty-nine by The Royal Institute in 1943. The subject of his thesis was "The Transductor, D.C. Pre-Saturated Reactor."

His employment began shortly after the completion of his master's degree and a short compulsory period of service in the Swedish military. As was customary for newly graduated engineers, he entered an apprentice program in 1928 with ASEA. His first assignments were in mechanical assembly in what today we would call the blue collar sector of the work force. Here he learned "hands on" the business of producing a product that had been conceived, designed, and planned by engineers.

This assignment was of short duration. After less than a year of service he was withdrawn from the apprentice program and asked to take charge of the development of a new product: the low-voltage mercury-arc rectifier. By 1929 he was named the manager of ASEA's newly formed rectifier department at the Ludvika manufacturing complex. Also in 1929 ASEA applied for a patent on Lamm's design for a mercury-arc "valve" (rectifier) that would operate at high voltages. This was to be the first of some 150 patents covering the work of his fertile mind.

With this impressive start, Lamm's career was firmly launched into what would be his lifetime's work. Over the years, he and his team of engineers at ASEA would evolve the technology that would make high-voltage direct-current transmission a reality: a technology that would permit needed transmission links to be constructed over many hundreds of miles in point-to-point distance, over all kinds of terrain, under the sea, and underground in populous areas. It would make possible the application of back-to-back alternating-current-direct-current-alternating-current (AC-DC-AC) links to overcome adverse effects of phase angle variations and circulating vars on large integrated alternating-current systems. It would provide the inspiration and incentive for others to develop the solid-state technology that would be a successor to the mercury plasma valves that were the result of this early work.

Many people in industry recognized the need for this technology before it was available. Some despaired that it would become a reality. But as in all things there had to be a beginning. For some twenty years the management of ASEA funded the research and development work of Uno Lamm and his associates without near-term prospect of a product that would return a profit. That Uno was able to persuade the company to do this is a singular achievement in management.

Over those twenty years, the Swedish State Power Board maintained their interest and offered encouragement through the use of their system for experimentation. Finally in 1950 the power board ordered the first commercial DC transmission system in the world. It was to be built between the mainland of Sweden and the Island of Gotland. The venture was a success, and like all successes it was replicated and improved upon not only by ASEA but also by other manufacturers and power systems in the world. In less than twenty years there were DC systems in operation in Europe, Asia, North America, and elsewhere in the world.

A landmark achievement in direct-current transmission, and one that brought the technology to full maturity, was the building of the so-called Pacific Intertie. This was a transmission system built by a consortium of large electric power systems, public and private, on the Pacific Coast of the United States. It was also to be the high point in the use of mercury-arc technology—future systems would look to the emerging technology of solid-state, semiconductor, or transistor-type valves. In the engineering and construction of the Pacific Intertie, it was planned to build two parallel AC lines and one DC line. They would interconnect the hydro-based systems of the Pacific Northwest with the large market area served by the predominantly thermal-based systems of Southern California and the Southwest. It would be the first time that high-capacity AC and DC systems would be operated in parallel.

The problems in this venture were many and diverse. Advances in the state of the art in both AC and DC practice were to be made. Moreover, there were significant political problems, because the project involved entities of different regions of the western states and of different ownership format. In all of this Uno Lamm filled the role of technical consultant, political adviser, and peacemaker. While many individuals, corporate entities, and political subdivisions of government made notable and enabling contributions to the success of the undertaking, that of Uno Lamm was salient in its importance. From this endeavor DC transmission emerged as a truly mature and established technology with Uno Lamm as the acknowledged founder, pioneer, and practitioner. Electrical engineering as a science and a profession would from that point forward be in his debt.

It would be misleading to represent the technical contributions and interests of Uno Lamm as limited to rectifier or direct-current technologies. His interests were many and his other contributions were significant. For example, in 1955 he organized the nuclear engineering effort for ASEA at Vasteras, Sweden, the location of the company's headquarters. He was subsequently their representative on the board of directors of the Swedish state-financed Atomic Energy Company. He saw the first nuclear reactors go into commercial operation and perform in a safe and successful manner. The situation at the end of the decade of the 1980s wherein more than 50 percent of Sweden's electric power needs were furnished by nuclear facilities is due in no small part to his participation in this venture. The fact that Sweden, beset with political and environmental controversy, subsequently made a political decision to phase out nuclear power production does not detract from the integrity of these plants or the achievements of Uno Lamm and his associates in these ventures.

It is not uncommon for technical and scientific innovators to add words to our lexicon. Such was the case with Uno Lamm. Perhaps he little knew when he wrote that early thesis and coined the word *transductor* that it would lead him to apply the word *transistor* casually to a similar device while making a speech on this technology. When William Shockley received the Nobel Prize for the invention of the transistor and applied this name to it, he was reported to have said that he had heard "some Swede" use the word in a technical presentation and thought it aptly applied to his new discovery. Today it is a household word in several languages. When Uno in 1970 introduced the semiconductor into Sweden to replace mercury-arc technology, he ap plied the name "Thyristor" to it. This word is also in general use today.

Uno Lamm was also a prolific writer over his long and eventful life. Some eighty technical papers bear his name and enrich the technical literature of our profession. In addition he has contributed something on the order of one hundred articles, mostly in Swedish newspapers and magazines, on such diverse subjects as societal commentary, education, technology, political commentary, and economics.

The institutes, academies, and professional societies have also recognized him. He was elected to membership in the Royal Academy of Engineering Sciences, Royal Academy of Sciences, and the Royal Society of Sciences, all in Sweden. In the United States he was elected a foreign associate of the National Academy of Engineering in 1976. The Institute of Electrical and Electronics Engineers (IEEE) elected him a fellow and named him director-at-large for the years 1967 to 1988.

In 1973 his portrait was hung in Gripsholm Castle on the outskirts of Stockholm. In this he joined the King and Queen of Sweden and many of his distinguished countrymen who are thus honored for the credit and recognition they have brought to their country.

Awards, medals, and similar recognitions were numerous. They included the Gold Medal of the Swedish Royal Academy of Engineering, Knighthood of Sweden's Royal Order of Vasa, France's Ordre du Merite pour la Recherche et l'Invention, and the IEEE Lamme Medal. Lastly, the IEEE Power Engineering Society in 1981 established the Uno Lamm High Voltage Direct Current Award.

Now, just a word about the man of the notable career and the person behind the legends. Uno Lamm was known by legions of associates, peers, colleagues, and friends as a kind, gentle, person with a warm heart, a ready hand, and a friendly smile. He is remembered as being pleasant company in all social or business situations. He charmed all, especially the ladies, with his gallant manner. He was a loving father and a doting grandfather. The fondness for music, literature, the theater, and the arts with which he was endowed in childhood persisted throughout his life and flowered in his later and less-active years. It was a sincere pleasure to have known him and a high privilege to have called him a friend.

In closing this inadequate tribute, we value a great man—one of the giants in our profession of engineering; a man with a fertile and prolific mind for innovation and invention; one who left the field better than he found it; a man without guile or offense, but capable of intolerance of mediocrity in societal, engineering, and political institutions. And above all he was a warm and true friend. We salute August Uno Lamm.

Helmut E. Landsberg

1906–1985

Written by Ferdinand Baer

Submitted by the NAE Home Secretary

Helmut E. Landsberg, perhaps the most renowned climatologist of the twentieth century, died on December 6, 1985, in Geneva, Switzerland, while attending, as a delegate, the ninth session of the World Meteorological Organization (WMO) Commission for Climatology. He was at that time a professor emeritus of meteorology at the University of Maryland, College Park.

It normally takes many individuals working jointly to make significant scientific disciplinary advances. Of those contributors, some develop special interests and pursue and expand those specialties for following generations to continue. Some administer scientific programs and activities. Some educate the next generation of scientists. Some move public opinion to attract resources and fresh manpower to their discipline. Some integrate current and past ideas to open avenues for new concepts and studies. Occasionally an individual may span several of these activities in a career. Only exceptionally rarely does one individual make significant contributions to all these activities in one lifetime. Helmut E. Landsberg was one of these rare people. Landsberg advanced our knowledge of climatology through his own research, that of his students, and that of his many coworkers. He was in the forefront of teaching at universities, guiding international organizations, and directing national agencies. He developed regional and national applied climatological networks. He integrated atmospheric science into human affairs through political input and public documents. He stimulated professional organizations to interact and clarify scientific thought, and he interwove government, university, and private practitioners into a creative medium for scientific progress.

Landsberg was born in Frankfurt am Main, Germany, on February 9, 1906. He spent his student years from 1925 to 1930 at the University of Frankfurt, taking a basic curriculum of physics, mathematics, and geophysics. He took courses in meteorology at the Geophysics Institute and completed his thesis dissertation in seismology in 1930. At this juncture Landsberg realized his intense interest in the atmosphere, and more from an observational viewpoint; he was fond of saying that meteorology was an observational science. He first took on a project to set up a climatological network in a local wine-producing district. He then turned to practical forecasting by joining the Taunus Observatory where he stayed, ultimately becoming its chief, until 1934. The observatory provided extensive experience and broadened Landsberg's perspective. Indeed, it was at Taunus that his love for libraries blossomed. Because the observatory was more often than not surrounded by fog, Landsberg used the time to devour all the meteorological literature he could find.

Landsberg was recruited to teach geophysics at Penn State in 1934. As the first meteorologist at that institution, he set up an observatory with the help of some students and began a teaching program that evolved into the present meteorology department. In 1941 he joined the faculty at the University of Chicago, where he developed a field course for cadets who were in attendance during that period.

Shortly before the end of the Second World War, Landsberg shifted gears, moved out of academia and into the world of science administration in the federal government. He first was a consultant to the U.S. Air Force and then became executive director of the Commission on Geophysics and Geography of the Research and Development Board, a position he held from 1948 to 1951. From 1951 to 1954 he was director of the Geophysics Directorate of the Air Force Cambridge Research Center. There he had occasion not only to develop in-house research with young protégés but also to fund high-quality university research. He then returned to Washington to direct the Office of Climatology of the United States Weather Bureau (USWB), at which position he remained until reorganization of the Weather Bureau into the Environmental Science Services Administration (ESSA) in 1965. At that time he became head of the Environmental Data Services of ESSA.

In 1967 Landsberg returned to the academic world where he would spend the rest of his life. He joined the University of Maryland as a research professor and concurrently held several administrative posts. He was acting director of the Institute for Fluid Dynamics and Applied Mathematics and subsequently became director of the meteorology program that evolved from that Institute. In 1976 he retired from the university and began his final career as a professor emeritus with no loss of intensity. Without administrative responsibilities, he devoted more time to students, to traveling, and to producing creative-research results at a rate that would put most scientists in their prime to shame.

Landsberg offered his abilities liberally and enthusiastically to any and all who requested them, as noted by his outside commitments. He was elected to membership in the National Academy of Engineering in 1966, and was an honorary life member of the New York Academy of Sciences. He was a fellow of the Royal Meteorological Society, the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the American Geophysical Union (AGU), the Meteoritical Society, the American Meteorological Society (AMS), and the Washington Academy of Sciences. In addition, he was a member of the German Meteorological Society, the American Institute for Medical Climatology, the International Society of Biometeorology, the Mount Washington Observatory, the Sneckenberg Society of Natural History, the Society of Sigma Xi, the Society of Sigma Pi Sigma, the Society of Sigma Gamma Epsilon, and he was an honorary member of Phi Beta Kappa.

He served as president of the WMO Commission for Special Applications of Meteorology and Climatology from 1969 to 1978; he was a member of a WMO Advisory Working Group from 1978 to 1981; and he was a member of its Commission for

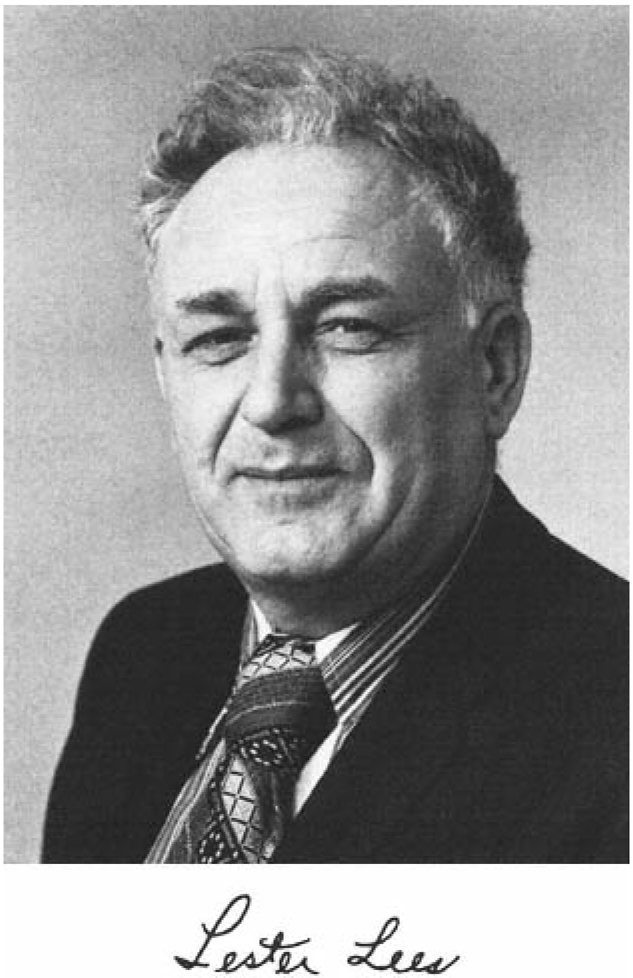
Climatology from 1981 until his death. He served the National Academy of Engineering as a member of its Awards Committee in 1974 and 1975. At the National Research Council (NRC) he served on the Geophysics Research Board as chairman of the Geophysical Predictions Panel in 1977 and 1978 and as a member of its Panel on Energy and Climate from 1975 to 1978. For the NRC Division of Physical Sciences he was a member of its Climatic Impact Committee from 1972 to 1975. He served the government as a member of the National Advisory Committee on Oceans and Atmospheres from 1975 to 1977. He served the universities as trustee to University Corporation for Atmospheric Research (UCAR) from 1968 to 1972 and assisted the private sector as a certified consulting meteorologist of the AMS. He served the AMS as councillor from 1952 to 1960, as vice-president in 1963–1964, and as chairman of the Awards Committee in 1974–1975. In support of the American Association for the Advancement of Science he was vice-president of Section E in 1972. The AGU will remember Landsberg particularly well. He served as vice-president, Section on Meteorology (1953–1956), as president of that section (1956–1959), as vice-president of the Union (1966–1968), and finally as its president (1968–1970).

Landsberg loved books and often browsed in out-of-the-way bookshops, thereby acquiring a unique and unequalled collection of rare historical books on meteorology, which he subsequently donated with great generosity to libraries. He was an associate editor of the *Journal of Meteorology* (1950–1961), the editor of *Advances in Geophysics* (1952–1977), the editor-in-chief of the *World Survey of Climatology* (1964–1985), and the chairman of the Publications Committee of the International Society of Biometeorology (1960–1985).

For his extensive professional contributions, he was rewarded by numerous acknowledgments. He received the Exceptional Meritorious Service Award from the Department of Commerce in 1960. The AMS bestowed on Landsberg their Award for Outstanding Achievement in Bioclimatology in 1964, the Charles Franklin Brooks Award for Outstanding Services to the Society in 1972, and the Cleveland Abbe Award for Distinguished Service to Atmospheric Sciences by an Individual in 1983. The

Duetsche Meteorologische Gesellschaft E.V., the German Meteorological Society, awarded him the Alfred Wegener-Medaille in 1980. He was the recipient of the William Bowie Medal in 1978 from the AGU. In 1979 he received the International Meteorological Organization Prize from the WMO. The W. F. Peterson Foundation Gold Medal was awarded to him in 1983, and in 1985 he was honored with the Solco W. Tromp Memorial Award by the Enviroscience Foundation. Ultimately he was bestowed the National Medal of Science by President Reagan in 1985.

Landsberg's scientific productivity was astounding and his breadth of interest and involvement remarkable. He left us with almost four hundred written published documents, including several books, and his written contributions to collective documents from his many committee assignments would substantially augment that total. His research explorations command numerous topics, including seismology, geography, geology, climatology, weather forecasting, bioclimatology, urban climate, climate history, and climate services among many others. Yet, given the enormity of his formal output, to most of his colleagues and acquaintances Landsberg is remembered best as a man whose door and mind were always open to discussion and the exchange of ideas, and who was overwhelmingly supportive and encouraging. He had the perception and serenity that unfailingly led to meaningful solutions for the most complex of problems.


Lester Lees

Lester Lees

1920–1986

By Frank E. Marble

Lester Lees, authority on the subjects of supersonic and hypersonic aerodynamics, a highly respected teacher, and one who played a pivotal technological role in the creation of the United States ballistic missile defense system, died November 10, 1986, from complications attending Parkinson's disease. His death came only two days after the celebration of his sixty-sixth birthday. Lester Lees was a member of the faculty at the California Institute of Technology from 1953 until the time of his death.

Lester thoroughly enjoyed his life; he enjoyed his family; he enjoyed his work, his students, good food and wine, and a good argument! He pursued everything with zest, enthusiasm, and humor. He had an unusual ability to identify the key elements of new technological issues and possessed an immense reservoir of energy with which to pursue them. This uncompromising drive led him to grow from his aeronautical background to make vital contributions to the fields of transportation, energy production and management, and environmental protection.

Born in New York City on November 8, 1920, Lester Lees entered the prestigious Stuyvesant High School in September 1933 and was admitted as a freshman to the Massachusetts Institute of Technology (MIT) three years later, at the age of fifteen. He emerged in 1941 with a B.S. and an M.S. in aeronautical engineering, having pursued additional advanced work in mathematics and physics. An appointment as research assistant during his last year at MIT gave him his initial experience with research and culminated in his master's thesis, "The Influence of Static Pressure Gradients upon the Turbulent Boundary Layer." That he should pursue such a difficult and highly competitive area of research at this stage of his scientific development proved an accurate indicator for the course of his career!

With the United States entry into the war imminent in 1941, Lester Lees joined the U.S. Air Force's Air Materiel Command at Wright Field, Dayton, Ohio, as an aeronautical engineer. While at MIT, Lester met Constance L. Morton, a student at Simmons College, School of Library Science. They were married in Dayton on August 30, 1941. Connie, a strong, intelligent, and gracious person, became and remained a principal factor in Lester's career.

It was at Wright Field that Lester met Theodore von Kármán, whose personal magnetism drew Lester to the California Institute of Technology in the fall of 1942. There he served as an instructor in mathematics and a research fellow in aeronautics; collaborated with von Kármán on the design of a supersonic wind tunnel; and continued, closely with the distinguished theoretician H. S. Tsien, research in supersonic gasdynamics.

As the war gradually enveloped most scientific personnel, Lester was taken into the Army Air Corps Enlisted Reserve and joined the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics. Langley was an active and stimulating research center where many of Lester's young colleagues were also destined to join the leaders of the postwar aeronautical research establishment.

During this period, the original theory of laminar instability was transformed from highly suspect to firm reality by the classic experiments of G. B. Schubauer. Almost simultaneously, Lester Lees, together with Professor C. C. Lin, extended this theory to the new regime of supersonic flows, beginning a field of investigation that to the present time has remained active for supersonic and hypersonic flows.

As the war ended, Lester accepted an assistant professorship in aeronautical engineering at Princeton and for the next five years directed its supersonic and hypersonic research. It is important to note that events of this period interrupted Lester's orderly progress through the doctorate and, given his stature in aeronautical research, he found no compelling reason to divert himself toward that end. The few indignities he suffered as a consequence received appropriate responses.

The Princeton colleague who exerted the deepest and most lasting influence was Luigi Crocco, a splendid, creative scientist and a gentleman of great personal warmth. Together they developed a vitally important theory of dissipative gas flows, the spirit of which would play an essential role in Lester's future. Toward the end of the Princeton period, David Grayson Leeswas born. David grew to share the intellectual attributes of his mother and father and maintained a warm and understanding relationship with Lester throughout his life.

In 1953 the hypersonic wind tunnel in Caltech's Guggenheim Laboratory was nearing completion, and that summer Lester was persuaded by Clark Millikan to return to Caltech as a member of the faculty and to assume responsibility for directing hypersonic research. The next seventeen years saw Lester develop, through his energy and personal commitment, a sequence of outstanding research accomplishments and a following of intensely devoted students. These students were an integral part of Lester's and Connie's life; essentially they were his extended family. They were always welcome at the Lees home, where they would be well fed by Connie; their parties were legendary!

At Caltech Lester continued his important work on hypersonic viscous flows initiated at Princeton in collaboration with his student Ronald Probstein, particularly the leading-edge shock-boundary layer interaction problem. He also expanded his activities into the field of rarified gas dynamics related to very high-altitude flight. At this time the hypersonic technology community began to realize the advantages of a blunt-nosed body in reducing heat transfer during atmospheric reentry. Lester's work on chemically reacting turbulent boundary layers placed him in a unique position to deal with the nose ablation issue. As consultant to the Space Technology Laboratories (later Thompson-Ramo-Woolridge (TRW)), he guided the military research and development of the successful reentry body design. This activity had, of course, a strong influence on the direction of his academic research program with regard to both hypersonic flow about blunt slender bodies and the stability of laminar boundary layers in very high-speed flow. It was during this period of his career that one of his students, Dr. Toshi Kubota, became his close faculty associate and lifelong collaborator, sharing with Lester the duties of teaching and supervising students in hypersonic research.

In the early 1960s the technology issues centered on ballistic missile defense and, in particular, on the question of discrimination between heavy bodies and decoys as they entered the earth's atmosphere. Through an exhaustive effort, carried out in collaboration with Dr. Leslie Hromas of TRW, Lees showed that the characteristics of the trail left behind as the objects reentered the atmosphere differed significantly between heavy bodies and decoys. It transpired that the bodies' viscous boundary layer had a significant effect upon the wake structure, and the joint work with Luigi Crocco, mentioned earlier, became relevant. Again, the fundamental aspects of this problem became the motivation for his academic program.

Lester Lees always took an active interest in government and politics, and in the late 1960s it seemed natural that he should become involved with environmental issues. When President Harold Brown formed Caltech's Environmental Quality Laboratory in 1971, he persuaded Lester to become its first director. Under his stimulating guidance, this became a flourishing and prolific organization, and because Lester was not one to minimize the unpopular facts concerning sources of pollution, it also produced its share of controversy. Time, however, has proven Lester correct, and as a consequence, his influence on environmental legislation has been very significant. This time also marked the creation of Caltech's Department of Environmental Engineering, and Lester became professor of environmental engineering and aeronautics. He remained in the position of director of the laboratory until 1974 when, feeling the laboratory to be firmly established, he stepped down from that position. Although he remained intensely active in environmental, ener gy, and transportation problems, he gradually returned to aeronautical and aerospace research and moved his office back to the Graduate Aeronautical Laboratories. He resumed teaching and research supervision in aeronautics, but his declining health gradually undermined the energy that characterized his technological activity.

Lester Lees was a fellow of the American Institute of Aeronautics and Astronautics and was elected to the American Academy of Arts and Sciences in 1964 and the National Academy of Engineering in 1971. He was a member of the National Aeronautics and Space Administration (NASA) Lunar and Planetary Missions Advisory Board. He served for several years on the President's Scientific Advisory Board as a member of the Space Vehicle Panel, the Space Technology Panel, and the combined Space Science and Space Technology panels.

Lester Lees was devoted to the practice and teaching of sound cutting-edge technology rooted in scientific fundamentals. In this he must be considered one of the most successful of his generation.

Benjamin G. Levich

1917–1987

By Andreas Acrivos

Benjamin G. Levich, an internationally known physicist and electrochemist and the founder of the discipline known as physicochemical hydrodynamics, died suddenly of a heart attack on January 19, 1987, in Englewood, New Jersey. During the previous eight years, he was the Albert Einstein Professor of Science at the City College of the City University of New York as well as a distinguished professor of chemical engineering and of physics at the City College. He also held a dual appointment as a professor of physics at the University of Tel Aviv.

Ben Levich was born in Kharkov, U.S.S.R., on March 30, 1917, and received his first degree from the university in that city at the age of twenty. He then enrolled at the State Pedagogical Institute in Moscow, where he earned his D.Sc. in physics under the supervision of Academician Lev D. Landau, one of the world's outstanding theoretical physicists. His thesis dealt with a theory of the processes that occur in electrolytic cells and led him to single out the phenomenon of concentration polarization as being of singular importance and to develop, as a research tool, the rotating-disk electrode, which brought him international recognition. He then joined Academician A. N. Frumkin at the Institute for Colloid Chemistry and Electrochemistry (later renamed the Institute for Electrochemistry) of the U.S.S.R. Academy of Sciences where he continued his research until he left Russia at the end of 1978. He was head of the theoretical department in that Institute from 1958 until 1972 and was also a full professor and department head, first of theoretical physics at the Moscow Institute of Physics and Engineering (1954–1964) and then of chemical mechanics at the University of Moscow (1964–1972).

Ben Levich was a researcher of extraordinary originality and productivity who, during his lifetime, authored more than three hundred scientific papers ranging from electrochemistry to turbulence, flows with chemical reactions, and flows dominated by variations in surface tension. He was, for example, the first to show conclusively that the seemingly paradoxical observation that the rise velocity of small air bubbles in viscous liquids equals that of solid spheres having the same density is due to the accumulation of trace amounts of surface-active agents on the gas-liquid interface. This fact has important implications in a large variety of mass transfer operations. He also showed, against all prior expectations, that certain viscosity-dominated flow phenomena, such as the attenuation of capillary waves or the steady rise velocity of moderate-sized bubbles in low viscosity liquids, can be computed simply through knowledge of the corresponding motion of fluids having zero viscosity. Other papers dealt with theories of gas-phase collision reactions, the photoemission of electrons from electrodes into solutions, and the quantum mechanics of electron transfer between ions in solution and between an ion and an electrode.

In addition, Ben Levich authored a four-volume treatise on *Theoretical Physics*, which rivals in scope the famous series by Landau and Lifshitz. Undoubtedly though, of all his publications, the one that had the biggest and most lasting impact is his book *Physicochemical Hydrodynamics* , which was first published in Russian in 1952 and then translated into English in 1962. A new field of research was thereby born at the interface between physics and chemistry, which deals with the effects of fluid motion on chemical and physicochemical transformations and conversely with the influence of the latter on the motion of fluids. This book was widely acclaimed as a masterful synthesis of different branches of science that had, until then, developed separately. Indeed, Levich showed how to create a scientific unity out of seemingly highly diverse phenomena by lucidly expounding the relatively few underlying patterns and basic laws of science. This was achieved by using mathematical analysis to explain experimental observations and by citing the results of measurements with sufficient frequency to illustrate principles without, however, overburdening the reader with detail. Even though out of print, this book still brims with a wealth of useful information and, as befits a classic, it is very much a pleasure to read.

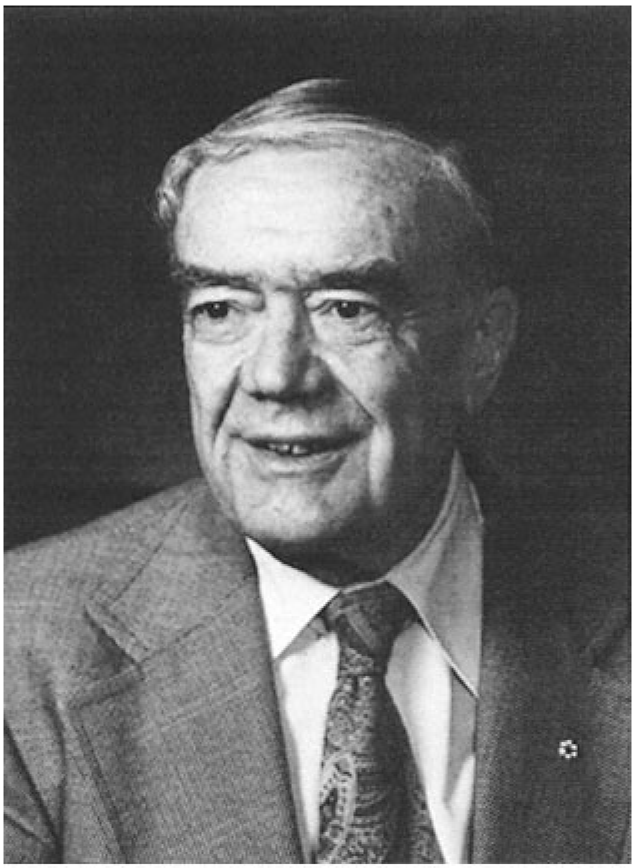
Ben Levich was elected a corresponding member of the U.S.S.R. Academy of Sciences in 1958, and his meteoric rise within the academic establishment of the Soviet Union as well as his research productivity would have continued unabated had he not in 1972, after long consultations with his wife, his two sons, and his conscience, applied to emigrate to Israel. All at once, his chair at the university was abolished and his status at the Electrochemistry Institute was reduced to that of a scientific worker without supervisory responsibilities. In addition, his former colleagues and collaborators, almost without exception, found reasons to distance themselves from him; Soviet journal editors declined to publish his articles; and his frequently cited name was laboriously excised from all the copies of Western publications distributed in the U.S.S.R. In fact, during this period and prior to his emigration, Levich's primary source of income was his stipend as a corresponding member of the U.S.S.R. Academy of Sciences.

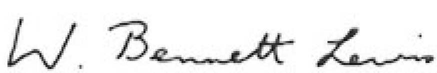
Although his sons and their families were allowed to emigrate in 1975, Ben Levich and his wife, Tanya, had to stay behind on the pretext that he was in possession of state secrets. Fortunately, he was so well known and respected by his Western colleagues that the scientific establishment in the free world was quickly mobilized on his behalf. Thus, in addition to the numerous protests and letters addressed to Soviet officials, an international conference on physicochemical hydrodynamics was organized at Oxford University in 1977 and specifically dedicated to Levich, whose sixtieth birthday fell in that year. A second conference, similar in spirit, was held in Washington, D.C., the following year. Eventually, in late 1978, as a result of this continuous agitation and following the personal intervention of Senator Edward Kennedy, Ben and Tanya were allowed to leave for Israel, where the University of Tel Aviv had, for several years, been keeping a chair ready for the most distinguished Soviet scientist ever to settle in his ethnic home.

The following year, Benjamin Levich accepted the prestigious Albert Einstein Professorship in Science at the City College of the City University of New York, where he also founded the Institute of Applied Chemical Physics, renamed the Levich Institute upon his death. In his later years, his research dealt with aspects of theoretical turbulence, but it is a measure of his universality that he felt equally at home among physicists, chemists, chemical engineers, fluid mechanicists, applied mathematicians, and biologists.

He received the Palladium Medal of the American Electrochemical Society in 1973 and was elected a foreign member of the Norwegian Academy of Sciences in 1977 and a foreign associate of the U.S. National Academy of Engineering in 1982. He was also a member of numerous scientific organizations, although on leaving the U.S.S.R. in 1978 he had to relinquish his Soviet citizenship and, therefore, was expelled from the U.S.S.R. Academy of Sciences.

Ben Levich leaves two sons, Evgeny and Alexander, and their families; his wife Tanya passed away in 1983. He was a unique scientist who left a permanent imprint and legacy in this world.





W. Bennett Lewis

1908–1987

By Floyd L. Culler

In each generation there are men of skill and foresight who are recognized as founders, and W. Bennett Lewis most certainly is one of the founders of the nuclear era. All who have worked in nuclear power anywhere in the world are aware of the contributions to nuclear science and technology made by W. Bennett Lewis. During his lifetime, atomic science evolved to a major technology and became a major force in our society.

There are so many things to be remembered about Dr. Lewis. He deserves the highest honors for directing the Canadian nuclear program, which produced the CANDU heavy water reactor, one of the world's few commercially successful power reactor types. Dr. Lewis's personal persistence in pursuing this reactor type, and in developing several generations of outstanding engineers and scientists to support it, resulted in the centerpiece of Canadian technological achievements and of his distinguished career.

He recognized the importance of abundant and available energy as a resource and a catalyst to improve the well-being of people in the underdeveloped nations. He recognized that the underdeveloped world might escape from the misery of bare subsistence, in his words, "from survival to super living," if adequate energy were available to provide water for agriculture and the bare necessities of shelter and transport. These thoughts were extended in his writings and in the International Atomic

Energy Agency (IAEA), on whose Scientific Advisory Committee he served for more than twenty years.

In addition to his advocacy of the CANDU reactor, he was the most constant supporter of a special accelerator to generate intense, high-energy neutrons by spallation, with which to produce fissionable isotopes without a basic dependence on the natural uranium.

His long-term interests in the production of radioisotopes for research and treatment in human disease were reflected in the major role that Chalk River played in isotope production and research. As a member and long-time chairman of IAEA's Scientific Advisory Committee, he encouraged the establishment of effective programs in the use and application of radioactive materials for the improvement of human health worldwide.

Early on he recognized the desirability of substituting clean energy forms—his clean energy was nuclear power—for carbon-based fuels to reduce dependence on depletable resources and to cut back on the atmospheric burden of deleterious products of combustion, including carbon dioxide.

With his election as a foreign associate of the National Academy of Engineering of the United States in 1976, Dr. Lewis was recognized by his colleagues as a pioneer and visionary. We shall be as influenced by his legacy as we were by his presence during his very productive life.

Ray K. Linsley

1917–1990

By Robert L. Smith

Ray K. Linsley, internationally known hydrologist and water resources engineer, died November 6, 1990, at the age of seventy-three. Professor Linsley was born January 13, 1917, in Hartford, Connecticut. He was educated at Worcester Polytechnic Institute and graduated with a B.S. in civil engineering. He retired from a distinguished career at Stanford University in 1975. At the time of his death he was president of Linsley, Kraeger Associates Ltd., Santa Cruz, California.

Ray was elected to membership in the National Academy of Engineering in recognition of his worldwide leadership in the field of engineering hydrology. He was a dedicated professional with a legendary reputation for contributing his time and efforts to improving the quality of engineering practice.

After several years as a young engineer with the Tennessee Valley Authority, Linsley spent a decade pursuing hydrologic tasks with the U.S. Weather Bureau. It was during this period, in 1949, that his first book, jointly authored with colleagues M. A. Kohler and J. L. H. Paulhus, appeared. At the close of his tenure with the Weather Bureau, he was serving as assistant chief, Division of Climatological and Hydrologic Services, in charge of hydrologic activities, including river forecasting, data collection, and hydrometeorological studies. He left the Bureau in 1950 to begin an illustrious twenty-five-year career at Stanford University.

During his tenure at Stanford, he fulfilled some very signifi cant administrative roles in addition to his primary teaching and research efforts. He was head of the Department of Civil Engineering from 1956 to 1967 and associate dean from 1966 to 1968. In addition he was cofounder and director of the Program in Engineering-Economic Planning from 1962 to 1971. He was also a productive author during this period. *Elements of Hydraulic Engineering*, coauthored with Professor J. Franzini, appeared in 1955, to be followed in 1958 by *Hydrology for Engineers*, again with former colleagues Kohler and Paulhus. The latter publication, as well as the Linsley-Franzini effort recast in 1964 as *Water Resources Engineering*, enjoyed multiedition success. Suffice it to say, these textbooks have had an enormous educational influence in the fields of engineering hydrology and water resources engineering, both in this country and throughout the world.

Four salient points should be noted relative to Linsley's academic career. First, as previously indicated, he was the senior author of the most widely used textbooks in his field. Second, he pursued an extensive research effort that produced an outstanding group of doctoral graduates, many of whom are currently recognized as emerging leaders in the field. Third, his research program pioneered the development of digital simulation models in engineering hydrology—models now commonly used in hydropower, flood control, water supply, and water quality studies. Fourth, in cooperation with others at Stanford he pioneered the development of a program in engineering-economic planning. This was an effort to improve the profession by stressing the planning process as distinct from design. It sought to prepare engineers to undertake the planning process with direct regard for social, political, environmental, and economic considerations in addition to the technical engineering aspects. Few, if any, can match this diversity of distinguished academic success.

Ray's educational efforts extended far beyond this nation. Early on he served as Fulbright Professor of Hydrology at the Imperial College of Science and Technology in London. Less formal efforts took him to Japan and Australia. His most unique and extensive contribution to international education came during the period 1966–1981 when he served as academic director of the graduate course in water resources at the University of the Andes in Venezuela. In this program he directed efforts to educate engineers from all over Latin America. Sponsored by the Venezuelan Ministry of Public Works, the program awarded an M.S. after three consecutive summers of study.

Linsley's career also included significant elements of public practice and service. In 1964–1965 he was chairman of the Committee on Water Resources Research (COWRR) of the Federal Council for Science and Technology and a special assistant for water resources in the Office of Science and Technology (OST). At OST he was responsible for handling specific problems of national water resources policy as requested by the White House. As chairman of COWRR he was directly responsible for the coordination of federal water resources research scattered throughout more than twenty federal agencies. In 1968 President Johnson appointed Linsley a member of the National Water Commission. The commission's task was to undertake a multiyear, multimillion-dollar study of U.S. water policy and to report back to the President and Congress. The resulting report, even today, remains one of the most objective examinations of water policy ever undertaken. Over the years he was also a member of several National Research Council committees.

Many have commented over the years on the pragmatic essence of his research and publications. This was undoubtedly a reflection of his long association with private-sector problems. He served for a number of years as vice-president of the consulting firm of Bradbury and Associates. Later he was a cofounder and initial chairman of Hydrocomp International, a hydrologic modeling firm in Palo Alto. Subsequently, he became president of Linsley, Kraeger Associates Ltd., the position he held at the time of his death. In his continuing efforts to improve both public-and private-sector practice, he became a prime mover in the formation of the American Institute of Hydrology. He later became the institute's honorary president, and an award was created in his name.

Ray's many efforts and accomplishments led to numerous awards from peers in this country and abroad. The American Society of Civil Engineers bestowed on him the Collingwood

Prize in 1942 and its Julian Hinds Award in 1978. Later in 1978 the society elevated him to the status of honorary member. He was the recipient of the American Water Resources Association's Icko Iben Award in 1974. His alma mater, Worcester Polytechnic Institute, and the College of the Pacific awarded him honorary doctoral degrees. Internationally, both the Venezuelan Society of Hydraulic Engineers and the Japan Society of Civil Engineers granted him honorary membership. There were many more.

Ray Linsley was a true giant of the profession. The citation upon his election to the National Academy of Engineering read, for "leadership in hydrology and water resources planning through distinguished teaching, research, professional practice and service to the government." It could not have been stated better.

John A. Logan

1908–1987

By Abe Silverstein

John A. Logan, a noted educator and internationally known environmental engineer, died February 16, 1989, at age seventy-eight. He served as president of Rose-Hulman Institute of Technology from 1962 until 1976, guiding the private engineering and science college through a period of significant renovation and academic restructuring during his fourteen-year tenure.

Logan earned a B.Sc. and B.Eng. from the University of Saskatchewan in 1929 and 1934, respectively, and an M.Sc. in 1935 and a D.Sc. (environmental engineering) in 1942 from Harvard University. He also received honorary doctorate degrees from Wabash and Franklin Colleges, the University of Evansville, Indiana University, and Indiana State University.

After serving as a major in the U.S. Army, Logan was employed for eight years in Europe by the International Health Division of the Rockefeller Foundation. He was named chairman of the Department of Civil Engineering at Northwestern University in 1954, and served there until he was named president of Rose Polytechnic Institute, as Rose-Hulman was known in 1962.

Logan served for nearly forty years as a consultant and member of several committees of the World Health Organization. In addition, he was a consultant to the government of Guatamala on waste disposal and food production and to the Epidemiological Board of Waste Disposal in Alaska.

Before assuming the presidency of Rose-Hulman, Logan had been involved in several international environmental engineering projects for which he won praise from the United States, Italy, and Brazil. As superintendent of Ente Regionale Lotts Antianofelica en Sardegna, he was in charge of one of the largest experiments ever carried out in the field of malaria and mosquito eradication and reclamation. The problem was to determine whether developed technology in the eradication of an invading malaria vector (Gambia) in Brazil could be used against an indigenous species (Labranchiae) in the island of Sardinia. Malaria was successfully eradicated, new technology was developed, the mosquito population was reduced to the vanishing point but not eradicated, and land was reclaimed and made habitable. The techniques, administrative and logistical procedures, and engineering innovations developed by Logan were adopted and had a major impact on the World Health Organization's international project for the worldwide eradication of malaria.

As chief engineer of the Amazon Valley Project while an officer in the U.S. Army Core of Sanitary Engineers (Office of Inter-American Affairs) from 1943 to 1946, he successfully demonstrated the widespread application of sanitary engineering programs (malaria control, water supply, waste disposal, health centers, and hospitals) to public health and area development. This large engineering program contributed greatly to the Point Four philosophy later adopted by President Truman, and Logan was honored by the American and Brazilian governments for bringing sanitation to the Amazon basin.

He was elected a member of the National Academy of Engineering in 1968 and was one of only six Americans with a membership in the British Institution of Civil Engineers, the oldest engineering society in the world.

Honors also included membership in Tau Beta Pi. He was a fellow in the American Society of Civil Engineers and a member of Sigma Xi, the American Society of Professional Engineers, the American Public Works Association, and the American Society of Tropical Medicine and Hygiene. In 1974 Logan was selected the Indiana Engineer of the Year. He served as president of the Association of Independent Engineering Colleges, Associated

Colleges of Indiana, and the Indiana Conference on Higher Education.

Logan and his first wife, who was killed in an automobile accident, had three sons, Douglas, Jack, and Carlo. In 1972 Logan married Norma Addison Schlenz.

The special interest of John Logan was in the development of a rational approach to the conservation and control of Man's environment. His overseas assignments for the United States Army, Rockefeller Foundation, and U.S. State Department helped him to develop an appreciation of the interrelationships between man and his environment, and a firm conviction that civil engineers, with a broad understanding of their professional responsibilities, could provide leadership in making the world a more attractive, convenient, and healthy place to live.

Bernard D. Loughlin

1917–1988

By Harold A. Wheeler

Beynard Dunlevy Loughlin, retired vice-president, technology, of Hazeltine Corporation, died of a heart attack on December 25, 1988, at the age of seventy-one. His career with that company spanned forty-nine years, from 1939 to 1988.

Barney (as he was known to his family and friends) was born in New York City on May 19, 1917, and lived in New Jersey during his college years. He earned a B.E.E. in 1939 and an E.E. (professional degree) in 1945, both from Cooper Union, and a M.S.E.E. in 1946 from Stevens Institute of Technology. In 1943 he married Dorothy Turner, and they had three children, David, John, and Mary Ellen.

Barney was steered into the field of radio by his uncle, Charles A. Weingardner, a Cooper Union graduate who was working at Bell Telephone Laboratories in New York City. While in high school, he became active as a "ham" with operator's license dated in 1933 and amateur station license W3EAL, later W2GQX. Using a short-wave CW transmitter, he was qualified in the Amateur Radio Relay League network.

Working at home while attending Cooper Union, he made a small television receiver to pick up the experimental signals from the RCA transmitter on the Empire State Building in New York City. Then he conceived and constructed what he called a "vector response indicator." On a frequency sweep on a small cathode-ray tube, he displayed the amplitude and phase response of a band-pass amplifier. This subject he presented in the 1939 annual student paper contest hosted by the American Institute of Electrical Engineers at Cooper Union. He won first prize. This concept developed into the "phase-curve tracer" that later became his first major project after joining Hazeltine.

After his graduation in 1939, Barney Loughlin applied for employment at the new Hazeltine laboratory in Little Neck, Long Island, New York. He was interviewed by Dan Harnett (chief engineer), Les Curtis, and me. (When Dan sent him in to talk with me, he said, "Don't let him get away.") Barney also was favorably impressed and accepted our offer of employment before he left that day.

His first major assignment was to design and build the "phase-curve tracer" for TV circuits, based on his previous work at home. On a large cathode-ray tube, he displayed the phase angle of response over a frequency band on a horizontal frequency sweep. That was test equipment that was needed but was not available anywhere. It required a rack containing many vacuum tubes (sixty-seven). Prominent engineers from the major laboratories came to see demonstrations of its operation. It was presented at the 1940 Rochester Fall Meeting of the Institute of Radio Engineers (IRE) and Radio Manufacturers Association, and published in the *Proceedings of IRE* for March 1941. Subsequently it became the subject of Barney Loughlin's first patent (of the one hundred and twenty U.S. patents issued to him over his career).

Before Pearl Harbor in 1941, he worked on several projects of interest to the military. During World War II, he worked on the U.S. Navy program of Interrogation Friend-or-Foe, an adjunct to radar for which Hazeltine had the prime contract. From 1946 to 1948 Loughlin was a member of the Hazeltine research team working on FM receivers and TV receivers (monochrome).

The years 1949 to 1951 saw the intensive activity on color television that brought international fame to the Hazeltine group. The group was headed by Art Loughren (IRE fellow 1944, president 1956). In addition to Loughlin, other leaders were Bill Bailey (fellow 1954) and Charlie Hirsch (fellow 1951). They assembled equipment for demonstrating the problems and optical behavior peculiar to a color television system (transmitter and receiver). They educated the industry and the regulating agencies to enable a prompt decision on the essentials of the present color television service. Their contributions were recognized by writers and their principal competitor, RCA, which collaborated in adopting the standards.

In addition to the facilities for demonstrations, Hazeltine contributed three major concepts of innovation, two of which were adopted in the U.S. standards. The third became practical after further advances in technology, so it also was adopted in the later color TV standards in Europe.

Barney Loughlin was individually responsible for these three concepts. They required an education in the behavior of the human eye toward colors, followed by circuit inventions for their practice in transmitters and receivers. They were used with RCA tubes (three tubes with mirrors in the transmitter and the three-gun picture tube in the receiver).

These three concepts are difficult to describe in a few words, but they are identified by simple names: "Shunted Monochrome," U.S. Patent 2,774,072, December II, 1956; "Constant Luminance," U.S. Patent 2,773,929, December 11, 1956; and "Color-Phase Alternation," U.S. Patent 2,943,142, June 28, 1960. Unfortunately, these were not patented in Japan because the company did not anticipate that the Japanese would produce many TV receivers. (Japan did pay royalties on U.S. patents for receivers imported to the United States.) The royalties on these patents were a substantial fraction of the company's income during the years before they expired (December 11, 1973) and even afterward on prior usage and foreign patents.

A by-product of the experience with color TV was the Color Film Analyzer (CFA). From a color-film negative, it displayed instantly the positive that would be obtained by processing in accordance with a formula described by a set of numbers seen on dials. This avoided a laborious trial-and-error process. Developed by Loughlin, Bill Bailey, and Charlie Page, in response to a conversation with an engineer at Pathe, a breadboard model, U.S. Patent 2,976,348, March 21, 1961, was delivered to Pathe in 1957, described in the, *Journal* of the Society of Motion Picture and Television Engineers (SMPTE) in January 1958. It achieved universal use in the film industry. (When China was opened to U.S. commerce, China's first order included three CFAs.) In April 1970 in Hollywood, it was recognized by an Academy Award to Hazeltine Corporation.

A shift in the orientation of research in the company in 1957 influenced Loughlin to "retire at forty" and engage in consulting work for a few years. In 1962 he accepted an invitation to return to Hazeltine and head the research operations.

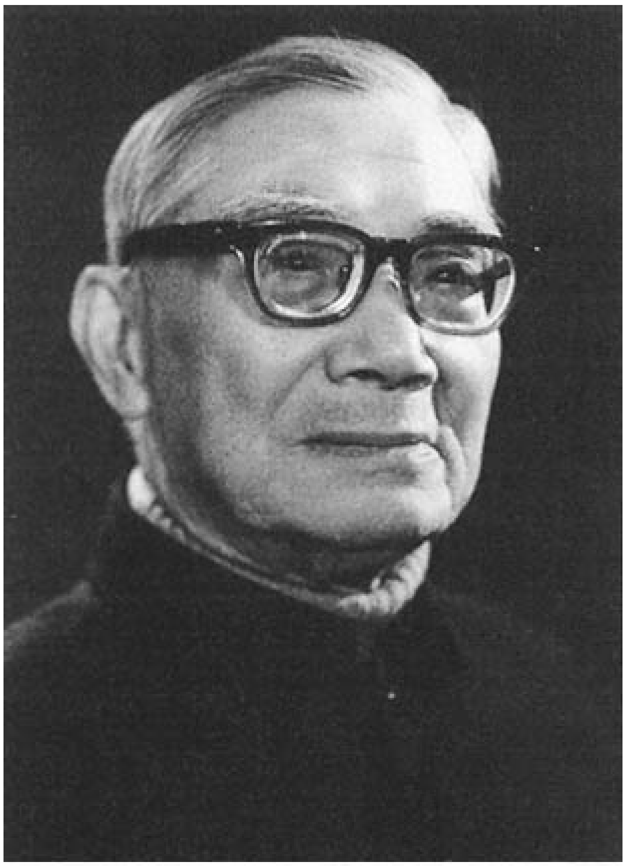
From 1969 to 1974, Loughlin served as chairman of the Broadcast Television Systems (BTS) Committee of the Electronic Industries Association (EIA). This group comprised outstanding engineers with experience in broadcast networks, receiver manufacturing, and television systems. In addressing practical programs, they perceived the need for a feature they called a Vertical Interval Reference Signal. This was shortly standardized, and Loughlin was accorded much of the credit for this result.

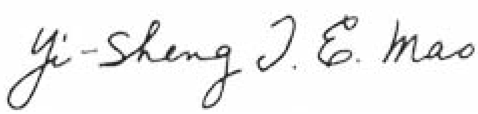
In the last decade of his employment, from 1977 to 1987, Loughlin devoted much effort to the development of "AM Stereo," which so far has not realized its potential as a service. It was brought to the company by Leonard Kahn, an Institute of Electrical and Electronics Engineers (IEEE) fellow and Loughlin's neighbor on Long Island. It was distinguished from other proposals by the designation IS (Independent-sideband) AM Stereo System. The two separate sidebands within the AM channel were used to excite the separate speakers of a stereo audio system. The result was rather impressive, with transmission limited to the standard AM channel bandwidth. The future of this system remains to be seen.

The last major effort of Barney Loughlin, before final retirement in 1988 at age seventy-one, was the writing of a monumental, largely autobiographical, story of his life and the contemporary activities of Hazeltine Corporation. Centered on the intensive developments relating to color television, he named the story, *Hazeltine's Colorful Days*.

My friend and colleague, Barney Loughlin, has been one of the most brilliant engineers and delightful companions of my acquaintance.

In addition to his many U.S. and foreign patents, the following principal honors and awards give some measure of the recognition accorded to his contributions in the field of color television. In 1952 he received from the IRE the Vladimir K. Zworykin Award, and in 1955 he became an IRE fellow. In 1957 he received an award from the IRE's Professional Group on Broadcast and Television Receivers. In 1965 he earned from the National Association of Manufacturers the Modern Pioneer Award. In 1967 Barney was elected a member of the National Academy of Engineering "for research and development of television systems." In 1968 he became a member of Tau Beta Pi, Cooper Union. In 1970 he received the Gano Dunn Medal, Cooper Union, and in 1972 Barney was honored with the Consumer Electronics Award, IEEE. In 1973 he was recognized with an International Television Symposium Citation, and in 1977 Barney received a special commendation award, SMPTE. In 1978 he was given the Engineering Emmy Award, BTS/EIA, and in 1981 he received the Armstrong Medal, Radio Club of America, "for his pioneering contributions to Color TV."





Yi-Sheng Mao

1896–1989

By Steven J. Fenves

Yi-Sheng Mao, outstanding engineering educator, designer of major bridges in China, and influential leader of Chinese engineering and scientific organizations, died on November 12, 1989, at the age of ninety-three.

Elected as a foreign associate of the National Academy of Engineering in 1982, Dr. Mao was recognized for his distinguished leadership in the development of China's transportation system, his significant accomplishments as a bridge designer, and his guiding role in engineering education.

Dr. Mao was born in Zhenjiang, Jiangsu Province, China. After graduation from the Tangshan Engineering Institute in 1916, he came to study in the United States. He received his M. C.E. in civil engineering from Cornell University in 1917 and Ph.D. in civil engineering from Carnegie Institute of Technology (now Carnegie Mellon University) in 1919. This was the first Ph.D. granted by that university. His dissertation on secondary stresses in trusses was a major contribution to bridge theory at that time. While in Pittsburgh, he also worked for the McClintick-Marshall Company as a designer.

Upon his return to China in 1920, Dr. Mao assumed a series of educational positions, which eventually included professorships at five major institutions and the presidencies of four of these universities. Among these universities are the two oldest and most prominent engineering schools of China: the National

Beiyang University (formerly Beiyang Engineering College) in Tianjin and the National Beifang Jiaotong University (formerly Tangshan Engineering Institute) in Tangshan. Dr. Mao was widely respected as a major innovator in Chinese engineering education, introducing both new subject matter and new pedagogical approaches.

Simultaneously with his educational activities, Dr. Mao held a series of other positions, including director of bridge engineering for Zhejiang Province, director of the bridge designing and engineering division of the Ministry of Communications, and general manager of the China Bridge Engineering Company. In these positions he became recognized as a pioneering and brilliant bridge engineer. He designed and supervised the construction of two of the most famous modern bridges in China. The Qiantang River Bridge near Hangchow was completed in 1937, after a construction period of two-and-a-half years. The bridge, with a main span of 1,072 meters, provides highway and railroad connections on separate levels. Its construction required many innovative solutions, particularly in the substructure that had to penetrate forty meters of quicksand in the riverbed. The bridge was destroyed by the retreating Chinese army during the Japanese invasion and rebuilt after World War II under Dr. Mao's supervision. Dr. Mao served as chairman of the Technical Consultative Committee on the Yangtze Bridge at Wuhan, which was completed in 1957 after two years of construction. This bridge also provides highway and railroad service on separate levels. In addition to bridge building, Dr. Mao contributed to the structural design of many major buildings in Beijing. He was chief consultant for the structural design of the Great Hall of People in Beijing. The building has since then withstood a major earthquake.

Dr. Mao held a number of major positions in professional organizations, including the presidencies of the Institute of Railway Technology, the China Academy of Railway Sciences, the China Engineers' Association. and the Chinese Civil Engineering Society. He was vice president and then honorary president of the China Association for Science and Technology. Under his leadership for thirty years, the China Academy of

Railway Sciences developed into a comprehensive research institute, providing research support for railway transportation and construction and training for a large number of engineers and scientists. In the political arena, he was a deputy to the National People's Congress (NPC), member of the NPC Standing Committee, and member and vice chairman of the Chinese People's Political Consultative Conference. He headed numerous delegations of Chinese engineers and scientists to Czechoslovakia, the Soviet Union, Italy, Switzerland, France, Portugal, Great Britain, Sweden, Japan, and the United States. He personally contributed to the strengthening of technical and scientific exchanges between China and other countries.

Dr. Mao was particularly interested in the history of Chinese science and technology. He wrote a book on ancient and modern Chinese bridges, supervised the compilation of a series on the history of natural sciences, and served many organizations dealing with the dissemination of scientific knowledge in China.

Dr. Mao's numerous awards included a senior membership in the International Association for Bridge and Structural Engineering, honorary membership in the Canadian Society of Civil Engineers, and outstanding alumnus awards from Cornell University and Carnegie Mellon University.

Sachio Matoba

1899–1987

By Merton C. Flemings

Sachio Matoba, pioneer in physical chemistry of steelmaking, died on September 28, 1987, shortly before announcement of his election as a foreign associate of the National Academy of Engineering.

He was internationally known as early as 1927 to 1935 for his work on the physical chemistry of reactions of importance in iron and steelmaking, especially the equilibrium between carbon and oxygen in liquid iron with CO/CO_2 gas mixtures, based on his original papers in Japanese. He was a leader in research on iron and steelmaking systems and in promoting through papers, lectures, and education of students the understanding and use of physical chemistry as applied in the steel industry. He led in developing participation by Japanese technical people from industry and academia in international committees, conferences, and exchange programs. He was a leader in the 1940s and 1950s in establishing a strong technical base for the developing steel industry in Japan.

Professor Matoba was born in Tokyo on March 23, 1899, the first son of Professor Naka Matoba of the University of Tokyo. He graduated from Kyushu Imperial University in 1924, when Professor Kuniichi Tawara and Kotaro Honda were planning to start the new department of metallurgy at Tohoku Imperial University. Professor Tawara invited Professor Matoba to Tohoku as a lecturer. He took up his duties there, first in the area of physical metallurgy, and then, after two years, in his first love of chemical thermal dynamics. He married Yasuko Nakahara in 1926, and in their lifelong marriage they had two children who have distinguished themselves personally and professionally, Naoya and Koko.

He was a faculty member at Tohoku University from 1924 to 1962 and served as dean of the faculty of engineering from 1959 to 1962. He was a member of the National Science Council from 1960 to 1963. In 1962 he joined Fuji Iron and Steel Company as vice-president and director of the Central Research Laboratory, and later became executive vice-president. When Fuji Iron and Steel Company became a part of the newly formed Nippon Steel Company, he served the new organization as executive adviser and later as adviser until his passing in 1987.

Professor Matoba's leadership in Japanese engineering and scientific organizations was an inspiration to Japanese scientists. He was a strong proponent of emphasis on quality, which has been so successful in the Japanese manufacturing segment and has raised quality to unmatched levels of achievement in that country.

He was widely recognized for his accomplishments and contributions to the iron and steel industry. He received the Tawara Prize of the Iron and Steel Institute of Japan (ISIJ) in 1963; the Honorable Prize, ISIJ, 1965; Honda Memorial Gold Medal, 1966; Nishiyama Medal, ISIJ, 1968; Gold Medal of Japan Institute of Metals; and Tawara Gold Medal, ISIJ, 1980. He held honorary memberships in the American Iron and Steel Institute, 1970; the German Iron and Steel Institute (VDEH), 1970; Iron and Steel Institute of Japan, 1973; and Korean Institute of Metals, 1983.

Professor Matoba's works on physical chemistry of ironmaking, steelmaking, and ore beneficiation played major roles in awakening Japanese metallurgists to the importance of physical chemistry in metallurgy. His equilibrium studies and chemical kinetic studies showed operational metallurgists how to improve their operations. In other important work at that time, he studied sintering and reduction behavior of many kinds of iron ores, sinters, and pellets. These studies were critical to the Japanese steel industry, because prior to 1950 it was necessary for them to use low-grade iron ore and high ash coal. During his long research career, he also contributed much to improve chemical analysis of steel, iron ore, and slag, and especially determination of gaseous elements in liquid steel.

Later, as dean of the faculty of engineering, he made a most significant contribution to Tohoku University through his leadership role in establishing the new campus of the Faculty of Engineering on the hill Aobayama. Professor Matoba understood that for future development of the Faculty of Engineering, more space was required, space that could be found at Aobayama, and so he took the initiative, over much faculty resistance, to initiate the move. The government supported the move, and the new campus was established much earlier than expected, leading directly to the current great strength of the engineering school of Tohoku University.

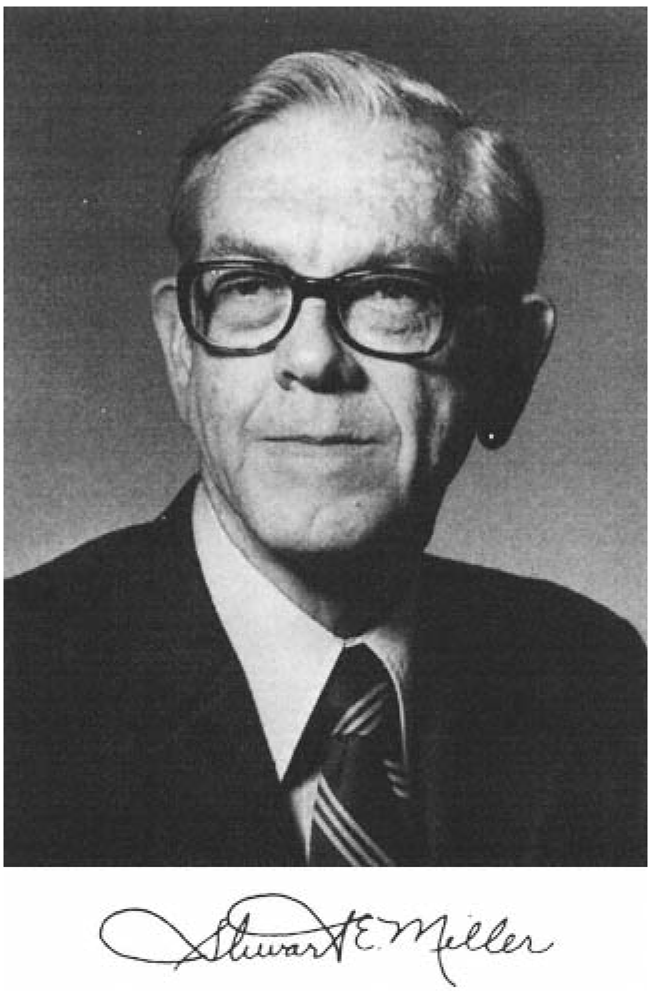
Later, Professor Matoba's leadership was critical to the decisions of the Iron and Steel Institute of Japan and to the Japan Institute of Metals to publish their transactions in English. This was just one of the ways in which Professor Matoba contributed greatly to turn Japanese metallurgists' eyes outward to the rest of the world. In another example, he invited Professor and Mrs. John B. Chipman to Japan in 1965 when he was vice-president, Fuji Steel Company. Professor Chipman at that time was a leading U.S. academician in the field of steelmaking. Matoba did not monopolize Professor Chipman's time simply for Fuji Steel, but arranged for him to visit most of the leading universities and leading steel companies from Hokkaido to Kyushu.

Professor Matoba was a man who made everyone, independent of age, occupation, social status, or race, feel friendly and warm-hearted. He was fair and impartial, with compassion for all, but keeping to himself his good works, making way or room for others even if honors were given to them instead of to him, and heartfully celebrating his friends' or students' honors. Nonetheless, he was strict in training students and staff in his laboratory. It was rare for him to directly order his students, but rather he was patient until his students themselves overcame their difficulties based on his suggestions. He was strict with himself and deeply introspective.

Professor Matoba was a great reader, interested in books on religion, literary works, essays, and travel. He was interested in classical music and loved sports, especially walking with his family and mountain climbing. He climbed most of the high mountains in japan and was a head of Tohoku Academic Alpine Club while he worked at Tohoku University.

Professor Matoba would surely consider as one of his greatest honors the establishment of the Matoba-Kawatabi Seminar. The seminar was planned and initiated in 1974, following the style of the Gordon Conferences. The Seminar is unique in japan, held in August each year at the Kawatabi Seminar House, about one hundred kilometers north of Sendai. It is open to graduate students and to others from the steel industry, although limited in attendance because of the capacity of the house. Professor Matoba would begin the seminar each year with a profound and significant lecture. It should be added that, respecting Professor Matoba's modesty, the seminar was not officially designated as the Matoba Seminar until his passing.

Professor Matoba will be long remembered by his friends and colleagues in Japan, the United States, and throughout the world for his accomplishments, wisdom, and foresight and for his leadership in academia and industry in applying scientific principles to the technology of iron and steel production.



Stewart E. Miller

1918–1990

By C. Chapin Cutler and John R. Whinnery

Stewart Edward Miller, a pioneer in microwave and optical communications, died February 27, 1990, in Middletown, New Jersey. Most of his career was with the Bell Laboratories, but following his retirement from there in 1983 he was active as a consultant to Bellcore until his death. His fifty-year career in telecommunications established him as one of the most productive and influential leaders of this field.

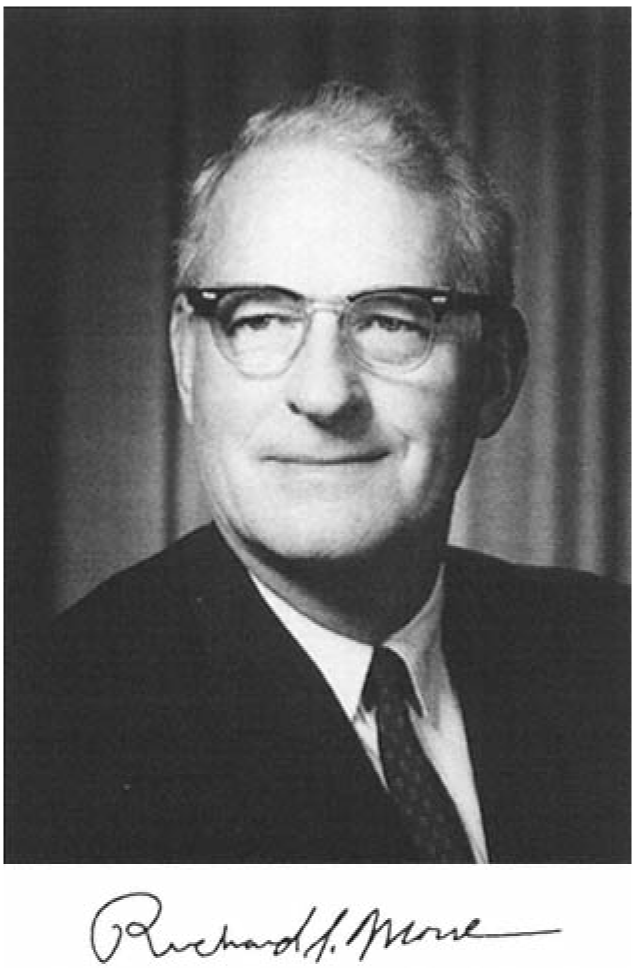
Stewart (known to friends and colleagues as "Stew") was born in Milwaukee, Wisconsin, on September 1, 1918. He attended high school in Wauwatosa, Wisconsin, and three years at the University of Wisconsin before transferring to the Massachusetts Institute of Technology, receiving S.B. and S.M. degrees in electrical engineering there in 1941. He joined the Bell Telephone Laboratories (now AT&T Bell Laboratories) that year and began work on microwave radar and its components. He was a technical leader in design of X-band (3 cm) microwave plumbing for the radar bombsight used on B-29 aircraft during World War II. Following the war, he became the key person on the L-3 coaxial cable carrier systems, but saw the potential for greater information capacity through the use of higher carrier frequencies and other wave-guiding systems. He transferred to the Radio Research Department in Holmdel and made vital contributions to circular-electric modes for low-loss millimeter-wave guides, microwave ferrite design, and many other millimeter-wave components.

In the early 1960s, following the demonstration of the laser, Stew was among the first to recognize the potential of optical communications and from that point on concentrated on this rapidly developing technology. At that time there was no good transmission medium for optics because fibers of that date were impossibly lossy. As a result, Stew, who was then director of Guided Wave Research, initiated a program to investigate a variety of periodic lens systems. With the availability of low-loss fibers in the late 1960s, he proposed and participated in the demonstration of single-material fibers that achieved single-mode and multimode guiding through transverse variation of the dielectric material. He also proposed the combination of several optical components on one semiconductor chip, and proposed the name "integrated optics" as analogous to the "integrated circuits" of modern electronics. This proposal stimulated a lively research endeavor, resulting in units that are now being placed in systems.

Stew was made director of Lightwave Research at Bell Laboratories in 1980. Following his retirement from that position, his work at Bellcore concentrated on analysis of semiconductor lasers for improvements in noise and linewidth properties important to advanced fiber-optic communication systems, and he also contributed to the new field of neural networks. Just a year before his death he wrote a fundamental and incisive paper on modal partition noise that was published in the Institute of Electrical and Electronics Engineers' (IEEE) *Journal of Quantum Electronics* (February 1990, p. 242). He had more than forty journal papers and eighty patents to his credit and was also coeditor of two very comprehensive books, *Optical Fiber Telecommunications* (with Alan Chynoweth) and *Optical Fiber Telecommunications II* (with Ivan Kaminow).

Stew was elected to the National Academy of Engineering in 1973. He was also a fellow of the Optical Society of America, the American Association for the Advancement of Science, a Life Fellow of the IEEE, and a member of the honor societies Sigmi Xi, Tau Beta Pi, and Eta Kappa Nu. He was instrumental in establishing the annual Optical Fiber Conference, with the first meeting in 1975, and was active in many other conference and professional society committees. He received the Naval Ordnance Development Award in 1945, the IEEE Morris Liebmann Award in 1972, the IEEE W.R.G. Baker Prize Award (with Tingye Li and E.A.J. Marcatili) in 1975, the Stuart Ballantine Medal of the Franklin Institute in 1977, and in 1989 the John Tyndall Award of the Laser and Electro-optics Society of IEEE for distinguished contributions to fiber optics technology.

Stew was an active member of the Freehold, New Jersey, Rotary, and was an enthusiastic and skillful renovator of Corvairs. He is survived by his wife Helen and three sons, Chris Richard of the U.S. Foreign Service; Stewart Ferguson, a pathologist in Tom's River; and Jonathon James, a software designer. His family, friends, and colleagues are proud of the key role he played in the development of lightwave communications—one of the major technologies of this century.



Richard Stetson Morse

1911–1988

By Courtland D. Perkins

On a summer day several years ago, a teenager, Laura Morse, was sitting with several of her friends in a small lunchroom near Quissett Harbor on Cape Cod in Massachusetts. Up drove a spectacular sports car, from which emerged a vigorous, handsome, white-haired man who immediately changed the ambience in the restaurant. Laura turned to her greatly impressed friends and said in their vernacular, "That's my grandfather and he's a Cool Cat." The Cool Cat was Richard S. Morse, an eminent and successful entrepreneur, a member of the National Academy of Engineering, a blithe spirit, a brilliant engineer, and a success at many important undertakings. A man full of wit and the friend of almost everybody.

Dick Morse died several years later, July 1, 1988, of a massive heart attack after playing tennis with friends in his usual mode of full speed ahead. He was born on August 19, 1911, in Abington, Massachusetts, and therefore was seventy-six at the time of his death. His friends agree that his abrupt demise was a blessing as he would have been an impossible invalid.

Dick attended the Massachusetts Institute of Technology (MIT), from which he received a B.S. in 1933, and did graduate work at the Technische Hochschule, Munich, during 1933–1934. Later he received honorary degrees, a D.Eng. from the Brooklyn Polytechnic Institute (1959) and a D.Sc. from Clark University (1960).

His forceful character was evidenced early when he met a beautiful young lady named Marion Elsa Baitz. He decided immediately that this was the girl for him. After their third date, he drove Marion to her home, went upstairs to her parents bedroom, woke them up, and announced that he was going to marry their daughter. It didn't bother him at all that Marion was engaged to someone else. Dick maneuvered around this difficulty and married Marion in 1935. This was a very successful marriage that soon involved two splendid sons, Richard S. Morse, Jr., a successful lawyer in Boston, and Kenneth P. Morse, like his father an energetic entrepreneur. Later the two sons married, and Dick and Marion acquired two outstanding daughters-in-law, Susan and Laura, both of whom they loved very much. This love was reciprocated fully. The family soon expanded with the birth of a handsome grandson, Richard III, and three lovely granddaughters, the Laura whom we have already met, and Amy and Allison. Dick was a hero to all four.

After Dick graduated from MIT and returned from his studies in Munich, he went to work for the Eastman Kodak Company in 1935. While on the staff, he became interested in the technology of high vacuums and their potential for new industrial products. Convinced of this potential, he left Kodak in 1940 to found the National Research Corporation of Cambridge, Massachusetts, a venture capital-funded organization dedicated to the development of new manufacturing techniques and new products. Among his successes were vacuum processes for powdered drugs, the coating of optical lenses, dehydrating food without sacrificing taste or vitamins, and refining metals without impurities. One of his greatest successes was helping to set up the Minute Maid Corporation in 1946 to promote his new technique for making orange juice concentrate. This resulted in the now-famous Minute Maid orange juice.

Dick Morse broadened his interests and slowly became involved with government programs in chemical, biological, and radiological warfare. In 1959 he resigned as president of National Research and became director of research and development for the U.S. Army. This position was later upgraded to a presidential appointment of assistant secretary U.S. Army for research and development. Dick did not go along too well with the U.S. Defense Department's downgrading of many U.S. Army programs, in particular postponing development of the Nike Zeus and the awarding of almost all military space programs to the U.S. Air Force. In the election of 1961, Dick, an ardent Republican, was vocal against the candidacy of John F. Kennedy. This, of course, led to his eventual resignation in 1961.

After Dick left the government, he continued his interest in organizing small companies to exploit new developments in high technology. He had some successes and a few failures, but he continued his search for new technology-based ventures. He became involved with his old school, MIT, and its Alfred P. Sloan School of Management. He suggested the establishment of an MIT Development Foundation that would help MIT's innovative professors develop their ideas and organize new companies to exploit them. He felt that MIT should become a catalyst in this innovative process for if such companies became successful, MIT would also benefit. Dick pushed the idea for this foundation with his usual vigor. Unfortunately, the timing was bad, and it never was the success that he had hoped for.

Dick also became involved with the problems of pollution of the environment and the search for alternatives to energy production. This led him into contact with the U.S. Department of Commerce and his old MIT colleague, J. Herbert Hollomon, then the assistant secretary of commerce for research and development. He helped Hollomon organize a U.S. Department of Commerce Technical Advisory Board and for many years was an influential member of this active group. He received national recognition for this work and became an adviser to the administration and to the Congress on innovative solutions to problems involving energy and pollution. He attacked these problems with typical vigor and emphasized his basic philosophy of getting the data and moving out.

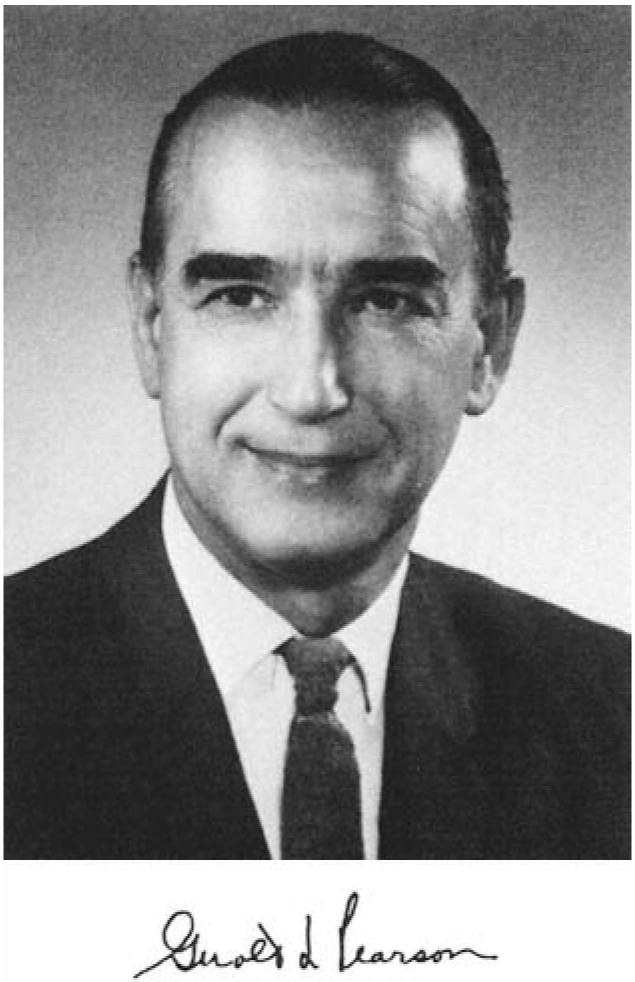
As a result of his many contributions to these national technological problems, he received much exposure on the engineering scene, leading to his being elected to the National Academy of Engineering in 1976.

He continued close connections with MIT and eventually was named senior lecturer in the Sloan School. His great enthusiasm, broad knowledge of technologies and financial management, together with his personal relationships with the major people involved, made his courses in entrepreneurship and managing innovation extremely popular.

He was active in many important organizations, serving on the Defense Science Board and as chairman of the Advisory Board to the U.S. Air Force Systems Command. He was a trustee of the Aerospace Corporation and the Marine Biological Laboratory at Woods Hole, a member of the corporation of the Woods Hole Oceanographic Institution and the Boston Museum of Science, and a long-time board member of the Dresser Industries.

His greatest hobby was sailing. He loved the Quissett Harbor area of Cape Cod and had a summer home there for all his later life. In 1959 he acquired a beautiful 47-foot sloop, the "Mandarin", built for him in Hong Kong from a John Alden design. Someone asked Marion if she was worried that his first love seemed to be for his boat. Marion answered brightly, "It's all right as long as I'm in the top ten."

Dick was a unique man who made many contributions to the national scene. He was well loved by his family, his business associates, his neighbors, and his colleagues in the Academy and elsewhere. He was a hard-driving, brilliant, and witty man, and the comment of his granddaughter Laura, that he was a "Cool Cat," fits him very well indeed.



Gerald L. Pearson

1905–1987

By John G. Linvill

Gerald L. Pearson, professor emeritus of electrical engineering at Stanford University, died on October 25, 1987, at the age of eighty-two. He was a key participant in the research effort at the Bell Telephone Laboratories (BTL), which brought the transistor and related semiconductor devices into being. In 1960 he took early retirement from the Bell Laboratories and initiated a faculty career at Stanford in the newly started solid-state electronics program. His faculty career, which started when he was fifty-five, produced thirty outstanding Ph.D. graduates and a rare kind of professional colleagueship with faculty members and Ph.D. students as well as a continuing flow of personal research results.

Gerald Pearson was born in Salem, Oregon, on March 31, 1905. He attended Willamette University in Salem and obtained an A.B. in mathematics and physics in 1926. In 1927 he undertook graduate study at Stanford and obtained his M.A. in physics in 1929. He went directly to the Bell Telephone Laboratories to begin his career as a research physicist.

Pearson's research at BTL in temperature-sensitive resistors had an important impact on the telecommunications industry. His work led to thirteen patents related to thermistors. Then he joined the research group at Bell Laboratories doing fundamental research on semiconductor materials. He conceived and carried out an elegant series of experiments on semiconductors, experiments that were crucial in identifying physical models of behavior of materials, pn junctions, and semiconductor devices. His experimental results were essential to the development of models of semiconductor behavior developed by his colleagues William Shockley and John Bardeen, models that led to new device and systems conceptions in an industry just being born. His best-known invention is the silicon solar battery, which evolved into the power source for satellite communication. He invented the solar battery jointly with C. S. Fuller and D. M. Chapin.

In the late 1950s Stanford University was initiating a semiconductor electronics program and planning an industry-class experimental facility to promote research that could only succeed in such a facility. Pearson's experience and perspective were central to the realization of that objective. He joined the Stanford faculty in 1960 and made the transition from the Bell Laboratories to Stanford with rare flexibility and insight. He promptly developed a team of research students, mastered the task of getting governmental support for his and their research, and established expectations in his team for excellence of work and publication that had long characterized his research at Bell Laboratories. One of Pearson's BTL colleagues remarked that when new facets of solid-state research emerged, he usually found that Pearson had already done a few definitive experiments. That characteristic continued at Stanford, where he undertook research on compound semiconductors and set up one of the first university programs in that area. When he became emeritus professor in 1970, his research activity was at full volume. He was recalled to active duty annually through his seventy-ninth year.

Gerald Pearson's career was rich with recognition and awards. In 1956 Willamette University, his undergraduate school, conferred on him an honorary doctoral degree. In 1968 he was elected to membership in the National Academy of Engineering and, later, to membership in the National Academy of Sciences. He was a fellow of the American Physical Society and the Institute of Electrical and Electronics Engineers and a life member of the Franklin Institute and the Telephone Pioneers of America.

Pearson received the John Scott Award from the city of Philadelphia Board of Directors of Trusts, the John Price Wetherill Medal from the Franklin Institute, the Medal Mariana Smoluchowskiego from the Polish Physical Society, the Golden Plate Award from the American Academy of Achievement, the Solid State Science and Technology Award from The Electrochemical Society, and the 1981 Gallium Arsenide Symposium Award from Japan.

Gerald Pearson was a colleague inclined to work productively and congenially outside his own domain. As an experimentalist, he sought and was sought by theoreticians. In the university he was a colleague to other academic types but also retained his contacts with industrial contemporaries who valued his work and ideas. He bridged the generations in the university, working closely with the graduate student population even while he was an emeritus faculty member. He left a trail of constructive interactions because of his intellectual and professional standards and magnanimous personality.

Kendall Perkins

1908–1987

Written by Frederick H. Roever

Submitted by the Nae Home Secretary

Kendall Perkins was a leader of aviation engineering for nearly fifty years. He retired after some thirty years as chief of engineering for the McDonnell Douglas Corporation. During that time, he and his team designed and produced McDonnell's many military and commercial aircraft and three U.S. spacecraft.

After graduating from the School of Engineering of Washington University in 1928 with a B.S. in electrical engineering, he joined the Curtiss-Roberston Airplane Manufacturing Company. For a decade, Mr. Perkins was involved in project engineering for its half-dozen aircraft that were produced in St. Louis, Missouri. Brief periods of employment followed with American Airlines and the U.S. Government Office of Production Management. In 1941 Kendall Perkins began an association, which would span nearly four decades, with the newly established McDonnell Aircraft Company. In the 1950s his yearlong study of manned spacecraft culminated in McDonnell's contract with the National Aeronautics and Space Administration (NASA) to produce the Mercury capsule that carried the first Americans into earth orbit. He became engineering vice-president in 1951 and corporate vice-president of engineering and research in 1967.

The following reviews Kendall Perkin's activities in slightly more detail. Upon graduating from Washington University, Ken Perkins went into the factory of the Curtiss-Robertson Airplane

Manufacturing Company. His first job was sawing steel tubing and other bench work in the shop, but in six months he was foreman of the fuselage department. After two years in the shop he assumed duties in the Engineering Department, which eventually led to the post of project engineer. In this capacity in the early 1930s, he worked on such famous airplanes as the Curtiss Kingbird, the Travelair, and the Curtiss Condor. Culmination of his twelve-year career with Curtiss was research, design, and finally responsibility as project engineer on the CW-20 Transport. This twin-engine airplane also became the Army Air Corp C-46 Commando, which saw cargo service throughout the world during the 1939–1945 war years and was subsequently used worldwide by many air cargo operators.

Early in 1940 Ken Perkins joined American Airlines as a research engineer. Based in New York, he served as a consultant to the vice-president of engineering and advised on transport aircraft design requirements and associated engineering problems. Later that year he took the position with the Office of Production Management in Washington, D.C., a predecessor to the War Production Board. As head of the Aircraft Scheduling Unit, he supervised scheduling of deliveries from manufacturers to the U.S. Army, the U.S. Navy, and the British.

He moved to the McDonnell Douglas Aircraft Company in St. Louis in late 1941. Ken started as a project engineer in advanced design and worked on the XP-67 twin-engine fighter. In 1942 he became an assistant chief engineer, and from 1943 to 1947 was responsible for the XFD-1, the U.S. Navy's first jet airplane, and its production version—the FH-1 Phantom, the first complete airplane designed and produced in quantity by McDonnell. The success of this program laid the groundwork for other jet fighters for the U.S. Navy and U.S. Air Force (USAF), which represented most of the subsequent business of the company. He was appointed assistant to the vice-president for engineering and contracts in September 1948 and subsequently became manager of engineering in July 1949. In April 1951 Ken was elevated to engineering vice-president, responsible for engineering work on aircraft, missiles, and spacecraft. Notable engineering work included the F-2H Banshee and the F-3H Demon carrier-based fighters for the U.S. Navy; the F-101 Voodoo fighters for three Commands of the U.S. Air Force; and the F-4 Phantom II attack and fighter aircraft for the U.S. Navy, the U.S. Air Force, and a number of other nations. Unmanned vehicles included the GAM-72 Quail decoy and the Asset hypersonic test vehicle along with a variety of related electronic products. Manned space vehicles included the Mercury spacecraft and the Gemini spacecraft, which carried the first two Americans into orbit.

Kendall Perkins was elected a company director and a member of its board's Executive Committee in December 1952 and served through 1966. After the merger of McDonnell and Douglas in April 1967 that formed the McDonnell Douglas Corporation, he was made vice-president of engineering and a member of the board of directors of two of the component companies—McDonnell Aircraft Company and McDonnell Douglas Astronautics Company. Subsequently, in July 1968 he became corporate vice-president of engineering and research. Notable engineering work since the merger has included development of the DC-10 Commercial Transport, the USAF F-15 Fighter, the NASA Skylab, the Saturn S-IVB Stage, the Spartan Interceptor Missile, the Dragon Anti-Tank Missile, the Harpoon Anti-Ship Missile, and the EROS Collision Avoidance System.

In 1973 when he reached age sixty-five, Kendall Perkins retired from the corporation. He retained his position on the board of directors of five McDonnell Douglas corporate divisions and served as a consultant. In 1975 he was asked to return to his former position on an interim basis, finally retiring in August 1978.

Outside his realm of engineering employment, he served on the Board of Trustees of Washington University for a number of years and subsequently became a trustee emeritus. He received the university's Alumni Achievement Award in 1982.

Kendall Perkins was elected to the National Academy of Engineering in 1970. He was cited for his contributions to aerospace technology and to engineering management in the design of aircraft and spacecraft.

Ken held a representative number of patents and also authored publications on aircraft design and articles on technical management.

Kendall Perkins was born in St. Louis on February 23, 1908, the son of Robert Fulton Perkins and Florence Gleason Perkins. He married Elizabeth Dorothy MacIvor on October 16, 1934. Their children are John MacIvor Perkins (August 2, 1935) and Amy Doris Perkins Bethke (June 11, 1938). Following Elizabeth Perkin's death in 1980, he married Vera Autry on January 9, 1981. He died on August 8, 1987.

Dean F. Peterson

1913–1989

By Robert L. Smith

Dean F. Peterson, professor emeritus of civil and agricultural/irrigation engineering at Utah State University, died on April 21, 1989, at the age of seventy-five. He was born on June 3, 1913, in Delta, Utah. His undergraduate education was at Utah State University, where he received a B.S. in civil engineering. His graduate education was at Rensselaer Polytechnic Institute, where he obtained an MCE and DCE. Dean was elected to membership in the National Academy of Engineering in 1974.

Dr. Peterson had a distinguished and multifaceted career in academe, government service, and consulting. He was involved with the design and operation of water resources projects and engineering education worldwide.

His first decade after college saw him in a number of engineering construction assignments scattered across the nation, culminating in several years of military service. His military commitment continued in the active reserve following World War II, and he retired as a captain in the U.S. Naval Reserve.

Dean initiated a serious commitment to the academic portion of his career in 1946 when he accepted appointment as an assistant professor at Utah State University. He left Utah State in 1949 to begin an eight-year assignment at Colorado State University as professor and head of the Department of Civil Engineering. Dean returned to Utah State in 1957, where he served as dean of engineering until 1973. From 1973 until his retirement to emeritus status in 1976, he was vice-president for research.

Dr. Peterson's role in government service was also extensive. In 1965–1966 he was on leave from the university to serve as technical assistant, Office of Science and Technology, Executive Office of the President; and concurrently, chairman, Committee on Water Resources Research of the Federal Council for Science and Technology. As special assistant, he was responsible for handling specific problems of national water resources policy as requested by the White House. The committee he chaired was charged with coordinating water resources research in the federal establishment. Again in 1968–1969 Dr. Peterson returned to Washington to head the Office of Water for Peace in the U.S. Department of State.

Following his retirement from the university, Dr. Peterson returned to government service where he concentrated on addressing problems of developing countries. From 1976 to 1978 he was chief, Soil and Water Division, Technical Assistance Bureau, U.S. Agency for International Development (USAID), Department of State; in 1978–1979 he was director, Office of Agriculture, Development Support Bureau, USAID; and from 1979 to 1981 he served in India as agricultural research and irrigation adviser, USAID. He continued in similar advisory capacities almost to the time of his death.

Dean was an acknowledged leader in the technical field of irrigation. He was equally at home in his knowledge of all aspects of worldwide food policy, ranging from economics to nutrition. Those who knew him well were continually struck by his compassion for all mankind, and his innate desire to improve the lot of the developing nations.

Dean Peterson was a quiet-spoken individual, but his work did not go unnoticed by his peers. They chose to honor him on numerous occasions. The American Society of Civil Engineers extended three major awards. These were the Royce Tipton Award for Irrigation in 1968, the Julian Hinds Award for Water Resources Management in 1980, and designation as an honorary member in 1976. The American Water Resources Association presented him with its Icko Iben Award in 1979. Also, in 1979 he received the U.S. Department of State's Superior Honor Award. He received the Distinguished Service Award of the Utah Academy of Sciences, Arts and Letters in 1976 and was designated an honorary citizen of Texas in 1971. He was also the recipient of two honorary doctor of science degrees, one from Utah State University, the other from Mahatma Phule Agricultural University in India.

Dean cared about his profession and he cared about people. He is missed.

Samuel Cochran Phillips

1921–1990

By George E. Mueller

General Samuel C. Phillips, truly a hero of our time, was a superlative leader, an unequaled manager, a true friend to all who knew him, and a quiet fighter who never lost a battle until his death, January 31, 1990.

The nation lost one of its most eminent engineering managers, the man who led the team to put men on the moon, the team that restored the prestige of our nation in the eyes of the world.

Sam was elected to the National Academy of Engineering (NAE) in 1971 in recognition of his continuing leadership of advanced technological programs. As a U.S. Air Force officer, his career began with the development of the B52 bomber, the deployment of the Thor missiles in England, the development of the Minuteman missile system (a driving force for the large-scale strategic integrated circuit breakthroughs in silicon technology), and the direction of the Apollo manned lunar landing program for the National Aeronautics and Space Administration (NASA); progressed to becoming the director of the National Security Agency for all the U.S. Armed Forces; and culminated as the commander of the U.S. Air Force Systems Command, responsible for all the development programs in the U.S. Air Force. As a civilian he managed the Energy Systems Group of TRW, led the "Phillips Committee" review of NASA management following the Challenger accident, and served as a councillor of NAE and panel member for committees of the National Research Council and joint activities of the Academies (the NAE and the National Academy of Sciences).

Sam was a Westerner, with all the understated strength and integrity of that people. Born in Springerville, Arizona, he graduated from the University of Wyoming in 1942 to go into the U.S. Air Force and to serve with distinction in the Eighth Air Force in Europe. After returning to the States and completing an M.S. in electrical engineering at the University of Michigan, he began his career as a manager. Typical Sam, on finding his role as a manager in the U.S. Air Force system hamstrung by the division between the program manager and the contracting officer, he took the necessary steps to qualify as a contracting officer as well as a program manager. He always found a way to make the system work for him. As a U.S. Air Force program manager, he was responsible for the innovative and enduring B52 bomber, which led to his selection by General Schriever to manage first the deployment of the Thor missile in England and then the development of the Minuteman ballistic missile, the workhorse of our missile systems.

Not widely recognized, then or now, Sam's Minuteman electronic systems were a driving force that speeded development of the reliable, ubiquitous integrated circuits, which are the foundation of our electronics technology today.

Perhaps his greatest contribution to the future of mankind was his leadership of the Apollo program from 1964 until the first landing of men on the moon in July of 1969. Sam's contribution to this, the most outstanding achievement of this century, was neither understood nor adequately recognized by the public or the media, although fully appreciated by his many friends in government and industry.

In recognition of his many achievements, he was widely honored by his peers. In addition to his election to the National Academy of Engineering, he was elected a fellow of the American Institute of Aeronautics and Astronautics, the Institute of Electrical and Electronics Engineers (IEEE), and the American Astronautical Association. He was given an honorary doctor of law degree from the University of Wyoming.

He received the Simon Ramo Medal of the IEEE, the White

Space Trophy from the National Geographic Society, the Langley Gold Medal from the Smithsonian Institution, the Astronautics Engineer Award from the National Space Club, the Distinguished Service Medal: Air Force from the U.S. Department of Defense, and the Distinguished Service Medal twice from NASA.

Sam did not rest on his laurels. After the successful landing on the moon, he returned to active duty in the U.S. Air Force and took command of the space and missiles systems organization, where he led the studies that defined the follow on to the Minuteman program and began the implementation of the U.S. Air Force's shuttle program. His next assignment was as commander of the National Security Agency, where he was instrumental in invigorating the research program and in improving the management of their development programs. His final U.S. Air Force assignment was as commander of the U.S. Air Force Systems Command, with responsibility for all the development projects in the U.S. Air Force.

After retiring from the U.S. Air Force, he began a new career in an entirely different field, where his management skills were put to the test and he became vice-president and general manager of TRW's Energy Products Group. After successfully guiding that group to profitability, he returned to his original field of interest, where he ended his industrial career as vice-president of TRW's Defense Systems Group.

Over the years, Sam continued to serve the nation, including serving as chairman of the "Phillips Committee," advising NASA on management improvements following the Challenger accident.

General Samuel C. Phillips served his nation well and long. May his memory serve as an example for those who follow.

Jan A. Rajchman

1911–1989

By William C. Hittinger

Jan A. Rajchman, retired staff vice-president, RCA Laboratories, died on April 1, 1989, after a long career as an innovator, technical leader, and consultant. During his forty years with RCA, he made significant contributions in the fields of electron devices and computers and was a prolific inventor and publisher.

Born on August 10, 1911, in London, England, he moved at the age of seven with his parents to their native Poland and three years later to Geneva, Switzerland. He graduated from the College de Geneve in 1930 and was awarded the M.S. in electrical engineering from the Swiss Federal Institute of Technology in Zurich in 1935 and the D.Sc. in 1938.

Jan Rajchman had a strong desire to do research in America and arrived as an immigrant in the spring of 1935. He sought employment at RCA because of its early work in electronics, but found that there were no openings because of the great depression. He therefore attended the Massachussetts Institute of Technology summer session and in August was offered a job by RCA in an engineering testing laboratory where variable condensers for radio receivers were calibrated against standards by bending the condenser plates by hand. By January 1936 he was assigned to an electronics laboratory directed by Vladimir Zworykin, which began an association lasting for many years.

Jan's first work was in electron multipliers. He developed an electronically focused device that was much simpler than the existing magnetically focused types. In a study that became the basis of his doctoral thesis, he found ways to eliminate the main causes of dark current, thereby extending the sensitivity of phototubes at low light levels. His designs are still the mainstay of present-day vacuum multipliers.

In 1939 he became deeply interested in the possibility of electronic calculations and began a long involvement in computer concepts and structures. He conceived, patented, and published concepts of many basic logic circuits, including a resistive matrix that served as the first true read-only memory. This effort emerged from a government-sponsored program during World War II to develop an electronic computer at the University of Pennsylvania. Jan joined the project and his memory device was used in the first electronic computer, the ENIAC.

He continued his computer research after the war and conceived in 1949 the magnetic core memory, for which he is perhaps best known. He developed the memory system, including aspects of the tiny ferrite cores strung on wires, that were widely used in commercial computers for many years. The transfluxor, one of his inventions, used a multiaperture core to perform many analog storage and logic functions in a number of applications, including subway control systems and assembly line motor controls.

In 1959 Jan Rajchman became director of research at the RCA Laboratories and led efforts in many emerging fields, including magnetic and semiconductor memory and logic devices, electronic displays, and computer software. He also directed the technical efforts of RCA's overseas research laboratories in Zurich and Tokyo from 1971 until his retirement in 1976.

These many exploratory efforts led to the issuance of 118 U.S. patents and 50 technical papers. He was much sought after as a speaker and organizer of technical conferences. He held membership in some ten professional societies, was elected to NAE membership in 1966, and was highly honored for his services to his profession. His awards include the Morris N. Liebmann Memorial Award and the Edison Medal of the Institute of Electrical and Electronics Engineers, the Harold Pender Award by the University of Pennsylvania, the NASA Certificate of Rec ognition, the Franklin Institute Louis E. Levy Medal, and four RCA Laboratory Achievement Awards.

Jan Rajchman served as a consultant to government and industry, particularly after his retirement from RCA. His efforts included working for the Defense Advanced Research Projects Agency in computer studies; as a consultant to AMP, Inc.; and as Visiting McKay Professor at the University of California, Berkeley.

His family had a strong tradition of learning. His father was a doctor; his wife, Ruth, a practicing lawyer; and his two children, Alice R. Hammond and John A. Rajchman, both doctoral graduates. Jan was a beloved colleague of many friends and associates, relationships developed during his highly productive technical career. His calm, witty manner and his vision of the future, coupled with broad cultural interests, made him unusually effective as a counselor to many young scientists, a legacy that will endure for years.


William B. W. Rand.

William Bradford Whitehill Rand

1902–1988

By Elmer P. Wheaton

William B. W. Rand, a pioneer in offshore drilling, died in Santa Monica, California, on March 9, 1988, after a long illness. Dr. Rand was best known for his early offshore geological surveys of the California coast and the development of the methods and equipment for conducting such surveys.

Bill Rand was born in Salt Lake City, Utah, on January 17, 1902. His family moved to northern California in 1906. He earned an A.B. in geological sciences at the University of California, Berkeley, in 1926, and was then employed by Shell Oil Company in southern California as a field geologist until 1929. During the depression years of 1931 and 1932, he was head of the Geology Department of Sacramento California Junior College, after which he rejoined Shell Oil as a field geologist in southern California. During this time, he completed his studies for a Ph.D. in geological sciences at the University of California, Berkeley. His dissertation was titled "The Geology of Santa Cruz Island, Santa Barbara County, California." He worked for Shell Oil until 1945 and held many responsible positions, his last being regional geologist for the area east of the Mississippi River.

In 1946 he joined the Union Oil Company in California and was assigned the task of developing a program for an offshore geologic survey of the California coast. Bill assembled a unique team of professionals who knew the area: sea captains, small boatmen, fishermen, divers, and geologists. Together they con verted a small navy surplus vessel into a geological exploration ship to obtain ocean bottom information that could be correlated with the seismic geophysical data.

In 1949 it became apparent that it would be necessary to find a way to get through the silty overburden to obtain samples of the ocean bottom formations. Bill came up with the idea of jetting through the overburden and exposing the formation. This jetting system worked very well, but it was soon realized that it would be necessary to core drill into the bottom formations to obtain the information needed. This new and challenging requirement of drilling in several hundred feet of water and through several hundred feet of overburden into the ocean bottom formations would require the design of new equipment.

Bill decided to form his own company, which he named "Submarex," to design the equipment that would accomplish this task and under contract make exploratory surveys for the various oil companies. He proceeded to design and install the first rotary drill rig mounted on a self-propelled vessel, which he named after his company. The *Submarex* drilled the first rotary core holes in the Pacific Ocean in 1951 and is credited with being the world's first offshore drill ship. This first ship had a small geophysical-type drilling rig mounted over the side of the ship with a steel grid runround for the roughnecks, who stood in knee-deep water while making connections or pulling the drill string. Bill's company then converted and operated a fleet of exploratory drilling vessels, with some of these vessels being equipped with a moon pool and a center-mounted derrick. The ships with side-mounted rigs could drill holes up to two thousand feet deep in the sea floor, while the center-mounted ones could drill to four thousand feet. One of his vessels drilled the first rotary core hole in the Atlantic Ocean in 1955. Bill and his company flourished and provided many innovations to offshore geological exploration, one being a device that Bill patented for taking oriented submarine cores.

Seeing 1958 bring decreasing exploratory activity, Bill turned his attention to consulting. He did consulting work for General Motors Santa Barbara Marine Laboratory and for various Japanese petroleum organizations on offshore exploration. In 1963 under a contract with the U.S. Coast and Geodetic Survey, he set an experimental submerged recording buoy on a three-point mooring in six thousand feet of water and conducted an associated bottom sampling and sea floor topographic investigation of the area.

In 1966 Scripps Institution was preparing a bid to the National Science Foundation for the Deep Sea Drilling Project. It was an absolutely unique undertaking, both scientifically and technically, and exceptional lead personnel would be required. Bill was considered a key candidate for the position of program manager because of his early and successful experience in the field and his education as a geologist. The only difficulty was the potential conflict of interest due to his offshore drilling company holdings. When it was discovered that he had sold his company and no longer had a conflict of interest, they persuaded him to join the Scripps project team. William A. Nierenberg, director emeritus of Scripps, has stated that Bill went to work immediately, preparing the specifications and bid package for the drilling ship and its operations with an ease and professionalism that was a key to the success of the project. Bill stayed with the project until after the first trial runs in 1967 and until he could see that the project was well under way and that he had trained an able successor.

He returned then to general consulting in offshore mineral recovery. He became a member of the National Academy of Engineering's Marine Board at its inception in 1965, actively serving on it until 1974. During this period, he made many important contributions to their studies. He was elected to the National Academy of Engineering in 1973. In 1976, due to illness, he discontinued his professional activities.

A member of Bill's exploration crew has said, "Bill was immediately popular aboard ship. Not only was he a gentleman, but he had that rare quality of a common touch with all the crew." All who were acquainted with Bill were impressed not only with his knowledge of offshore geology but also with his understanding of mechanics and his capability in designing and adapting equipment to work in the marine environment. He was a true pioneer in the field of offshore engineering.

Philip C. Rutledge

1906–1990

By James P. Gould

Philip C. Rutledge, consulting engineer and teacher, died on July 14, 1990, at the age of eighty-four. Elected to the National Academy of Engineering in 1968, Dr. Rutledge was a pioneer and leader in geotechnical engineering since its early development in the United States in the 1930s. His consulting was marked by the systematic application of fundamental soil mechanics to many of the most important earthwork and foundation projects of his time.

A graduate of Harvard College in 1927, Rutledge received an M.S. in civil engineering from the Massachusetts Institute of Technology (MIT) in 1933 and D.Sc. from Harvard in 1939. In 1957 he was awarded an honorary doctor of engineering degree from Purdue. His career spanned fifty years between graduation in 1927 and retirement from consulting practice in 1977. This time was divided into two periods: he spent the first twenty-five years as a teacher and specialized consultant to industry and the federal government, the last twenty-five as a partner of Mueser Rutledge Consulting Engineers in New York City. In his early years, Rutledge worked with the leaders of the new soil mechanics at MIT until 1933 and at Harvard from 1933 to 1937. With Arthur Casagrande he organized the first International Conference on Soil Mechanics and Foundation Engineering, which was held in Cambridge in 1937.

As a professor from 1937 to 1943 at Purdue University and from 1943 to 1952 at Northwestern University Technological Institute, he was instrumental in establishing geotechnical studies in their civil engineering departments. At Northwestern he collaborated with Jorj O. Osterberg to design and build an impressive array of laboratory testing equipment, which gave Northwestern one of the strongest soil mechanics programs in the country. He moved from the position of department chairman at Northwestern to a consulting practice at Mueser Rutledge in 1952.

While teaching, he served the U.S. Army Corps of Engineers as consultant on airfield pavements and as chairman of their panel on soil mechanics research and development, receiving in 1949 the War Department's Certificate of Appreciation for services in developing airfield pavements for heavy aircraft. One of his most important contributions was a 1947 review of the Waterways Experiment Station research program on shear strength of clay, research that had been performed by Casagrande at Harvard and Donald Taylor at MIT.

Rutledge's contacts while at Northwestern University with the then Moran Proctor Freeman and Mueser firm led to his acceptance of an offer to join the firm in 1952. During the next twenty-five years his consulting activities expanded to include many of the largest heavy-construction projects of the day. In collaboration with his partners, who were foundation engineers of vast experience, Rutledge contributed the insights and logic of modern soil mechanics. His specialties included earth dams, tunnels, building foundations, waterfront structures, and underground construction.

For twelve years, from 1962 to 1974, he was chairman of the Board of Consultants for earth and rockfill dams of the California Department of Water Resources. He participated in the completion of seven major dams. Five of these range upward from 300 feet in maximum height to the 770-foot-high Oroville Dam. Pumped storage hydroelectric developments were another specialty, comprising seven major projects including the Blenheim-Gilboa facility of the State of New York Power Authority.

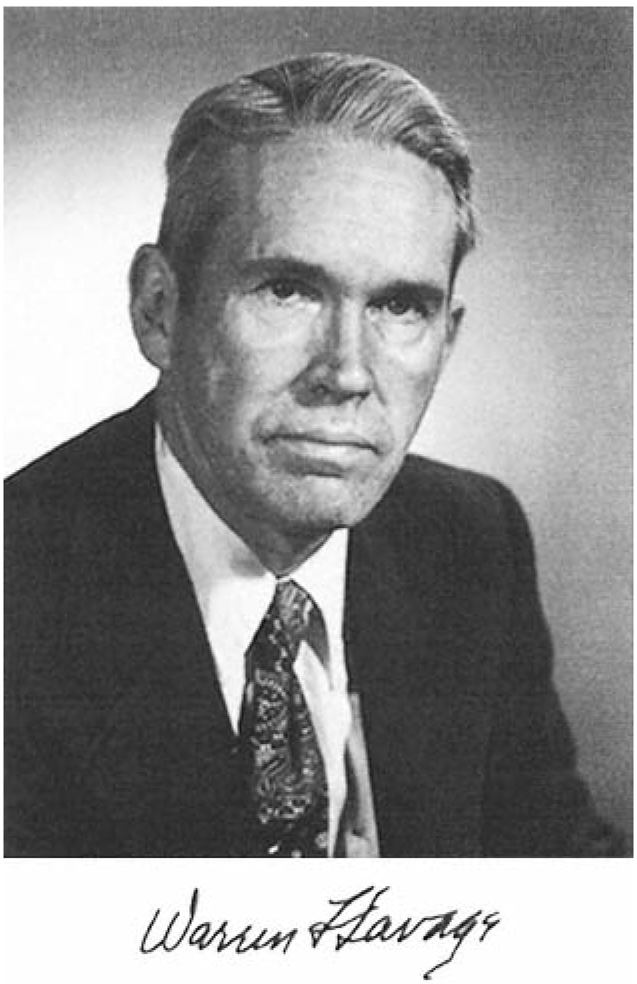
Because of his extraordinary ability to adapt basic geotechni cal engineering to practical construction problems, he was much sought after as a consultant on projects of grand scale. Rutledge participated in advisory boards for the Plowshare project of the U.S. Atomic Energy Commission, Salinity Control Barriers in San Francisco Bay, foundations for atomic accelerators of Lawrence Radiation Laboratory, and the AtlanticPacific Interoceanic Sea Level Canal Study of the Corps of Engineers.

Some of his most effective work was done in a classic collaboration with his partner William H. Mueser. Mueser was the hard-driving doer, Rutledge the quiet analyst never committing until he had thought through the problem. Together they forged the basic foundation concepts for the Savannah River atomic plant, Texas Tower radar platforms, the Washington subway, the Vertical Assembly Building at Cape Kennedy, and a series of new buildings for the expanded congressional facilities in Washington, D.C.

Throughout his career, he was active in the American Society of Civil Engineers, serving as president of the New York Metropolitan Section in 1955, national director from 1958 to 1960, and member and chairman of the Executive Committee of the Geotechnical Engineering Division from 1947 to 1952. He was the 1969 Terzaghi Lecturer and recipient of the Terzaghi Award.

To his many students during the first twenty-five years of his career, Rutledge was an extraordinarily well-organized, concise, and sympathetic teacher, presenting rapidly evolving ideas in soil mechanics, a field in which he had contributed significantly. His particular research interests included the relationship of shear strength of clays to their preconsolidation stress, stability of foundations under lateral load, mechanics of load transfer in foundation piles, and the assessment of sample disturbance in consolidation testing.

To his partners and colleagues at Mueser Rutledge Consulting Engineers, he was the final authority on geotechnical matters. If no answer was forthcoming from the literature or from the firm's experience, Rutledge would make his own concise analysis and recommendation. Nothing pleased him more than an opportunity to solve a difficult foundation problem by work ing up from first principles of mechanics. Although he was entirely separated from academia in the latter half of his career, he functioned as teacher and preceptor for his colleagues. Whatever the accomplishments of his successors, their best work will bear the imprint of Philip C. Rutledge.



Warren F. Savage

1922–1988

By Merton C. Flemings with the Assistance of William D. Manly and Nathan E. Promisel

"Doc" Savage, an international leader in welding and high-temperature testing, died on January 24, 1988, at the age of sixty-six.

Elected to the National Academy of Engineering in April 1981, Dr. Savage became the "chief mentor" to a major sector of the world of welding metallurgy.

During his career, which stretched across four decades, Dr. Savage published more than one hundred papers, mostly on welding metallurgy. He was graduate adviser and research adviser for more than fifty masters and thirty Ph.D. students, including the adviser to the president of Nippon Steel, the deputy director of the British Welding Institute, four university professors, a department chairman, a dean of engineering, three research directors, three chief welding metallurgists, and approximately forty welding engineers.

Dr. Savage developed a high-speed thermomechanical simulator and founded a company, Duffers Associates, Inc., for manufacturing and marketing this apparatus. He developed this apparatus to evaluate the influence of rapid thermal cycles on mechanical properties, such as those associated with affected zones of fusion welds. More than eighty of these devices, known as "Gleebles," are currently in use around the world for evaluating short-time elevated temperature properties, simulating hot rolling and forging operations, evaluating weldability, and studying solidification phenomena.

He also developed a metering system for measuring the secondary current and weld time in electric resistance welding as an aid to quality control of spot and seam welding. More than three thousand of these metering systems are in use in automotive and aircraft assembly plants to monitor weld quality, which is vital to personnel safety. Dr. Savage held the patent on the Verestraint Test, a key method of evaluating the weldability of metals, which is used worldwide to provide a quantitative means not only for determining weldability but also for optimizing welding procedures.

His international reputation was amply demonstrated during his many visits to the U.S.S.R. as a member of the U.S.\U.S.S.R. Science Exchange Program. His reputation encouraged disclosure of Soviet progress and developments in important and novel welding techniques. He was invaluable in critically assessing the merits and potentials of this (and other foreign) information important to future productivity and quality.

Dr. Savage earned his undergraduate and graduate degrees while at Rensselaer Polytechnic Institute (RPI). After receiving his B.Ch.E. in 1942, he worked for two years as metallurgical engineer at Adirondack Foundries and Steel Company in Watervliet, New York. He then returned to RPI, receiving his M.Met.E. in 1949 and Ph.D. in 1954. Simultaneously he was a member of the teaching staff at RPI, as instructor from 1948 to 1952, and faculty member from 1952 onward. He became professor of metallurgy and director of welding research in July 1960.

Doc Savage received many awards during his illustrious career. He became an honorary life member of the American Welding Society (AWS) in 1970, and received from that society its Clarence H. Jennings Memorial Award in 1978 and 1980 and its award for the best research paper in 1977 and 1980. In 1986, friends and former students of Dr. Savage established through the AWS an award in his name to recognize his lifetime accomplishments and dedication in the field of welding metallurgy. He was a fellow of the American Society of Metals and of the Welding Institute. He was also a member of the Rensselaer Society of

Engineers and an expert on the American Delegation of the International Institute of Welding (IIW) and presented the 1980 IIW Houdremont Lecture in 1980. Professor Savage's long-term contributions to the field of welding research included the development of scientific principles; the translation of these principles to engineering, particularly for causes of weld cracking and methods of eliminating cracking; educational activities in technical societies; teaching of students; international societies leadership; and many other activities that reflect his foremost standing in the field of welding research.

Dr. Savage retired in 1984 but continued to play an active role in student advising and research activities for Rensselaer. Throughout his career he was sought after as a consultant by both government and industry. He served as a member of the U.S./U.S.S.R. Joint Commission on Welding and Special Electrometallurgy, was Welding Adviser to the Energy Research and Development Administration's Priorities Committee on Materials Research, and served as consultant to the U.S. Department of Transportation and the Association of American Railroads.

It is noteworthy that, apart from his professional prowess, Dr. Savage had a strongly humanistic side. He was a cordial, friendly, approachable person and could easily become enthusiastic in a dialog on practically any subject. He was a delightful companion, combining his professional astuteness with this social behavior.


H. Bolton Seed

Harry Bolton Seed

1922–1989

By James K. Mitchell

Harry Bolton Seed was born in Bolton, England, on August 19, 1922. He studied at King's College, London University, receiving the B.Sc. in civil engineering in 1944 and the Ph.D. in structural engineering in 1947. Following two years as assistant lecturer at King's, he came to the United States to study soil mechanics at Harvard University under the tutelage of Karl Terzaghi and Arthur Casagrande. He received the S.M. from Harvard in 1948 and spent the next year as an instructor. This was followed by a year as a foundation engineer for Thomas Worcester, Incorporated, in Boston.

In 1950 Professor Seed joined the civil engineering faculty at the University of California, where he spent the remainder of his career as an engineering educator, researcher in geotechnical. engineering, and consultant to numerous companies and government agencies. He built the program in geotechnical engineering at Berkeley into one of the largest and best in the world. A major factor in this development was his bringing colleagues together from different areas of geotechnical engineering, including geological engineering and rock mechanics, as well as soil mechanics and foundation engineering. He served as chairman of the Civil Engineering Department from 1965 to 1971, a period during which it rose to number one ranking in the United States for the quality of its graduate programs.

Professor Seed had an enormous impact on every area of research activity in which he worked. His early work on the mechanics of pile foundations still forms the basis of modern methods of pile-soil interaction. His research on soil compaction and the influences of methods of compaction on soil structure and mechanical properties provides the foundation for current understanding. His contributions to analytical methods of pavement design were of the first rank.

About 1960 he introduced the field of geotechnical earthquake engineering, and he is recognized worldwide as the "father" of this field. His pioneering studies included the development of methods for site response analysis, for the analysis of soil-structure interaction, for seismicity evaluation, and for assessment of liquefaction potential. The results of his research have led to a total revision of concepts and methods for earthquake-resistant design of earth dams, nuclear power plants, coastal facilities, and building foundations, as well as revision of codes of practice, design procedures, and regulations. This work, founded on sound scientific principles, has been adopted throughout the world. He served as a consultant on projects all over the world and to virtually every major federal agency and large engineering organization in the United States.

Through his research Professor Seed developed design methods that revolutionized many aspects of engineering practice and thinking. They have had enormous influence on the safety of critical structures such as major dams, nuclear power plants, and high-rise buildings. His investigations of major disasters, such as the 1964 Great Alaska earthquake, the 1971 San Fernando earthquake in California, the 1976 failure of the Teton Dam, the 1979 slide at the Port of Nice in France, and the 1985 Mexico City earthquake, have, with the aid of modern methods of analysis and experimental techniques, led to a basic understanding of their causes and to the measures that must be taken to prevent similar occurrences in the future. His selection by the government of Egypt, under AID sponsorship, to make a seismic safety evaluation of the Aswan High Dam placed the safety of literally millions of people in his hands. His work in all these areas will have an impact on the world for generations to come.

Harry Seed's work as an engineering educator, scholar, and servant of his profession was unsurpassed. He was the epitome of a model scholar, devoted to the advancement of engineering science and practice. He devoted large amounts of time to public service activities. He was always brilliant as a public speaker and was recognized for years as the best lecturer and teacher in his department. He guided fifty Ph.D. candidates to the successful completion of their dissertation research; many of them have gone on to distinguished careers of their own in the geotechnical engineering field. His writings—nearly three hundred papers and reports—are exceptionally lucid and insightful and provide eloquent testimony, as well as a lasting record of his work. He was active, maintaining a full schedule of teaching, research, and professional activity until very shortly before his death.

Professor Seed recieved many awards and honors for his contributions. Among them are more awards from the American Society of Civil Engineers (ASCE) than any other engineer in the history of the society. These include the Norman Medal twice, the J. James Croes Medal three times, the Thomas A. Middle-brooks Award four times, the Thomas Fitch Rowland Prize, the Arthur M. Wellington Prize, the Walter L. Huber Civil Engineering Research Prize, and the Karl Terzaghi Award. For his excellence as an educator he received the Distinguished Teaching Award from the University of California and the Vincent Bendix Award and the Lamme Award from the American Society for Engineering Education.

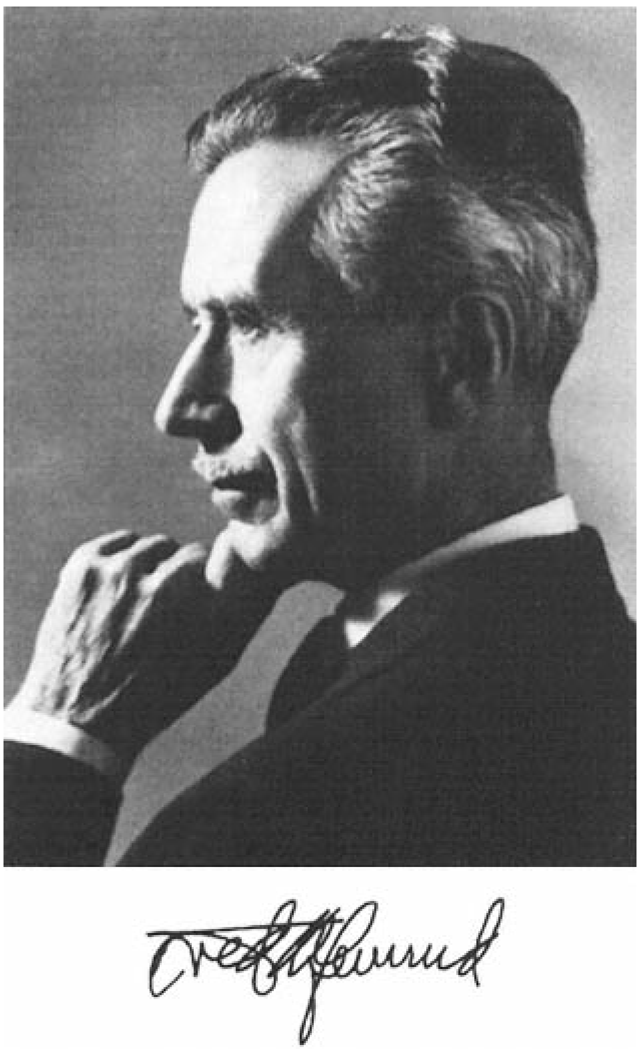
Other awards include election as fellow of King's College, London University; the T. K. Hsieh Award of the British Royal Society and Institution of Civil Engineers, Great Britain; the Distinguished Engineering Achievement Award of the Institute for the Advancement of Engineering; and the first Kevin Nash Gold Medal of the International Society for Soil Mechanics and Foundation Engineering.

He was selected as Faculty Research Lecturer at the University of California in 1986, the highest honor that the faculty can bestow on one of its own. Other distinguished lectureships awarded to Professor Seed include the Horace A. McCrary Lecture at the Massachusetts Institute of Technology; the Karl

Terzaghi Lecture of the American Society of Civil Engineers; the Henry M. Shaw Lecture at North Carolina State University; Terzaghi Memorial Lecturer at Bogazici University, Turkey; the Rankine Lecture of the Institution of Civil Engineers, Great Britain; Northern Testing Services Distinguished Lecturer; Martin S. Kapp Memorial Lecturer of the ASCE; James H. Haley Memorial Lecturer, Boston Society of Civil Engineers; Distinguished Civil Engineering Lecturer, University of Nevada; Charles Schwab Memorial Lecturer, American Iron and Steel Institute; and the Nabor Carrillo Lecturer, Mexican Society for Soil Mechanics.

Dr. Seed was elected to the U.S. National Academy of Engineering in 1970, to honorary membership in the American Society of Civil Engineers in 1985, to the U.S. National Academy of Sciences in 1986, and to honorary membership in the Earthquake Engineering Research Institute in 1988. In 1987 he was awarded the National Medal of Science by President Reagan, and in 1988 he was awarded the first honorary doctorate presented by the Ecole Nationale des Ponts et Chaussees in Paris.

Dr. Harry Bolton Seed was truly a giant of his generation, and all of us are the richer for having had him among us. For those who knew him well, he will be most remembered as a generous and compassionate gentleman, with wit, incisive insights, and wide-ranging interest in the world around him. No problem was too small to be analyzed and solved; every person was given his time and consideration. He was truly a teacher in the highest sense of the word.



Fred N. Severud

1899–1990

By Anton Tedesko

Fred N. Severud was born in Bergen, Norway, on June 8, 1899, and died in Miami, Florida, on June 11, 1990. As one of the foremost structural engineers of his time, he left his imprint on many famous buildings, as well as a host of conventional structures. Severud was an innovator responsible for many unusual creative structural solutions. He was an excellent speaker who inspired complete confidence.

Severud graduated in 1923 from the Institute of Technology in Trondheim, Norway. He married his college sweetheart, Signe Hansen, and they headed for the United States. Shortly after their arrival he obtained a position with an engineering company, where he advanced rapidly. After several years he decided to start his own engineering practice, was recommended for a major housing project, and made his reputation as a troubleshooter for buildings that had developed problems. He found satisfaction in developing engineering solutions to difficult problems. It seemed that in his structural engineering there was always at work a good bit of ingenuity and intuition. He learned many lessons from nature, observed for instance the structure of flowers, and applied this knowledge to structural design. He pioneered many new structural systems and was respected for his structures, which stand today in fine condition.

Among the innovations introduced by Severud was the cable-supported roof. He applied the principles known and used for suspension bridges to buildings, such as the Raleigh, North Carolina, Livestock Judging Arena; the Yale University hockey rink; and Madison Square Garden.

Quite a few of the structural designers in Severud's office had attended European universities, where they received a much broader education and training than was then obtainable by students in American technical universities. Initially, Severud's firm was known as Severud-Elstad-Krueger; Elstad had come from Norway, Krueger from Germany. Twenty years later, the name of the firm had changed to Severud-Perrone-Sturm-Bandel, and eventually this was shortened to Severud Associates.

The Severud firm on its own or in collaboaration with well-known architects created a number of stunning projects, such as the Place Ville Marie Center in Montreal, and the superb City Hall Complex in Toronto. Severud was the favorite engineer of several prestigious architects known for their contemporary work. He cooperated with architect Eero Saarinen on the design and the supervision of construction of the Gateway Arch, a 630-foot-high stainless steel sculpture on the bank of the Mississippi River at St. Louis.

The American Institute of Architects elected Fred N. Severud an honorary associate member in acknowledgment of the creative stimulus derived by the profession from his leadership in structural design and engineering. A fellow of the American Society of Civil Engineers, he received numerous other honors, such as the Earnest E. Howard Award of that society, and the Frank P. Brown Medal of the Franklin Institute for outstanding engineering accomplishments. In 1968 he was elected a member of the National Academy of Engineering.

Severud was the author of several books on architectural and engineering subjects, and on the safety under nuclear blast. He wrote many technical articles that appeared in professional journals. Severud frequently lectured to groups of architectural students. The multitude of his technical skills was unusual, as was his skill in human relations. He will be remembered not just as an outstanding engineer, but as a man who cared about his fellow man and showed this concern by his actions.

Severud retired from his firm in 1973. Upon leaving he gave up all engineering-related contacts and activities and spent his time and efforts entirely on behalf of a Bible-oriented religious organization.

Mr. Severud is survived by his daughters, Laila Shalkoski and Sonja Susich, and by his son, Fred Severud, Jr., a civil engineer-member in the Severud firm.

William Pence Slichter

1922–1990

By David W. McCall

William Pence Slichter, retired executive director with AT&T Bell Laboratories, died at this home in Chatham, New Jersey, on October 25, 1990. He succumbed to cancer in his sixty-ninth year. Dr. Slichter's career coincided with the emergence of materials science as a recognized discipline, and he played an important role in research, development, management, and definition of the field.

Dr. Slichter was born in Ithaca, New York, where his father was a professor in the Economics Department of Cornell University. Sumner Slichter transferred to Harvard University in 1926. William Slichter grew up in Cambridge, Massachusetts, where he graduated from the Browne and Nichols School and Harvard College. Following graduation from Harvard in 1944, he entered the U.S. Army. He achieved the rank of lieutenant in the field artillery and that of captain in the reserve and saw service in the Pacific theater. He always spoke favorably of his military experience and invoked organizational principles learned there in diverse situations later in life. Upon discharge from the service in 1946, he enrolled for graduate study, again at Harvard, and emerged with a Ph.D. in chemical physics in 1950. His doctoral research was carried out in collaboration with Professor George Bogden Kistiakowsky in the area of molecular beams methodology. In those days molecular beams experiments were per formed with handmade glass apparatus, and the techniques were extremely difficult.

Dr. Slichter then elected to enter an industrial career with the Bell Telephone Laboratories as part of a new initiative in polymer research headed by W. O. Baker. The decade of the 1950s was an exciting time at Bell Labs, and Slichter lost little time in becoming a key contributor in the community. After a period of learning in the polymer area, he was called to join a team working on the processes of diffusion in semiconductor crystals. This work led in 1953 to a seminal paper with J. A. Burton and R. C. Prim in which the theory and experimental situation in regard to the distribution of impurities and desired solutes was described in useful terms. Their results were summarized in the now-classic Burton-Prim-Slichter equation, which describes the segregation of impurities during solidification as a function of experimental variables. Their findings were immediately applied to the preparation of silicon single crystals and were key to obtaining crystals satisfactory for early transistors. This became one of the building blocks of the field of semiconductor crystal growth and solid-state processing that continues until this day.

In 1954 Slichter returned to the area of high polymer studies and focused on solid-state structure and properties. The long chain nature of polymers had been discovered some years earlier, and important studies of the crystallography of polymers had been carried out by Baker and C. S. Fuller. Slichter perceived that the next essential step in understanding lay in the next higher level of molecular organization, that of polymer morphology, or specifically, the manner in which polymer crystals are organized into spherulites. The discovery and verification of chain folding in polymer lamellae in the late 1950s was a key step. (Interestingly, chain folding had been discovered at Bell Labs much earlier, in gutta-percha, but the general significance of the finding was not appreciated, and the phenomenon remained to be rediscovered by Keller in England in 1956.)

At the same time a new tool, nuclear magnetic resonance (NMR), arrived on the scene, and Slichter initiated a long-term program that provided the underpinnings for dielectric and mechanical relaxation. This work provided engineering insights that were essential in the application of polymers in communications equipment and also had great impact on polymer applications in other fields. While the morphology revolution remained largely focused on polyethylene in the 1950s and early 1960s, Slichter began to apply the principles to a wide variety of useful polymeric materials. He contributed to the experimental methodology through the development of NMR spectrometers built locally and involving the most advanced techniques known at the time.

His papers were clear and persuasive, and he was highly regarded for his ability to interpret advanced results in terms that were clear to coworkers concerned with engineering problems. For this work Dr. Slichter was awarded the American Physical Society High-Polymer Physics Prize in 1970. The prize committee recognized his contribution to the understanding of engineering properties of polymeric materials.

A large part of Dr. Slichter's career was devoted to the management of engineering and research activities within Bell Labs. He recognized early on that manufacturing processes were becoming less mechanical and more chemical, and he assembled an organization capable of supporting the design, manufacture, and maintenance of the most advanced communications equipment. He was instrumental in building organic and theoretical chemistry groups in the late 1950s and early 1960s. During the 1960s he assembled a highly regarded group covering polymer physics and chemistry, polymer engineering, and specific applications groups concerned with extruded products, molded products, adhesives, and many other classes of materials. In the 1970s he formed a chemical engineering organization well adapted to the needs of the company.

While metallurgy, ceramics, and glass technology were evolving into the other parts of materials science, Slichter assumed responsibility for the entire range of AT&T's materials activities as Executive Director of Research, Materials Science and Engineering Division, in 1973. Through his efforts the diverse branches of materials science were developed into a coherent, unified, and effective organization that successfully provided materials engineering to the design, manufacturing, and operating divi sions of AT&T. Dr. Slichter was an inspiring leader, who succeeded in bringing together effective teams to perform innovative tasks. Examples include optical fiber technology (including glass compositions and processing as well as the plastic coating), resist chemistry for electron beam production of integrated circuit masks, superior wire and cable insulation and sheathing, radiation cured distributing frame wire insulation, magnetic components for telephones, and novel alloys for connector applications, to mention only a few.

Dr. Slichter's technical and managerial skills were widely recognized; he was elected to the National Academy of Engineering (NAE) in 1976, and he was frequently asked to consult with and advise organizations other than AT&T. The following partial list of his activities will give a flavor of their importance and diversity:

Advisory Committee, Division of Mathematics and Physical Sciences, National Science Foundation

Visiting Committee on Advanced Technology, National Institute of Standards and Technology

National Academy of Engineering, Materials Engineering Peer Committee

Director, Michigan Macromolecular Institute

NAE Engineering Research Centers Assessment Committee

Committee on Major Materials Facilities, National Research Council (NRC), which reported to the White House

Board of Trustees, Gordon Research Conferences

Committee on Scientific and Technological Aspects of Materials Processing in Space, NRC

Director, American Society of Testing and Materials

Advisory Committee for Chemistry Department, Harvard University

National Materials Advisory Board, NRC

Advisory Council, National Aeronautics and Space Administration

Space Applications Board, NRC

Council of the American Physical Society

At the time of his death, Dr. Slichter's calendar contained many of these and similar commitments.

Dr. Slichter had remarkable instincts for good engineering and science. He did his homework carefully, and he knew how to deliver firm messages with kindness and tact. He thought deeply about the future, on both a corporate and national level. His managerial accomplishments were recognized by two awards in 1988: the Earle B. Barnes Award for Leadership in Chemical Research Management given by the American Chemical Society (ACS) and the Application to Practice Award of the Minerals, Metals and Materials Society.

Dr. Slichter took an active interest in education and published significant papers on the subject. His enthusiasm for engineering and science was infectious, and he influenced many young people in their career choices. He served on the ACS Committee on Professional Training for a number of years.

Beyond his many professional accomplishments, Dr. Slichter is memorable for his evident humanity. He was singularly generous with his colleagues at all levels. He was bright and friendly, and people generally gravitated to him. There was never a greater agent for inspiring high morale. His passing will be mourned by people of goodwill around the world. He was an active member of the Committee on Human Rights of the National Academy of Sciences and the Committee on Chemistry and Public Affairs of the American Chemical Society.

Dr. Slichter's wife, the former Ruth Kaple, died in 1988. He is survived by his daughters, Carol Dougherty, a chef and restaurateur in Larchmont, New York; Catherine Slichter-Aiuto, with the U.S. Department of State in New York City; Margaret Van Cott of Nantucket, Massachusetts, and two grandchildren. His brother, Charles P. Slichter, is a professor of physics at the University of Illinois, Urbana.

Eugene C. Starr

1901–1988

By Thomas H. Lee and Ralph S. Gens

Eugene C. Starr, engineer, educator, and leader in the electric power industry, both in the United States and in the international community, died on February 5, 1988, at the age of eighty-six.

Elected to the National Academy of Engineering in 1977, Gene was a respected engineering leader, a dedicated professional, and a beloved teacher. Throughout his entire life, he pursued the development of advanced technology for the electrical transmission system. He was extremely active in professional societies, where he provided inspiration to young engineers in the electric power field.

Gene received from Orevon State University his B.S. in electrical engineering in 1923 and his E.E. in 1938. From 1924 to 1927 he worked on high-voltage research at the General Electric Company. In 1927 he returned to Oregon State to become an instructor in electrical engineering, and was appointed professor in 1939. He remained in that position until 1954, when he left the university to become chief engineer for the Bonneville Power Administration (BPA) in Portland, Oregon. BPA was no stranger to Gene, because between 1939 and 1954 he had served as consulting engineer to BPA and thus was familiar with BPA activities. From 1962 to his death in 1988, Gene served as full-time senior consultant to all BPA administrators and chief engineers.

Gene led the technical development of one of the world's outstanding power transmission organizations—BPA—during some of its most important years of technological development. Although it is difficult to separate the impacts of his activities as manager from those as consultant, clearly the application of series capacitors on transmission systems had the greatest impact in the western United States. Without the series capacitors, the 500-kilovolt alternating-current system, stretching all the way from six hundred miles north of the Canadian border to the Mexican border, would not have been technically and economically feasible. His interest in direct-current transmission technology, first kindled by the need in 1939 to explore long-distance transmission, was applied again in the fourteen-hundred-mile-long West Coast direct-current intertie link. Other major interests were the introduction of large high-voltage shunt capacitor installation for transmission economy and reliability, and his quests to find fast, reliable, and restrike-free circuit breakers for transmission system applications. His experience with high-voltage research led to better understanding of arc deionization time requirements for transmission line lightning flashovers, radio noise, and corona phenomena, from both conductors in air or in oil-impregnated insulation structures. Not to be overlooked is his basic work on aircraft static charge precipitation, which also led to his involvement in similar work in the Manhattan Project.

However, Gene had also other interests. He was a crack pistol shot, an avid hunter, a connoisseur of powerful automobiles, and he had a willingness to share any experience, from making wine to making ammunition.

In addition to his duties with BPA, Gene was a life fellow of the Institute of Electrical and Electronics Engineers (IEEE); a member of the board of directors of the American Institute of Electrical Engineers (AIEE); the U.S. representative for CIGRE, the International Conference on Large High Voltage Electric Systems, Study Committee No. 14; a member of the executive committee of the American Nuclear Society's Power Division; a member of the Atomic Energy Commission's Advisory Committee on Reactor Policies and Programs; a consultant to UNESCO, the United Nations Educational, Scientific, and Cultural Organization, for activities in India; a member of the Federal Power Commission's Advisory Committee on Power System Reliability; and many other similar activities.

In 1965 he received the U.S. Department of the Interior's Distinguished Service Award with Gold Medal, and he was named Engineer of the Year by Professional Engineers of Oregon. He was the recipient of IEEE's William M. Harbirshaw Award in 1968 and its Lamme Medal in 1980, and BPA's Administrator's Award for Distinguished Service in 1982. In 1976 he received the Distinguished Service Award from Oregon State University. He published more than forty professional and technical articles in the field of high-voltage, high-capacity alternating-and direct-current power transmission, high-voltage dielectric and environmental phenomena, conventional and nuclear power generation, and power system reliability.

Charles W. Stephens

1930–1990

By J. R. Burnett

Charles W. Stephens, or "Charlie" as he was known to his family and friends, died on July 16, 1990, just a few days short of the age of 60. Charlie retired in 1986 as the corporate vice-president and deputy general manager of the Electronics and Defense Sector of TRW Inc. From retirement until his death, Charlie was a technical consultant to TRW.

Elected to the National Academy of Engineering in 1985, Charlie was an innovative, dedicated professional known for his many technical contributions to space electronic and communications systems, his mentoring the professional growth of many engineers, and his service to the engineering profession both within TRW and in the larger technical community.

Charlie was born on July 26, 1930, in Liberal, Kansas. He received his B.S. in electrical engineering from the University of Kansas in 1953. While at Bell Laboratories, he took the Graduate Engineering Program. He also graduated from the Executive Program at the University of California, Los Angeles, in 1971.

Charlie and Mary Stephens were married in August of 1952. They had three children, Craig, Cathy, and Kirk.

Upon graduation from the University of Kansas, Charlie joined Bell Telephone Laboratories, where he was involved in military electronics design until 1954. He served his country in the U.S. Army until 1956. In 1957 he joined the Ramo Wool dridge Corporation, the predecessor company to TRW, and remained there until his retirement in 1986.

Charlie, early in his TRW career, showed signs of being precocious not only technically but also managerially. His three-decade career was entirely in the fields of spacecraft electronics and space communications. The breadth of these fields included research and development, manufacturing, integration and test, and on-orbit operations. He contributed to all of these activities as he climbed the management ladder from design and research engineering through management of subsystems and complete systems, and then to overall management of the enterprise.

Charlie organized and managed the Systems Engineering Laboratory of the Electronic Systems Division, which was responsible for the system synthesis, analytical design, and performance analysis of advanced satellite and military communications systems. He was instrumental in the recruitment, mentoring, and development of many outstanding young engineers who are sprinkled throughout the management of the Space and Defense Sector of TRW.

From 1977 to 1981 he served as the vice-president and general manager of the Electronic Systems Division. He made personal contributions to advancements in the state of the art of communications technology and its applications to high-priority defense and space systems programs. His technical leadership and personal contributions to microelectronics, electro-optics, millimeter wave, microwave, and signal processing technology development have enhanced the national security posture of the United States.

He next was promoted to the position of vice-president and general manager of the TRW Electronic Systems Group, where he stayed from 1981 to 1984. This was a 5,000-person organization engaged in research, analysis, design, development, and manufacture of all of TRW's military electronic products. Charlie gave particular leadership to the Department of Defense Very-High-Speed Integrated Circuit program and was instrumental in expanding the TRW business into avionics. He was chairman of the board of Colorado Electronics, a subsidiary of TRW.

His last position, from which he retired, was vice-president and deputy general manager of TRW's Electronics and Defense Sector. This organization consisted of 43,000 people and was, and remains, a premier aerospace electronics, spacecraft, and information systems organization.

Charlie was very active in his profession. He had been a member of the board of governors of the Electronics Industries Association (EIA). Previously, he had served on the board of directors of the EIA Government Division. He served on the advisory boards of the University of Kansas's School of Engineering and Department of Electrical and Computer Engineering. He was a member of the Institute of Electrical and Electronics Engineers, American Institute of Aeronautics and Astronautics, and Armed Forces Communications and Electronics Association. From 1968 to 1988 he served on the National Research Council's Board of Telecommunications and Computer Applications and as its chairman in 1988. He also was chairman of the board of counselors of the School of Engineering at the University of Southern California.

Charlie's honorary academic societies included Eta Kappa Nu, Sigma Tau, Sigma Pi Sigma, Tau Beta Pi, and Sigma Xi. He received the Distinguished Engineering Service Award from the University of Kansas and was listed in American Men and Women of Science and in Who's Who in the World, America, and the West.

Charlie will be remembered by his friends and colleagues as a very incisive, very intelligent, very warm Christian human being who has contributed much to furthering the science and art of space electronics and communication and who has contributed much to the betterment of his fellow man.

Eli Sternberg

1917–1988

By Bernard Budiansky and James K. Knowles

Eli Sternberg, the nation's leading elastician, died suddenly on October 8, 1988, in Pasadena, California, just a few weeks before his seventy-first birthday. He had served as a member of the faculty of the California Institute of Technology for over two decades, becoming professor of mechanics emeritus in June 1988.

Sternberg was born in Vienna, Austria, on November 13, 1917. He completed his high school education at Vienna's Realgymnasium in 1936 and then enrolled in the Technische Hochschule of Vienna as a student of architecture. Two years later, when his studies were abruptly interrupted by the Nazi invasion of Austria, Sternberg made his way, alone, to London, with the assistance and encouragement of his family. There he restarted his college studies, this time in engineering, at the University of London. The following year he emigrated to the United States, continued his education at North Carolina State College, and received his B.S. in civil engineering in 1941. Graduate work at the Illinois Institute of Technology (IIT) followed, with a Ph.D. in mechanics conferred in 1945. In the same year, he became a United States citizen.

Sternberg remained at IIT as a faculty member, becoming a full professor in 1951. In 1957, following a yearlong visiting professorship in the Technische Hogeschool of Delft in the Netherlands as a Fulbright fellow, he joined the Division of

Applied Mathematics of Brown University as professor of mechanics. A sabbatical year in Japan as a Guggenheim fellow preceded his last academic migration, to the California Institute of Technology, where he was appointed professor of mechanics in the Division of Engineering and Applied Science in 1964.

Eli Sternberg's worldwide reputation as a leading scholar and researcher in the theory of elasticity became well established within a very few years after he started his professional career. His earliest postdoctoral research contributions, on stress concentrations around holes and cavities, carried the stamp of depth, elegance, authority, rigor, and precision that was to characterize all his later work. A rich variety of research topics in the theory of elasticity attracted Sternberg's probing interest during the ensuing decades: singular solutions associated with load and geometry discontinuities; static and dynamic thermoelasticity; viscoelasticity; thermoviscoelasticity; load transfer and load diffusion in fiber-reinforced materials; finite-deformation effects on stress singularities; and the breakdown of uniqueness in stress and displacement fields.

A superb mathematical analyst, Sternberg, throughout his career, not only provided explicit solutions to specific, basic problems of engineering importance but also contributed in fundamental ways to the foundations of the subjects with which he was concerned. Thus, while the early 1952 paper that Sternberg wrote (with his student F. Rosenthal) on the stresses and deformations in an elastic sphere under concentrated loads provided, for the first time, the solution to a problem of technological importance, it also led Sternberg to the incisive, rigorous formulation of general classes of problems involving load concentrations. This work preceded his trenchant study of the widely quoted but imperfectly understood St. Venant principle of the theory of elasticity. In a now-classic 1954 paper, Sternberg gave mathematical form and proof to von Mises'version of this principle. Conditions for the validity and completeness of mathematical representations of general solutions of elasticity theory were established by Sternberg (together with his student Eu-banks) in an important 1956 paper; and the analagous questions for elastodynamics were treated definitively by Sternberg in his monumental paper of 1960, "On the Integration of the Equations of Motion in the Classical Theory of Elasticity." Similarly, the general theories of thermoelasticity, viscoelasticity, and nonlinear elasticity are supported at their cores by theorems and formulations of permanent value that are due to Sternberg and his collaborators.

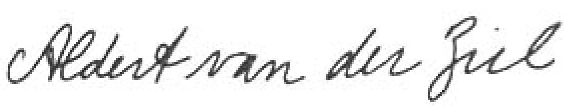
Some of these fruitful collaborations are particularly noteworthy. For more than a dozen years, Sternberg worked with R. Muki on a variety of topics that included thermal stress problems, couple-stress effects on singular stress fields, and load transfer in fiber-reinforced composites. Together with his student M. E. Gurtin, he explored special and general problems in static and dynamic elasticity, thermoelasticity, and viscoelasticity over a period of several years of intense activity. And a nearly quarter-century-long collaboration with J. K. Knowles that started soon after Sternberg arrived at Caltech was largely devoted to nonlinear singular problems and fundamental questions concerning loss of ellipticity in finite elasticity.

Eli Sternberg's scientific achievements earned him tremendous respect from the applied mechanics community the world over. He was greatly admired for the purity of thought, the depth of perception, and the high level of clarity and conviction that he achieved in scientific exposition. In addition to membership in the National Academy of Engineering, overt recognition came repeatedly, with election to the National Academy of Sciences and the American Academy of Arts and Sciences; the conferral of honorary doctorates from North Carolina State University and the Technion of Israel; and the award of the Timoshenko Medal of the American Society of Mechanical Engineers. A marvelous speaker, he was constantly in demand as a lecturer on his research, and he held numerous distinguished invited lectureships throughout his career.

Although a recital of Eli's contributions to engineering science and of the honors and acclaim bestowed upon him may suffice to delineate the distinction of his professional career, there were dimensions of charm, humor, warmth, and worldly perception in his personality and character that made him a much-loved colleague who will long be remembered as a won derful person who enriched the lives of all who knew him. A tall, imposing, gentlemanly presence, he brought to everyday discourse an elegance of expression and happy turn of phrase that made simply being in his company a joy. He had a special gift for recognizing and sharing with his friends and colleagues the ironies, contradictions, absurdities, and affectations of life in science and in academia. His bon mots were legendary. Concerning the perennially deplored academic dictum to "publish or perish," he pointed out that one method of coping has often been to "publish perishables." On the same subject, he once referred to the "statistical validity" of the publication list of an especially prolific engineering researcher: "He has published so many papers that there is a statistical chance that some of them are right." Alluding to the immaculately kept desk of another professor: "As soon as some trash accumulates there, he publishes it!"

Uncompromisingly serious about the achievement and maintenance of high scientific merit in his own work and that of his students, Eli nevertheless exuded an infectious sense of pleasure in scientific discovery and in the achievement of understanding. The heartfelt devotion of Sternberg's students is due as much to the sympathy and understanding with which he guided their careers as it is to the science he taught them. While Eli undoubtedly had a clear understanding of the major role he played in applied mechanics, he was uncomfortable with praise, which he tended to dismiss, graciously but firmly. "As you know," he said, in accepting the Timoshenko medal, "medals—much like arthritis—are a common symptom of advancing years."

Sternberg is survived by his wife Rae, a Ph.D. in psychology in private practice; his daughter Eve, a city planner and consultant in economic development; and his son Peter, a mathematician on the faculty of Indiana University. He leaves a legacy of scientific contribution of high and enduring merit, and the memory of a treasured friend and colleague.


Aldert van der Ziel

Aldert Van Der Ziel

1910–1991

Written by William G. Shepherd, C. M. Van Vliet, and P. H. Handel

Aldert Van Der Ziel, professor emeritus of electrical engineering at the University of Minnesota, died on January 20, 1991, at the age of eighty.

Aldert van der Ziel was born in Zandeweer, the Netherlands, on December 12, 1910. He earned a B.A. (1930), M.A. (1933), and Ph.D. (1934) in physics from the University of Groningen, the Netherlands. His Ph.D. thesis topic was written on spectroscopy.

Upon completing his doctoral studies he joined the research staff of the laboratory of the N. V. Philips Gloelampenfabrieken in Eindhoven, the Netherlands, as a research physicist. His tenure at that laboratory continued from 1934 to 1947. In 1947 he emigrated with his family to Canada, where he assumed a post as associate professor of physics at the University of British Columbia in Vancouver. In 1950 he accepted a position as professor of electrical engineering at the University of Minnesota in Minneapolis. He remained on the staff of that department until his retirement in 1980. Dr. van der Ziel served as a graduate research professor at the University of Florida in Gainesville from 1968 until 1989, where he usually spent a trimester per year. He also served as a consultant to a number of industrial companies.

Aldert van der Ziel was a prodigious scholar whose research output in the field of electronic devices began at N. V. Philips and continued up to his last year. He was also a remarkable educator who taught and advised hundreds of students and prospective scientists and engineers until he retired in 1980. After his retirement he continued his research on noise in electronic devices. In his research he supervised nearly eighty doctoral students as well as numerous master's thesis students. His doctoral students are working in industries and universities in this country and in many foreign countries including China, Korea, Japan, India, and Greece. He was the author of fifteen books and five hundred research papers. A large fraction of these papers were joint with his students; others were either joint with colleagues or alone. Examples of his books are *Noise* (Prentice Hall, 1959), *Solid State Physical Electronics* (Prentice Hall, 1958, 1968, and 1975), and *Fluctuation Phenomena in Semiconductors* (Butterworth, 1959). His last book was *Noise in Solid State Devices and Circuits* (Wiley, 1986).

Van der Ziel emphasized to his students the importance of relating physical observations to theory and interpretation. He himself recognized that an understanding of the operation of an electronic device was necessary to interpret the observed noise. He also recognized the converse—understanding the observed noise and its dependence on the operating parameters could illuminate the physical process in the device. He was an expert in all electronic devices and published papers on all of those developed in this century up to the present year. These began with vacuum tubes and later covered junction devices, field effect transistors, Josephson junctions, to developments on high electron mobility transistors.

Throughout his career van der Ziel sought a fundamental understanding of 1/f noise (the noise output versus frequency). In 1980 he examined the possibility of a quantum basis for 1/f noise and carried out experiments that verified this hypothesis and explained his 1/f experiments. He and his students were able to describe the 1/f noise of many modern electronic devices in terms of the simple basic quantum 1/f formula. This was presented in a chapter of his last book, *Noise in Solid State Devices and Circuits*.

Although the majority of his publications dealt with noise phenomena, van der Ziel published on quite different fields. An outstanding example of this was his paper on parametric amplification (*Journal of Applied Physics*, 19 (1948) 999–1006) that was a preview of the discovery of the parametric amplifier. This laid the basis for the later invention of maser and laser amplifiers. In addition to his extraordinary list of publications, his research led to a number of patents, eighteen in all. He served as a member of the editorial board of the *Journal of Applied Physics* for a number of years.

He was elected to the National Academy of Engineering in 1977 and has been the recipient of a number of honors. He was elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 1956, received the Western Electric award of American Society for Engineering Education in 1967, ASEE's Vincent Bendix Minorities in Engineering Award in 1975, and the IEEE Education Medal in 1980. He was the recipient of two honorary doctorates, the first from Universitie Paul Sabatier, Toulouse, in 1975, the second from Eindhoven University of Technology in 1981.

Aldert was interested in botany, cosmology, and theology. On the last subject one of his nominators for the Vincent Bendix award observed that, "He has made in addition a meaningful contribution to the dialogue between science and religion, and has taught and written in this demanding area."

Throughout his research and teaching, Aldert van der Ziel has, directly and through his students, markedly influenced the course of electronic science and technology during his lifetime. His accomplishments will continue to benefit society for the future. He will be missed as a dedicated and caring man.

Eugene W. Weber

1910–1989

By Robert L. Smith

Eugene W. Weber, retired water resources engineer and planner, died on February 14, 1989, at the age of seventy-eight. Born in Staceyville, Iowa, December 8, 1910, he obtained his engineering education at the University of Minnesota, where he received a B.S. in civil engineering.

Elected to membership in the National Academy of Engineering in 1979, Gene had an internationally established reputation in water resources planning. His primary career from 1931 to 1965 was spent in the service of the U.S. Army Corps of Engineers. At his retirement from the corps, he was serving as both special assistant, Chief of Planning, and deputy director, Civil Works for Policy. Following retirement from the civil service, he served as a consultant to various federal, state, and private organizations and internationally with the Organization for Economic Cooperation and Development.

There are four separate aspects of Mr. Weber's career that deserve specific comment. During World War II, he entered into active service from his reserve status as a captain. Several years later after service in Washington, London, Normandy, and Paris, he returned to reserve status as a colonel. His active military service, in keeping with his ensuing professional career, was served with distinction. For his accomplishments he received the Legion of Merit, the Bronze Star, the Army Commendation Ribbon, and the French Crois-de-Guerre.

His career with the Corps of Engineers literally touched all of the waters of this nation. He was a consummate team player, and many of his contributions to the literature were embodied in committee reports. These ranged from professional organizational efforts, including National Research Council assignments, to Presidential policy exercises. One of the most significant of these efforts was titled *Proposed Practices for Economic Analysis of River Basin Projects*. This 1950 report to the Federal Inter-Agency Basin Committee, revised in 1958, came to be known as the "Green Book." It became the foundation for federal project evaluation practice. As such, it served as the forerunner for subsequent congressional and executive policy documents in this general arena. A detailed accounting of his many corps assignments would demonstrate clearly that his overall engineering contributions have had a major influence on the Corps of Engineers civil works program. Gene received numerous citations and honors for this portion of his career. Included were the Rockefeller Public Service Award in 1963, the Department of Army Exceptional Service Award in 1963, and the Department of Defense Civilian Service Award in 1964.

For a quarter of a century, Mr. Weber served, concurrent with his corps responsibilities, a second major role for his country. This began in 1948 when President Truman appointed him a commissioner on the United States Section of the International Joint Commission, United States and Canada. He continued in this role until 1963, serving under five presidents. As a commissioner, he became deeply involved in the problems of the Columbia River, the St. Lawrence Seaway Project, and the Great Lakes. In this role he became highly respected by both American and Canadian interests for his objectivity and technical knowledge. Upon his resignation from the commission in 1973, the Prime Minister of Canada presented him with a Certificate of Appreciation for Outstanding Service. He also received the U.S. Department of State Superior Honor Award, and in 1974 he was the recipient of the "Can-Am" Civil Engineering Amity Award.

Gene's professional efforts extended beyond the workplace to numerous professional organizations. He was especially active in the American Society of Civil Engineers (ASCE) where he held several offices, including terms as president of the National Capital Section, chair of four national committees, and member of the national board of directors. In 1977 he received the ASCE Julian Hinds Award for "distinguished service to water resources planning," and in 1978 he was designated as an honorary member of ASCE.

Gene Weber was a most dedicated individual. Both his country and his profession are the better because of his efforts. He was one of those rare individuals who was equally at home discussing engineering concepts or negotiating with nontechnical decision makers.


Abel Wolman

Abel Wolman

1892–1989

By Gilbert F. White and Daniel A. Okun

Abel Wolman, engineer, scientist, and citizen of the world, died in his home in Baltimore, Maryland, on February 23, 1989. An active member of the faculty of the Johns Hopkins University from 1937 to 1962, and a leader in the public service for more than sixty years, he was elected to the National Academy of Engineering in 1965 and to the National Academy of Sciences in 1963.

Born in Baltimore on June 10, 1892, Abel Wolman lived his entire professional life in his native city, but his interests extended across the nation and around the world. He graduated from Baltimore City College in 1909 and received from the Johns Hopkins University a B.A. in 1913, a B.S. in engineering in 1915, and an honorary doctorate of engineering in 1937. He helped establish and became a professor in the university's Department of Sanitary Engineering both in the School of Engineering and in the School of Hygiene and Public Health. Throughout his career his abiding interest was in encouraging the application of engineering to the improvement of public health.

Following his retirement from formal duties in 1962, he continued to use his office as a base for far-flung activities, exercising a strong influence on students in the fields of engineering, public health, and environment. At a memorial service, the university stated, "It was perhaps through his role as teacher and scholar that he made his most long-lasting impact. Maintain ing a strong interest in the scientific and technical aspects of his profession, he also imparted his concepts of the planning process as a standard tool of the engineering profession to generations of environmental engineers and health professionals who carry on his teachings with their own students."

Abel Wolman and Anna Gordon were married in 1919, and their family itself became a Baltimore institution. Their son, M. Gordon (Reds) Wolman, was to chair a department in the School of Engineering, now the Department of Geography and Environmental Engineering.

Although his quarter-century stint as a Hopkins professor may well have been the hallmark of his career, he spent almost a quarter of a century serving public agencies and editing professional journals prior to joining Hopkins, and more than a quarter of a century after his retirement from the university as a much sought-after consultant.

While most clearly identified with efforts toward the promotion of public health, a particularly important contribution resulted from his collaboration in 1919 with Linn H. Enslow in the development of chlorination. They built on earlier research on the effects of chlorine on bacteria that made possible the adoption of simple, effective methods to curb waterborne disease. Chlorination is frequently cited as the single most significant measure to protect public health in urban areas.

At the local level, and beginning with his own city of Baltimore, Abel Wolman provided consulting services on water supply and sanitation that shaped approaches to the solution of urban problems in the United States and foreign countries. Typically, he insisted on comprehensive analysis and on examination of the wider implications of a planning decision. Over the years, his work had influence in Columbus (Ohio), Detroit, Harrisburg, Indianapolis, Jacksonville, Newport News, New York City, Portland (Oregon), southeast Michigan, Seattle, and Washington, D.C. Foreign metropolitan areas profiting from his expertise included Buenos Aires, Calcutta, and São Paulo.

The Wolman vision of the aims of integrated water resources management was early formed in his activity as chief engineer with the Maryland State Department of Health (1922–1939) and evolved during that period and subsequently, while his interests extended to other jurisdictions, nationally and overseas. As chairman of the Maryland State Planning Commission (1934–1945) and of the Water Resources Committee of the National Resources Planning Board and its predecessors (1935–1941), he dealt with a wide range of policy issues, always adding new dimensions, always comparing experience in one area with the challenges in another area.

It is impossible even to list, let alone describe, in this memorial all of the assignments he discharged over the seventy-five years of his very active professional life. Their flavor may be suggested by naming a few of the more important ones. At the state and regional level, they included services with the Potomac River Commission (1940–1950); the Board of Technical Advisors, International Boundary and Water Commission of the United States and Mexico (1976–1979); and the New Jersey Master Water Plan (1975–1980). At the foreign level, his activities covered consultancies with the governments of Argentina, Sri Lanka, Taiwan, and, most notably, Israel. At the international level, he chaired the Advisory Committee of the Centro Panamericano de Ingenieria Sanitaria y Ciencias del Ambiente (1977), and served as a consultant to the Pan American Health Organization (1979) and to the World Health Organization (1984) for the International Drinking Water Supply and Sanitation Decade (1981–1990). His advice was sought by the Senate Select Committee on National Water Resources (1959–1961), the House Committee on Science and Astronautics (1965–1968), and by the U.S. Geological Survey (1943–1967).

Beyond his numerous water-related activities, he was drawn into a variety of advisory roles in associated fields. Among these were the National Advisory Committee on Radiation for the U.S. Public Health Service (1957–1960) and the U.S. Atomic Energy Commission Safety and Licensing Board Panel (1960–1972).

His leadership among his professional peers was reflected in his election to the presidencies of the American Water Works Association and the American Public Health Association, the latter an organization dominated by medically related professionals. Honorary memberships were awarded in both those organizations and in the American Society of Civil Engineers, the Water Pollution Control Federation, the American Water Resources Association, the American Academy of Environmental Engineers (where for many years he was the sole honorary member), the Franklin Institute, and the Technion of Haifa Board of Directors.

Principal among special honors received were the Public Service Award of the Albert Lasker Awards Given Through the American Public Health Association (1960), the National Medal of Science (1974), and the Tyler Prize for Environmental Achievement (1976).

Over various periods, Abel Wolman was editor of the *Journal of the American Water Works Association* (1921–1937), associate editor of the *American Journal of Public Health* (1923–1927), and editor of *Municipal Sanitation* (1929–1935). His own writing comprised a review with Arthur Gorman of the significance of typhoid fever outbreaks (1931), the editing of manuals of water-works and wastewater practice in the mid-1920s, and about three hundred articles. In 1969 a selection from the articles was published under the editorship of Gilbert F. White, entitled *Water, Health and Society*. But the flow of challenging ideas from his pen did not stop with retirement. Some of his later thinking and his observations on his past work were caught by Walter Hollander, Jr., in a private publication in 1981, *Abel Wolman: His Life and Philosophy: An Oral History*.

Up to that time, Abel Wolman believed that trace contaminants were of little public health significance and did not warrant the levels of investment called upon to deal with them. A few years later, when he was about ninety, he was still flexible enough to accept new evidence gleaned from the genetics community; trace contaminants might, indeed, have mutagenic consequences. Over the last few years of his life, he seldom passed up the opportunity to raise this issue with those responsible for water quality management. He kept up with events, even ahead of some, to the last.

Despite his prodigious output of lectures, papers, and consultantships, he was so well organized that he always had time for people, in both professional and social settings. He also had time for notes to colleagues, calling attention to items of possible interest or offering congratulations for papers well written.

To the thousands of people who worked with Abel Wolman, there were his personal qualities that made lasting, invigorating impressions. The introduction to his selected papers captured some of these in noting that rare was the national conference touching on water and environmental engineering that had not felt the charm of his analysis of a policy issue. Usually extemporaneous, always felicitous, and punctuated with gentle wit, the typical Wolman talk summed up the problems in a lucid framework, and sent his audience away smiling, a bit puzzled by some of the generalizations, and refreshed by a new perspective. His gift for asking the pertinent, but disarming, question gave both direction and relief to countless discussions. Technical precision and insight blended with cultured urbanity.

In the words of the tribute by the *Baltimore Evening Sun:* "Abel Wolman ... envisioned a world in which the most basic of necessities, water to drink, would be safe and plentiful to all peoples of the world."

Appendix

Members	Elected	Born	Deceased
Herbert Allen	1979	May 2, 1907	June 12, 1990
Luis W. Alvarez	1969	June 13, 1911	September 1, 1988
Arsham Amirikian	1980	May 17, 1899	July 2, 1990
James Bliss Austin	1967	July 16, 1904	May 25, 1988
Roy Bainer	1965	March 7, 1902	January 18, 1990
William B. Bergen	1974	March 29, 1915	October 9, 1987
James Boyd	1967	December 20, 1904	November 24, 1987
Roy W. Carlson	1974	September 23, 1900	November 21, 1990
Leo Casagrande	1974	September 17, 1903	October 25, 1990
Carl Covalt Chambers	1970	May 8, 1907	November 25, 1987
Arthur A. Collins	1968	September 9, 1909	February 25, 1987
Thomas W. Dakin	1981	May 5, 1915	April 1, 1990
Richard W. Damon	1989	May 14, 1923	February 15, 1991
Duncan S. Davies	1978	April 20, 1921	March 25, 1987
Richard D. DeLauer	1969	September 23, 1918	April 22, 1990
Jacob Pieter Den Hartog	1975	July 23, 1901	March 17, 1989
Joseph K. Dillard	1975	May 10, 1917	February 13, 1988
Charles W. Elston	1967	December 7, 1914	June 5, 1989
Mars G. Fontana	1967	April 6, 1910	February 29, 1988
Michael L. Haider	1964	October 1, 1904	August 14, 1986
Paul D. Haney	1974	February 5, 1911	May 5, 1990
Raymond J. Hodge	1983	May 15, 1922	October 27, 1990
George Edward Holbrook	1964	March 4, 1909	February 26, 1987
J. Herbert Hollomon	1964	March 12, 1919	May 8, 1985
Raymond W. Ketchledge	1970	December 8, 1919	October 23, 1987
Garbis Hvannes Keulegan	1979	July 12, 1890	July 28, 1989
James R. Killian, Jr.	1967	July 24, 1904	January 29, 1988
August Uno Lamm	1976	May 22, 1904	June 1, 1989
Helmut E. Landsberg	1966	February 9, 1906	December 6, 1985
Lester Lees	1971	November 8, 1920	November 10, 1986
Benjamin G. Levich	1982	March 30, 1917	January 19, 1987
W. Bennett Lewis	1976	June 24, 1908	January 10, 1987
Ray K. Linsley	1976	January 13, 1917	November 6, 1990
John A. Logan	1968	September 26, 1908	February 16, 1987
Bernard D. Loughlin	1967	May 19, 1917	December 25, 1988
Yi-Sheng Mao	1982	January 9, 1896	November 12, 1989
Sachio Matoba	1988	March 23, 1899	September 28, 1987
Stewart E. Miller	1973	September 1, 1918	February 27, 1990

Members	Elected	Born	Deceased
Richard Stetson Morse	1976	August 19, 1911	July 1, 1988
Gerald L. Pearson	1968	March 31, 1905	October 25, 1987
Kendall Perkins	1970	February 23, 1908	August 8, 1987
Dean F. Peterson	1974	June 3, 1913	April 21, 1989
Samuel Cochran Phillips	1971	February 19, 1921	January 31, 1990
Jan A. Rajchman	1966	August 10, 1911	April 1, 1989
William Bradford Whitehill Rand	1973	January 17, 1902	March 9, 1988
Philip C. Rutledge	1968	February 17, 1906	July 14, 1990
Warren F. Savage	1981	March 10, 1922	January 24, 1988
Harry Bolton Seed	1970	August 19, 1922	April 23, 1989
Fred N. Severud	1968	June 8, 1899	June 11, 1990
William Pence Slichter	1976	March 31, 1922	October 25, 1990
Eugene C. Starr	1977	August 6, 1901	February 5, 1988
Charles W. Stephens	1985	July 26, 1930	July 16, 1990
Eli Sternberg	1975	November 13, 1917	October 8, 1988
Aldert van der Ziel	1978	December 12, 1910	January 20, 1991
Eugene W. Weber	1979	December 8, 1910	February 14, 1989
Abel Wolman	1965	June 10, 1892	February 23, 1989

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